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LATVIA UNIVERSITY OF LIFE SCIENCES AND TECHNOLOGIES
Latvijas Lauksaimniecības universitāte

Faculty of Food Technology
Pārtikas tehnoloģijas fakultāte

Mg.sc.ing. **Līva Aumeistere**

***Ph.D.* thesis**
Promocijas darbs

THE STUDY OF HUMAN MILK COMPOSITION

MĀTES PIENA SASTĀVA IZPĒTE

for the acquisition of a doctor degree Doctor of Science (*Ph.D.*) in Food and Beverage Technologies

Scientific supervisor of the *Ph.D.* thesis
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Author of the *Ph.D.* thesis
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Jelgava
2021

ANNOTATION

The *Ph.D.* thesis was elaborated during the period from November 2016 to March 2021 at the Faculty of Food Technology of the Latvia University of Life Sciences and Technologies and the Laboratory of Chemistry of the Institute of Food Safety, Animal Health and Environment BIOR.

The **hypothesis** of the *Ph.D.* thesis: maternal nutrition during lactation predicts human milk composition and serves as a basis for providing the essential nutrients for the infant.

The hypothesis is supported by the following **thesis**:

- a lactating woman can meet her nutritional needs by consuming a well-balanced diverse diet, which also serves as the basis for providing certain nutrients for infant via human milk;
- total fat, protein, lactose content in human milk is not directly affected by maternal diet;
- qualitative and quantitative fatty acid composition of human milk is influenced by maternal dietary habits during lactation;
- essential and potentially toxic element content in human milk is related to maternal dietary habits during lactation;
- exclusively breastfed infants till six months of age can receive a sufficient amount of energy and nutrients (fat, protein, lactose, fatty acids and essential elements) via human milk.

The **research object** of the *Ph.D.* thesis: mature human milk (at least 28 days postpartum).

The **aim** of the *Ph.D.* thesis: to evaluate human milk composition in relation to maternal nutrition and to assess nutritional supply for exclusively breastfed infants.

Consequential **research objectives** were set to achieve the aim of the *Ph.D.* thesis:

1) to analyse protein, lactose, fat, fatty acid, essential (Ca, Mg, Na, K, Zn, Se, Mn, Fe, Cu, Co, Cr) and potentially toxic element (Al, Ni, As, Sr, Cd, Sn, Sb, Pb) content in human milk;
2) to evaluate the compliance of the women's nutrition during lactation with the recommendations at the national and European level;
3) evaluate the association between maternal nutrition and human milk composition;
4) based on elaborated human milk composition results, theoretically evaluate nutritional adequacy of exclusively breastfed infants till six months of age.

The *Ph.D.* thesis consists of three chapters:

Chapter 1. Overview of the literature. Description of human milk and its composition influencing factors, including maternal nutrition;

Chapter 2. Recital of materials, methods, and statistical analysis methods used in the study;

Chapter 3. Summary of elaborated results regarding human milk composition and maternal dietary habits during lactation. Assessment of human milk composition in relation to maternal nutrition. Theoretical evaluation of the nutritional adequacy of exclusively breastfed infants (one to six months old).

At the end of the *Ph.D.* thesis, conclusions of the study are compiled, and suggestions for future research are stated.

The **scientific significance** of the *Ph.D.* thesis:

1) for the first time in Latvia, composition of human milk has been comprehensively analysed;
2) elaborated data serve as a contribution from Latvia to the global research area of human milk composition.

The **national significance** of the *Ph.D.* thesis:

1) elaborated findings can be used to develop nutritional guidance for lactating women in Latvia;
2) compiled results can be used to develop nutrient intake guidelines for infants in Latvia (≤6 months old).

The study has been financially supported by the grants:

- Strengthening Research Capacity in the Latvia University of Life Sciences and Technologies. Project "The study of human milk composition". Project No. Z2. Contract No. 3.2.-10/44. Project status – finished (project time from 1 January 2017 to 31 December 2018);
- Conducting Fundamental Research in the Latvia University of Life Sciences and Technologies. Project "Natural variations in fatty acid composition of human milk". Project No. G1. Contract No. 3.2-10/2019/LLU. Project status – ongoing (project time from 6 January 2020 to 5 January 2022);
- Latvia University of Life Sciences and Technologies Transition to the New Doctoral Funding Model. European Social Fund Project No. 8.2.2.0/20/I/001. Project status – ongoing (project time from 17 May 2021 to 16 May 2022).

The *Ph.D.* thesis is written in English on 127 pages and contains 34 tables, 15 figures, and 19 annexes. In total, 188 information sources were used in the study.

Approbation of the scientific work

Results of the research have been published in **8** peer-reviewed scientific issues, of which **7** are indexed in SCOPUS and/or Web of Science databases:

1) **Aumeistere L.**, Zavadska D. (2016) Raising awareness about breast milk composition among women in Latvia. **In:** *Journal of Breastfeeding Biology*, Vol. 1, No. 1, p. 21–28. https://doi.org/10.14302/issn.2644-0105.jbfb-16-1257;
2) **Aumeistere L.**, Ciprovica I., Zavadska D., Celmalniece K. (2017) Lactose content of breast milk among lactating women in Latvia. **In:** *FOODBALT 2017 – 11th Baltic Conference on Food Science and Technology: Food Science and Technology in a Changing World. International Scientific Conference Proceedings*, p. 169–173. https://doi.org/10.22616/foodbalt.2017.023 (indexed in Web of Science database);
3) **Aumeistere L.**, Ciprovica I., Zavadska D., Bavrins K. (2017) A preliminary study on essential minerals in human milk: association with dietary habits. **In:** *23rd Annual International Scientific Conference "Research for Rural Development 2017". International Scientific Conference Proceedings*, Vol 1. 2017, p. 230–236. https://doi.org/10.22616/rrd.23.2017.034 (indexed in SCOPUS and Web of Science databases);
4) **Aumeistere L.**, Ciproviča I., Zavadska D., Volkovs V. (2018) Fish intake reflects on DHA level in breast milk among lactating women in Latvia. **In:** *International Breastfeeding Journal*, Vol. 13, Article No. 33. https://doi.org/10.1186/s13006-018-0175-8 (indexed in SCOPUS and Web of Science databases);
5) **Aumeistere L.**, Ciproviča I., Zavadska D., Bavrins K., Borisova A. (2018) Zinc content in breast milk and its association with maternal diet. **In:** *Nutrients*, Vol. 10, Issue 10, Article No. 1438. https://doi.org/10.3390/nu10101438 (indexed in SCOPUS and Web of Science databases);

6) **Aumeistere L.**, Ciprovica I., Zavadska D., Bavrins K., Borisova A. (2019) Essential elements in mature human milk. **In:** *FOODBALT 2019. 13th Baltic Conference on Food Science and Technology. FOOD. NUTRITION. WELL-BEING. Conference Proceedings*, p. 25–29. https://doi.org/10.22616/Foodbalt.2019.005 (indexed in Web of Science database);
7) **Aumeistere L.**, Ciprovica I., Zavadska D., Andersons J., Volkovs V., Ceļmalniece K. (2019) Impact of maternal diet on human milk composition among lactating women in Latvia. **In:** *Medicina*, Vol. 55, Issue 5, Article No. 173. https://doi.org/10.3390/medicina55050173 (indexed in SCOPUS and Web of Science database);
8) **Aumeistere L.**, Ciprovica I., Zavadska D., Bavrins K., Borisova A. (2020) The relation between human milk sodium and maternal sodium intake. **In:** *Proceedings of the Latvian Academy of Sciences. Section B: Natural, Exact, and Applied Sciences*, Vol. 74, Issue 4, p. 232–236. https://doi.org/10.2478/prolas-2020-0037 (indexed in SCOPUS and Web of Science databases).

Results have been presented in **11** international scientific conferences & congresses in Latvia, Spain, Italy, the Netherlands, and Finland:

1) **Aumeistere L.**, Ciprovica I., Zavadska D., Bavrins K. (2017) Trace elements in human milk among lactating women in Latvia. **In:** *International Student Conference "Health and Social Sciences"*, 5 April 2017, Riga, Latvia (Poster presentation);
2) **Aumeistere L.**, Ciprovica I., Zavadska D., Celmalniece K. (2017) Lactose content of breast milk among lactating women in Latvia. **In:** *11th Baltic Conference on Food Science and Technology Foodbalt 2017*, 27 to 28 April 2017, Jelgava, Latvia (Oral presentation);
3) **Aumeistere L.**, Ciprovica I., Zavadska D., Bavrins K. (2017) A preliminary study on essential minerals in human milk: association with dietary habits. **In:** *23rd Annual International Scientific Conference Research for Rural Development 2017*, 17 to 19 May 2017, Jelgava, Latvia (Oral presentation);
4) **Aumeistere L.**, Ciprovica I., Zavadska D., Andersons J., Jakubone E. (2017) Fat content of human milk: a pilot study from Latvia. **In:** *11th European Nutrition and Dietetics Conference*, 29 June to 1 July 2017, Madrid, Spain (e-poster presentation);
5) **Aumeistere L.**, Ciprovica I., Zavadska D., Bavrins K., Borisova A. (2018) Zinc content in breast milk: a report from Latvia. **In:** *2nd EuroSciCon Conference on Food Technology*, 14 to 16 May 2018, Rome, Italy (Oral presentation);
6) **Aumeistere L.**, Ciprovica I., Zavadska D., Volkovs V. (2018) *Trans* fatty acid content in mature breast milk among lactating women in Latvia. **In:** *1th European Food Chemistry & Nutrition Congress*, 26 to 27 July 2018, Amsterdam, the Netherlands (Oral presentation);
7) **Aumeistere L.**, Ciprovica I., Zavadska D., Bavrins K., Borisova A. (2019) Maternal sodium intake reflects on sodium content in mature human milk. **In:** *6th International Conference on Nutrition & Growth*, 7 to 9 March 2019, Valencia, Spain (Poster presentation);
8) **Aumeistere L.**, Ciprovica I., Zavadska D., Bavrins K., Borisova A. (2019) Essential elements analysis in mature human milk. **In:** *13th Baltic Conference on Food Science FoodBalt 2019 & 5th North and East European Congress on Food NEEFood 2019*, 2 to 3 May 2019, Jelgava, Latvia (Oral presentation);
9) Beluško A., **Aumeistere L.**, Ciprovičа I., Zavadska D. (2020) Conjugated linoleic acid in human milk: a case study from Latvia. **In:** *3rd International Conference Nutrition and Health*, 9 to 11 December 2020, Riga, Latvia (e-poster presentation);

10) **Aumeistere L.**, Ciproviča I., Zavadska D., Volkovs V. (2020) Dietary vegetable oil impact on fatty acid composition in human milk. **In:** *12th Nordic Nutrition Conference*, 13 to 16, December 2020, Helsinki, Finland (e-poster presentation);
11) Beluško A., **Aumeistere L.**, Ciproviča I., Zavadska D. (2021) Omega-3 fatty acid composition in human milk. **In:** *16th International Scientific Conference "Students on their Way to Science"*, 23 April 2021, Jelgava, Latvia (Oral presentation presented virtually).

Public education activities

1) Event for future and new mothers Gaidību 4diena, 30 August 2018. Place – Domina Shopping. Lecture from Latvia University of Life Sciences and Technologies doctoral student Līva Aumeistere – Why omega 3 fatty acids are vitally important during breastfeeding? (https://www.facebook.com/events/302406270523397/);
2) Māmiņu klubs Online TV, 6 November 2018. A video conversation with the Latvia University of Life Sciences and Technologies doctoral student Līva Aumeistere. The need for omega 3 fatty acids from birth (https://vimeo.com/419410349);
3) Latvia Radio 1. Broadcast Ģimenes studija, 17 December 2018, participating Children's Clinical Hospital's neonatologist Renāte Zariņa, Lactation consultant Sandra Lase and Evita Žvagiņa-Jākobsone, and Latvia University of Life Sciences and Technologies doctoral student Līva Aumeistere. Effects of human milk composition on an infant's health (https://lr1.lsm.lv/lv/raksts/gimenes-studija/mates-piena-sastava-ietekme-uz-bernina-attistibu.a112722/);
4) Parental Society KKM klubs, 11 May 2019. Lecture from Latvia University of Life Sciences and Technologies doctoral student Līva Aumeistere for lactation consultants. Can the diet of a lactating mother influence the composition of human milk?;
5) Latvia Radio 1. Broadcast Ģimenes studija, 12 October 2020, participating nutritionists Lizete Puga, Inga Elksne, Ksenija Adrijanova, and Līva Aumeistere. Research: Infants in Latvia do not receive a sufficient amount of nutrients. How to ensure a balanced menu for the infant? (https://lr1.lsm.lv/lv/raksts/gimenes-studija/petijumi-latvijas-zidainu-uzturs-nav-pilnvertigs.-ka-veidot-saba.a135185/).

ANOTĀCIJA

Promocijas darbs izstrādāts Latvijas Lauksaimniecības universitātes Pārtikas tehnoloģijas fakultātē un Pārtikas drošības, dzīvnieku veselības un vides zinātniskā institūta “BIOR” Ķīmijas laboratorijā laika periodā no 2016. novembra līdz 2021. gada martam.

Promocijas darba **hipotēze:** mātes uzturs zīdīšanas periodā var ietekmēt piena sastāvu un nepieciešamo uzturvielu nodrošinājumu zīdainim.

Promocijas darba hipotēzi pierāda ar **aizstāvāmām tēzēm**:

- sieviete zīdīšanas periodā ar sabalansētu, daudzveidīgu uzturu var uzņemt nepieciešamo uzturvielu daudzumu, kas būs pamats atsevišķu uzturvielu nodrošinājumam zīdainim ar mātes pienu;
- kopējais tauku, olbaltumvielu, laktozes saturs mātes pienā nav tieši atkarīgs no uztura;
- taukskābju sastāvu un saturu mātes pienā ietekmē sievietes uztura paradumi zīdīšanas periodā;
- esenciālo un potenciāli toksisko elementu saturs mātes pienā ir atkarīgs no sievietes uztura zīdīšanas periodā;
- ekskluzīvi zīdīti zīdaiņi līdz sešu mēnešu vecumam ar mātes pienu var uzņemt nepieciešamo enerģijas un uzturvielu (tauku, olbaltumvielu, laktozes, taukskābju un esenciālo elementu) daudzumu.

Pētījuma **objekts** ir nobriedis mātes piens (pagājušas vismaz 28 dienas pēc dzemdībām).

Promocijas darba mērķis: analizēt mātes piena sastāvu saistībā ar uzturu un izvērtēt uzturvielu nodrošinājumu ekskluzīvi zīdītiem zīdaiņiem.

Pētījuma uzdevumi, lai sasniegtu promocijas darba mērķi, ir:

1) analizēt mātes piena sastāvu, nosakot olbaltumvielu, laktozes, tauku, taukskābju, esenciālo (Ca, Mg, Na, K, Zn, Se, Mn, Fe, Cu, Co, Cr) un potenciāli toksisko elementu (Al, Ni, As, Sr, Cd, Sn, Sb, Pb) saturu;
2) izvērtēt sievietes uzturu zīdīšanas periodā atbilstoši vadlīnijām nacionālajā un Eiropas līmenī;
3) novērtēt uztura ietekmi uz mātes piena sastāvu;
4) teorētiski novērtēt pētījuma ietvaros analizēto uzturvielu nodrošinājumu ar mātes pienu ekskluzīvi zīdītiem zīdaiņiem.

Promocijas darbs strukturēts 3 nodaļās:

1. nodaļa. Literatūras apskats par mātes piena sastāvu un tā ietekmējošajiem faktoriem, tai skaitā uztura ietekmi uz mātes piena sastāvu;
2. nodaļa. Promocijas darbā lietoto materiālu un metožu, un datu statistiskās apstrādes raksturojums;
3. nodaļa. Kopsavilkums par mātes piena sastāvu un sievietes uztura paradumiem zīdīšanas periodā. Mātes piena sastāva izvērtējums atkarībā no uztura. Teorētiskie aprēķini uzturvielu nodrošinājumam ekskluzīvi zīdītiem zīdaiņiem līdz sešu mēnešu vecumam.

Promocijas darba noslēgumā apkopoti secinājumi un ierosinājumi turpmākiem pētījumiem.

Pētījuma **zinātniskais nozīmīgums**:

1) pirmo reizi Latvijā visaptveroši pētīts mātes piena sastāvs;
2) pētījumā iegūtie dati būs Latvijas ieguldījums mātes piena sastāva izpētē pasaulē.

Pētījuma **tautsaimnieciskā nozīme**:

1) pētījuma rezultāti var kalpot par pamatu veselīga uztura vadlīniju izstrādei sievietēm zīdīšanas periodā Latvijā;
2) iegūtie pētījuma rezultāti var tikt izmantoti, lai izstrādātu ieteicamās uzturvielu normas zīdaiņiem Latvijā (≤6 mēnešu vecumam).

Promocijas darba izstrāde līdzfinansēta:

- Programma "Zinātniskās kapacitātes stiprināšanas Latvijas Lauksaimniecības universitātē". Projekts "Mātes piena sastāva izpēte". Projekta Nr. Z2. Līguma Nr. 3.2.-10/44. Projekta statuss – noslēgts (projekta laiks no 2017. gada 1. janvāra līdz 2018. gada 31. decembrim);
- Programma "Fundamentālo pētījumu veikšana Latvijas Lauksaimniecības universitātē". Projekts "Taukskābju sastāva variācijas mātes pienā". Projekta Nr. G1. Līguma Nr. 3.2.-10/2019/LLU. Projekta statuss – turpinās (projekta laiks no 2020. gada 6. janvāra līdz 2022. gada 5. janvārim);
- Eiropas Sociālā fonda projekts Nr. 8.2.2.0/20/I/001 «LLU pāreja uz jauno doktorantūras finansēšanas modeli». Projekta statuss – turpinās (projekta laiks no 2021. gada 17. maija līdz 2022. gada 16. maijam).

Promocijas darbs ir uzrakstīts angļu valodā, sastāv no 127 lapaspusēm, un iekļauj 34 tabulas un 15 attēlus. Darbs satur 19 pielikumus. Pētījumā izmantoti 188 literatūras avoti.

Zinātniskā darba aprobācija

Pētījuma rezultāti publicēti **8** recenzētos zinātniskajos izdevumos, no kuriem **7** ir indeksēti SCOPUS un/vai Web of Science datubāzēs:

1) **Aumeistere L.**, Zavadska D. (2016) Raising awareness about breast milk composition among women in Latvia. *Journal of Breastfeeding Biology*, Vol. 1, No. 1, p. 21–28. https://doi.org/10.14302/issn.2644-0105.jbfb-16-1257;
2) **Aumeistere L.**, Ciprovica I., Zavadska D., Celmalniece K. (2017) Lactose content of breast milk among lactating women in Latvia. *FOODBALT 2017 - 11th Baltic Conference on Food Science and Technology: Food Science and Technology in a Changing World. International Scientific Conference Proceedings*, p. 169–173. https://doi.org/10.22616/foodbalt.2017.023 (indeksēts Web of Science datubāzē);
3) **Aumeistere L.**, Ciprovica I., Zavadska D., Bavrins K. (2017) A preliminary study on essential minerals in human milk: association with dietary habits. *23rd Annual International Scientific Conference "Research for Rural Development 2017". International Scientific Conference Proceedings*, Vol 1. 2017, p. 230–236. https://doi.org/10.22616/rrd.23.2017.034 (indeksēts SCOPUS un Web of Science datubāzēs);
4) **Aumeistere L.**, Ciproviča I., Zavadska D., Volkovs V. (2018) Fish intake reflects on DHA level in breast milk among lactating women in Latvia. *International Breastfeeding Journal*, Vol. 13, Article No. 33. https://doi.org/10.1186/s13006-018-0175-8 (indeksēts SCOPUS un Web of Science datubāzēs);
5) **Aumeistere L.**, Ciproviča I., Zavadska D., Bavrins K., Borisova A. (2018) Zinc content in breast milk and its association with maternal diet. *Nutrients*, Vol. 10, Issue 10, Article No. 1438. https://doi.org/10.3390/nu10101438 (indeksēts SCOPUS un Web of Science datubāzēs);
6) **Aumeistere L.**, Ciprovica I., Zavadska D., Bavrins K., Borisova A. (2019) Essential elements in mature human milk. *FOODBALT 2019. 13th Baltic Conference on Food Science and Technology. FOOD. NUTRITION. WELL-BEING. Conference Proceedings,* p. 25–29. https://doi.org/10.22616/Foodbalt.2019.005 (indeksēts Web of Science datubāzē);

7) **Aumeistere L.**, Ciprovica I., Zavadska D., Andersons J., Volkovs V., Ceļmalniece K. (2019) Impact of maternal diet on human milk composition among lactating women in Latvia. *Medicina*, Vol. 55, Issue 5, Article No. 173. https://doi.org/10.3390/medicina55050173 (indeksēts SCOPUS un Web of Science datubāzēs);
8) **Aumeistere L.**, Ciprovica I., Zavadska D., Bavrins K., Borisova A. (2020) The relation between human milk sodium and maternal sodium intake. *Proceedings of the Latvian Academy of Sciences. Section B: Natural, Exact, and Applied Sciences*, Vol. 74, Issue 4, p. 232–236. https://doi.org/10.2478/prolas-2020-0037 (indeksēts Web of Science datu bāzē).

Par zinātniskā darba rezultātiem ziņots **11** starptautiskajās zinātniskajās konferencēs & kongresos Latvijā, Spānijā, Itālijā, Nīderlandē un Somijā:

1) **Aumeistere L.**, Ciproviča I., Zavadska D., Bavrins K. (2017) Trace elements in human milk among lactating women in Latvia. *International Student Conference "Health and Social Sciences"*, 5. aprīlis, 2017. gads, Rīga, Latvija (stenda referāts);
2) **Aumeistere L.**, Ciproviča I., Zavadska D., Ceļmalniece K. (2017) Lactose content of breast milk among lactating women in Latvia. *11th Baltic Conference on Food Science and Technology Foodbalt 2017*, 27. līdz 28. aprīlis, 2017. gads, Jelgava, Latvija (mutiskais ziņojums);
3) **Aumeistere L.**, Ciproviča I., Zavadska D., Bavrins K. (2017) A preliminary study on essential minerals in human milk: association with dietary habits. *23rd Annual International Scientific Conference Research for Rural Development 2017*, 17. līdz 19. maijs, 2017. gads, Jelgava, Latvija (mutiskais ziņojums);
4) **Aumeistere L.**, Ciproviča I., Zavadska D., Andersons J., Jakubone E. (2017) Fat content of human milk: a pilot study from Latvia. *11th European Nutrition and Dietetics Conference*, 29. jūnijs līdz 1. jūlijs, 2017. gads, Madride, Spānija (e-posteris);
5) **Aumeistere L.**, Ciproviča I., Zavadska D., Bavrins K., Borisova A. (2018) Zinc content in breast milk: a report from Latvia. *2nd EuroSciCon Conference on Food Technology*, 14. līdz 16. maijs, 2018. gads, Roma, Itālija (mutiskais ziņojums);
6) **Aumeistere L.**, Ciproviča I., Zavadska D., Volkovs V. (2018) *Trans* fatty acid content in mature breast milk among lactating women in Latvia. *1th European Food Chemistry & Nutrition Congress*, 26. līdz 27. jūlijs, 2018. gads, Amsterdama, Nīderlande (mutiskais ziņojums);
7) **Aumeistere L.**, Ciproviča I., Zavadska D., Bavrins K., Borisova A. (2019) Maternal sodium intake reflects on sodium content in mature human milk. *6th International Conference on Nutrition & Growth*, 7. līdz 9. marts, 2019. gads, Valensija, Spānija (stenda referāts);
8) **Aumeistere L.**, Ciproviča I., Zavadska D., Bavrins K., Borisova A. (2019) Essential elements analysis in mature human milk. *13th Baltic Conference on Food Science FoodBalt 2019 & 5th North and East European Congress on Food NEEFood 2019*, 2. līdz 3. maijs, 2019. gads, Jelgava, Latvija (mutiskais ziņojums);
9) Beluško A., **Aumeistere L.**, Ciproviča I., Zavadska D. (2020) Conjugated linoleic acid in human milk: a case study from Latvia. *3rd International Conference Nutrition and Health*, 9. līdz 11. decembris, 2020. gads, Rīga, Latvija (e-postera prezentācija);
10) **Aumeistere L.**, Ciproviča I., Zavadska D., Volkovs V. (2020) Dietary vegetable oil impact on fatty acid composition in human milk. *12th Nordic Nutrition Conference*, 13. līdz 16. decembris, 2020. gads, Helsinki, Somija (e-postera prezentācija);

11) Beluško A., **Aumeistere L.**, Ciproviča I., Zavadska D. (2021) Omega-3 taukskābju sastāvs mātes pienā. *16th International Scientific Conference "Students on their Way to Science"*, 23. aprīlis, 2021. gads, Jelgava, Latvija (mutisks ziņojums tiešsaistē).

Sabiedrības informēšanas aktivitātes

1) Seminārs topošajām un jaunajām māmiņām "Gaidību 4diena", 30.08.2018. Norises vieta – tirdzniecības centrs Domina Shopping. Lekcija, ko vada Latvijas Lauksaimniecības universitātes doktorantūras studente Līva Aumeistere – Kāpēc Omega 3 taukskābes ir vitāli nepieciešamas zīdīšanas laikā? (https://www.facebook.com/events/302406270523397/);
2) Māmiņu klubs Online TV, 06.11.2018. Video saruna ar Latvijas Lauksaimniecības universitātes doktorantūras studenti Līvu Aumeisteri. Nepieciešamība pēc omega 3 taukskābēm no dzimšanas (https://vimeo.com/419410349);
3) Latvijas Radio 1 raidījums "Ģimenes studija", 17.12.2018., piedaloties Bērnu klīniskās universitātes slimnīcas neonataloģei Renātei Zariņai, zīdīšanas konsultantēm Sandrai Lasei un Evitai Žvagiņai-Jākobsonei, un Latvijas Lauksaimniecības universitātes doktorantūras studentei Līvai Aumeisterei. Mātes piena sastāva ietekme uz bērniņa attīstību (https://lr1.lsm.lv/lv/raksts/gimenes-studija/mates-piena-sastava-ietekme-uz-bernina-attistibu.a112722/);
4) Vecāku apvienība "KKM klubs", 11.05.2019. Lekciju zīdīšanas konsultantiem vada Latvijas Lauksaimniecības universitātes doktorantūras studente Līva Aumeistere – Vai sievietes uzturs var ietekmēt mātes piena sastāvu?;
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LIST OF THE ACRONYMS, ABBREVIATIONS USED IN THE *PH.D.* THESIS / *PROMOCIJAS DARBĀ LIETOTIE SAĪSINĀJUMI* UN *SIMBOLI*

ρ – Spearman rank correlation coefficient / *Spīrmena rangu korelācijas koeficients*
AI / *AD* – adequate intake / *atbilstošais daudzums* – value set when there is not enough data to calculate an average requirement for a nutrient. The average level of intake of a nutrient, based on observations or experiments, that is assumed to be adequate / *vērtība, kas noteikta, ja nav pietiekami daudz datu, lai aprēķinātu vidējo uzturvielas* daudzumu. *Vidējais uzturvielas daudzums, kurš tiek uzskatīts par pietiekamu, aprēķināts balstoties uz novērojumiem vai eksperimentiem* (European Food Safety Authority, 2019a)
ALA / *ALS* – α-linolenic acid / *α-linolēnskābe*
ALAP / *CMVI* – as low as possible / *cik maz vien iespējams*
AR / *VD* – average requirement / *vidējais daudzums* – intake of a nutrient that meets the daily needs of half the people in a healthy population / *uzturvielas daudzums, kas nodrošina 50 % iedzīvotāju ikdienas vajadzības veselā, darbspējīgā populācijā* (European Food Safety Authority, 2019a)
ARA / *AS* – arachidonic acid / *arahidonskābe*
BDL / *ZNR* – below the detection limit / *zem noteikšanas robežas*
BMI / *ĶMI* – body mass index / *ķermeņa masas indekss*
CLA / *KLS* – conjugated linoleic acid acid / *konjugētā linolskābe*
DFE / *UFE* – dietary folate equivalents / *uztura folātu ekvivalenti*
dietary folate equivalents = food folates (μg) + (1.7 × μg of folic acid) /
uztura folātu ekvivalenti = pārtikas folāti (μg) + (1.7 × μg folskābes) (European Food Safety Authority, 2019a)
DHA / *DHS* – docosahexaenoic acid / *dokozaheksaēnskābe*
E % – the percentage of total daily energy intake / *procentuālais dienā uzņemtās kopējās enerģijas daudzums*
EA / *ES* – elaidic acid / elaidīnskābe
EFSA – European Food Safety Authority / *Eiropas Pārtikas nekaitīguma iestāde*
EN – European standard / *Eiropas standarts*
EPA / *EPS* – eicosapentaenoic acid / *eikozānpentaēnskābe*
et al. / **etc. / *u.c.* / *u.tml.*** – and others / *un citi*
FFQ / *PPLBA* – food frequency questionnaire / *pārtikas produktu lietošanas biežuma anketa*
Fig. / ***att.*** – figure / *attēls*
FSP / *PPP* – first study period / *pirmais pētījuma posms*
ICP-MS – inductively coupled plasma mass spectrometry / *induktīvi saistītās plazmas masspektrometrija*
IEC / *IEC* – the International Electrotechnical Commission / *Starptautiskā Elektrotehnikas standartizācijas komisija*
IQR / *SKI* – interquartile range / *starpkvartiļu izkliede*
ISO – International Standard Organization / *Starptautiskā Standartizācijas organizācija*
LA / *LS* – linoleic acid / *linolskābe*
LEA / *LES* – linolelaidic acid **/** *linolelaidīnskābe*
LIL / *ZUL* – lowest intake level / *zemākais uzņemšanas daudzums* (a cut-off intake value below which an intake could lead to clinical deficiency symptoms in most individuals / *robežvērtība, zem kuras uzņemtā deva var izraisīt klīniska deficīta simptomus vairumam cilvēku*) (Nordic Council of Ministers, 2014)
LVS – Latvian Standard / *Latvijas standarts*
Max / ***Maks*** – maximal value / *maksimālā vērtība*
Min / *Min* – minimal value / *minimālā vērtība*
MCFA / *VGĶT* – medium-chain fatty acids / *vidēji garo ķēžu taukskābes*
MUFA / *MNT* – monounsaturated fatty acids / *mononepiesātinātās taukskābes*

n – number of samples or participants / *paraugu vai dalībnieču skaits*
NA / *NP* – not applicable / *nav piemērojams*
ND / *ND* – not defined / *nav definēts*
NE / *NE* – niacin equivalents / *niacīna ekvivalenti (*1 niacin equivalent is equal to 1 mg niacin or 60 mg tryptophan / *1 niacīna ekvivalents ir vienāds ar 1 mg niacīna vai 60 mg triptofāna)* (European Food Safety Authority, 2019a).
NI / *NI* – no information / *nav informācijas*
OA / *OS* – oleic acid / *oleīnskābe*
PA / *PS* – palmitic acid / *palmitīnskābe*
PRI / *PRD* – population reference intake / *populācijas references daudzums* (the intake of a nutrient that is likely to meet the needs of almost all healthy people in a population / *uzņemtais uzturvielas daudzums, kas, nodrošinās gandrīz visu veselo, darbspējīgo iedzīvotāju vajadzības pēc konkrētās uzturvielas*) (European Food Safety Authority, 2019a)
PUFA / *PNT* – polyunsaturated fatty acids / *polinepiesātinātās taukskābes*
R^2 – the coefficient of determination / *determinācijas koeficients*
RAE / *RAE* – retinol activity equivalents / *retinola aktivitātes ekvivalenti* (1 µg retinol activity equivalent equals 1 µg of retinol, 6 µg of β-carotene or 12 µg of other provitamin A carotenoids / *1 µg retinola aktivitātes ekvivalenta ir vienāds ar 1 µg retinola, 6 µg β-karotīna vai 12 µg cita provitamīna A karotinoīdiem)* (European Food Safety Authority, 2019a)
RI / *ID* – recommended intake / *ieteicamais daudzums* – value based on different types of scientific evidence, and should, when consumed as part of a varied, well-balanced diet, assure optimal function and development and contribute to a reduced risk of major chronic diseases (cardiovascular diseases, type-2 diabetes, cancer, obesity etc.) */ vērtība, kas balstīta uz dažāda veida zinātniskiem pierādījumiem, un, ja noteikto uzturvielas daudzumu patērē kā daļu no daudzveidīga, sabalansēta uztura, nodrošina cilvēkam optimālu darbību un attīstību, kā arī samazina risku saslimt ar nopietnām hroniskajām slimībām (kardiovaskulārās slimības, 2. tipa cukura diabēts, ļaundabīgie audzēji, aptaukošanās u.c.)* (Nordic Council of Ministers, 2014)
RIR / *IUD* – reference intake range / *ieteicamais uzņemšanas diapazons* – proportion of energy that is adequate for maintaining health / *enerģijas daudzums, kas ir pietiekams veselības uzturēšanai* (European Food Safety Authority, 2019a)
SD – standard deviation / *standartnovirze*
SFA / *PT* – saturated fatty acids / *piesātinātās taukskābes*
SPSS – Statistical Package for the Social Sciences / *Sociālo zinātņu statistikas pakete*
SSP / *OPP* – second study period / *otrais pētījuma posms*
TE / *TE* – tocopherol equivalents / *tokoferola ekvivalenti* (1 tocopherol equivalent is 1.0 mg α-tocopherol, 0.5 mg β-tocopherol, 0.1 mg γ-tocopherol, 0.03 mg δ-tocopherol, 0.3 mg α-tocotrienol, 0.05 mg β-tocotrienol / 1 *tokoferola ekvivalents ir 1.0 mg α-tokoferola, 0.5 mg β-tokoferola, 0.1 mg γ-tokoferola, 0.03 mg δ-tokoferola, 0.3 mg α-tokotrienola, 0.05 mg β-tokotrienola)* (European Food Safety Authority, 2019a)
TFA / *TT* – *trans* fatty acids / *trans taukskābes*
UIL / *MUL* – upper intake level **/** *maksimālais uzņemšanas daudzums* (the maximum level of long-term (months or years) daily nutrient intake that is unlikely to pose a risk of adverse health effects in humans / *maksimālais ilgtermiņa (mēnešu vai gadu) ikdienā uzņemtais uzturvielas daudzums, kas, visticamāk, neradīs risku cilvēka veselībai* (Nordic Council of Ministers, 2014)
VA / *VS* – vaccenic acid / *vakcēnskābe*

INTRODUCTION / *IEVADS*

Infancy (0 to 12 months) and young childhood (1 to 3 years) is a critical period for human development. Adequate nutrition during this time ensures optimal physical growth, development, and maturation of organs and immune system, affecting both short and long-term health of a child (European Food Safety Authority, 2013).

Human milk is universally preferred as the first food and nutrient source for the infant (Erick, 2018). Human milk consists of water, macronutrients (lipids, carbohydrates, protein), and micronutrients (essential elements, vitamins) as well as various bioactive substances (secretory immunoglobulins A, lysozyme, lactoferrin, etc.) needed for the growth and development of an infant (European Food Safety Authority, 2013; Hale & Hartmann, 2017; Lawrence & Lawrence, 2015; World Health Organization, 2018).

Components in human milk are directly synthesized in the mammary glands or derived from maternal plasma, therefore originate from the current maternal diet or body stores (Andreas, Kampmann & Le-Doare, 2015; Hale & Hartmann, 2017). Accordingly, the quality of a woman's diet is an important factor that can affect human milk composition and the development of an infant, respectively (Hale & Hartmann, 2017; Lawrence & Lawrence, 2015).

All around the world the fatty acid composition of human milk has been extensively studied (Bravi et al., 2016; Keikha et al., 2017), and it seems that the type of fatty acids in human milk varies due to regional aspects and dietary traditions (Andreas, Kampmann & Le-Doare, 2015; Hale & Hartmann, 2017; Mohrbacher, 2010). Maternal fish intake frequency (higher in the coastal regions) correlates with the docosahexaenoic acid level in human milk, which is a vitally important fatty acid for an infant's brain development and vision (Fiorella et al., 2018; Innis, 2007; Lauritzen et al., 2016; Olang, et al., 2012). *trans* fatty acid synthesis in a human body is limited, therefore the source for these fatty acids in human milk is the maternal diet. *trans* fatty acid level in human milk varies around the world, and it is higher in regions with high industrially processed food or ruminant meat and dairy product intake (Friesen & Innis, 2006; Mueller et al., 2010; Turpeinen et al., 2002).

The importance of essential elements in diverse biochemical functions makes them a rather important dietary constituent in early youth (Grzunov Letinić et al., 2016). Essential elements are carried over to human milk from the maternal blood via cellular pathways (Montalbetti et al., 2014). Yet, there is still no clarity if maternal diet can affect essential element content in human milk (Bravi et al., 2016; Keikha et al., 2017). Some studies have found a significant correlation between specific element content in human milk and consumption frequency of some specific food products (Björklund et al., 2012; Leotsinidis, Alesopoulos & Kostopoulo-Farri, 2005; Valent et al., 2011), other researchers (Bravi et al., 2016; Keikha et al., 2017) indicate that essential element content in human milk is sustained tightly and not affected by maternal dietary intake of these elements, respectively.

During lactation, potentially toxic substances can be mobilised from the maternal body stores and excreted via human milk (Gundacker & Zödl, 2005). Infants are especially sensitive to toxic agents because their organs and immune system are still developing (Rebelo & Caldas, 2016). Potentially toxic elements are one of the most hazardous substances and may initiate serious health complications (prematurity, reduced renal function, and gastrointestinal diseases) (Burrell & Exley, 2010). They are ubiquitous and can be inhaled or ingested via drinking water or food, including human milk (Gundacker & Zödl, 2005; Rebelo & Caldas, 2016).

Human milk composition among lactating women in Latvia has not been comprehensively studied (Bake et al., 2007; Broka et al., 2016). There has been previously done research assessing the exposure via human milk to persistent organic pollutants (polychlorinated dibenzo-*p*-dioxins, dibenzofurans, chlorinated pesticides, and their metabolites) in Latvia (Bake et al., 2007). The target group of the research was mothers from town Olaine, and the control group was from the area without chemical industry objects.

Obtained results responded to the lowest detected levels of organic pollutants among European countries (Bake et al., 2007). Research conducted by Broka et al. (2016) is the latest study conducted in Latvia about macronutrient (fat, protein, lactose) content in human milk. Nevertheless, only transitional human milk samples (less than one month postpartum) were collected, and it was done while mothers and infants were admitted to the Neonatal Care Unit in Children's Clinical University Hospital. Therefore, study results cannot be ascribed to the overall population.

Currently, there are no data about the fatty acid composition and essential & potentially toxic element content in human milk among lactating women in Latvia. There is also a lack of information regarding women's dietary habits during lactation in Latvia. It raises a need to conduct research in this area as it would provide an insight into national differences in human milk composition, and allow us to evaluate the quality of maternal nutrition, its effect on human milk composition and therefore nutritional provision for the infant via human milk.

The **hypothesis** of the study: maternal nutrition predicts human milk composition and serves as the basis for providing the essential nutrients for the infant.

The hypothesis is supported by the following **thesis**:

- a lactating woman can meet her nutritional needs by consuming a well-balanced diverse diet, which also serves as the basis for providing the essential nutrients for infant via human milk.
- total fat, protein, lactose content in human milk is not directly affected by maternal diet;
- qualitative and quantitative fatty acid composition of human milk is influenced by maternal dietary habits;
- essential and potentially toxic element content in human milk is related to maternal dietary habits;
- exclusively breastfed infants till six months of age can receive a sufficient amount of energy and nutrients (fat, protein, lactose, fatty acids and essential elements) via human milk.

The **research object** of the study: mature human milk (at least 28 days postpartum).

The **aim** of the study: to evaluate human milk composition in relation to maternal nutrition and to assess nutritional supply for exclusively breastfed infants.

Consequential **research objectives** were set to achieve the aim of the study:

1) to analyse protein, lactose, fat, fatty acid, essential (Ca, Mg, Na, K, Zn, Se, Mn, Fe, Cu, Co, Cr) and potentially toxic element (Al, Ni, As, Sr, Cd, Sn, Sb, Pb) content in human milk;
2) to evaluate the compliance of the women's nutrition during lactation with the recommendations at the national and European level;
3) evaluate the association between maternal nutrition and human milk composition;
4) based on elaborated human milk composition results, theoretically evaluate nutritional adequacy of exclusively breastfed infants till six months of age.

The **scientific significance** of the study:

1) for the first time in Latvia, composition of human milk has been comprehensively analysed;
2) elaborated data serve as a contribution from Latvia to the global research area of human milk composition.

The **national significance** of the study:

1) elaborated findings can be used to develop nutritional guidance for lactating women in Latvia;
2) compiled results can be used to develop nutrient intake guidelines for infants in Latvia (≤6 months old).

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- Conducting Fundamental Research in the Latvia University of Life Sciences and Technologies. Project "Natural variations in fatty acid composition of human milk". Project No. G1. Contract No. 3.2-10/2019/LLU. Project status – ongoing (project time from 6 January 2020 to 5 January 2022);
- Latvia University of Life Sciences and Technologies Transition to the New Doctoral Funding Model. European Social Fund Project No. 8.2.2.0/20/I/001. Project status – ongoing (project time from 17 May 2021 to 16 May 2022).

1. OVERVIEW OF THE LITERATURE / *LITERATŪRAS APSKATS*

1.1. Breastfeeding statistics in Latvia / *Zīdīšanas statistika Latvijā*

World Health Organization, the European Food Safety Authority, and the Ministry of Health of the Republic of Latvia state that human milk is the most suitable first food for an infant. Exclusive breastfeeding (infant receives only human milk) is recommended as the best feeding option in the first six months postpartum (European Food Safety Authority, 2013; Veselības ministrija, 2003; World Health Organization, 2018).

Annual statistics from the Centre for Disease Prevention and Control of Latvia show that slightly more than 50 % of infants in Latvia are breastfed for the first six months (Fig. 1.1.) (Slimību profilakses un kontroles centrs, 2018). This is significantly higher compared to breastfeeding rates at the beginning of the 21st century (29 % to 42 % from the year 2000 to the year 2004) (Organizācija "Glābiet bērnus", 2006).

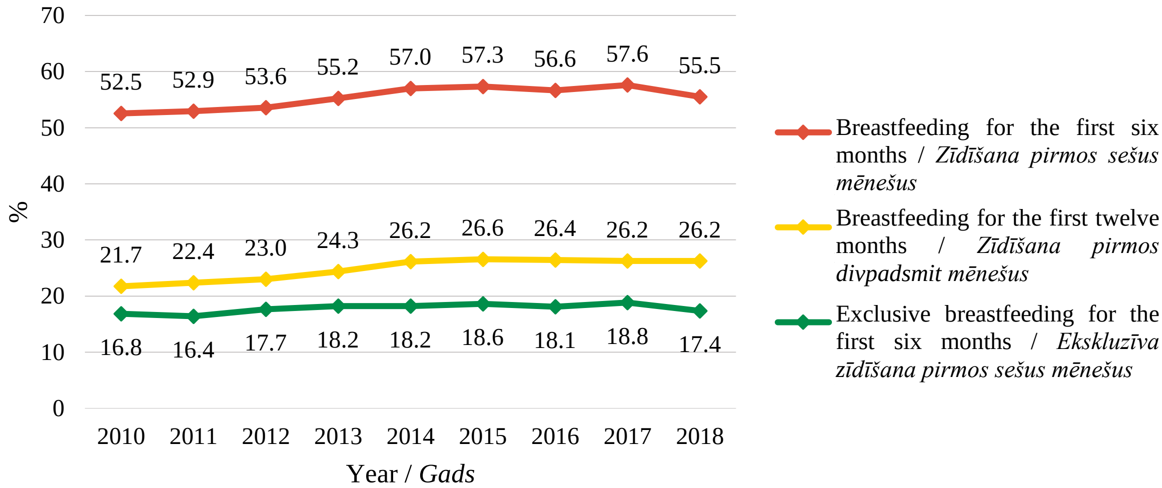

Fig. 1.1. **Breastfeeding rates in Latvia /** *1.1. att.* ***Zīdīšanas statistika Latvijā***
(Slimību profilakses un kontroles centrs, 2018)

However, only 16 % to 19 % of infants in Latvia are exclusively breastfed till six months of age, and this is lower than the average rate (~ 25 %) reported from the European region (Slimību profilakses un kontroles centrs, 2018; World Health Organization, 2015b). According to the data from Širina et al. (2015), a higher proportion of boys in Latvia are breastfed for at least six months – compared to girls. Also, women after the age of 30, are more tended to breastfeed for a longer period, compared to younger women (<30 years) (Širina et al., 2015).

In the Nordic countries, approximately 60 % (Finland, Sweden) to 80 % (Iceland, Norway) of infants receive human milk for the first six months of life (World Health Organization, 2015b). However, exclusive breastfeeding rates in Nordic countries are lower compared to Latvia – only 8 % to 12 % of infants solely receive human milk for the first half of the year (Nordic Council of Ministers, 2014). Overall, Europe is the region with one of the lowest rates for exclusive breastfeeding in the World (Theurich et al., 2019; World Health Organization, 2015a).

After the first four to six months, human milk can no longer solely satisfy the nutritional needs of a growing infant, and appropriate complementary feeding should be introduced to the diet together with a continued breastfeeding up to two years of age and longer (European Food Safety Authority, 2013; World Health Organization, 2018). Nevertheless, human milk continues to be a vital source of nutrients – ensuring more than half of energy and nutrient requirements for the infant in the second half of the first year and about one-third of energy and nutrient requirements in the second year (European Food Safety Authority, 2013; World Health

Organization, 2018). In Latvia, weaning is started around four to six months of age (Sirina et al., 2018).

1.2. Anatomy of the breast, physiology of lactation / *Krūts anatomija, laktācijas fizioloģija*

The breast (mammary gland) is a paired exocrine organ with the main function to synthesize and secrete a sufficient amount of milk with a conformable composition to fulfil the infant's requirements for growth and development (Kent, 2007; Montalbetti et al., 2014).

Lactation (secretion of milk) is a complex physiological process that includes the gradual development of mammary glands (mammogenesis) – the process when mammary glands acquire the ability to produce milk (lactogenesis) (Truchet & Honvo-Houéto, 2017).

The evolution of mammary glands starts during early foetal development, yet they do not fully develop in the prenatal period. After birth, mammary glands contain only a limited number of milk ducts. Breasts continue to develop during puberty (an increase of breast fatty tissue and proliferation of milk ducts) due to increased levels of plasma oestrogen, prolactin, luteinizing hormone, follicle-stimulating hormone, and somatotropin (Geddes, 2007; Lawrence & Lawrence, 2015; Truchet & Honvo-Houéto, 2017).

Breasts of non-pregnant, non-lactating women consist mostly of adipose tissues and a small portion of glandular (secretory) tissues, both supported by connective tissues (Cooper's ligaments) (Geddes, 2007; Lawrence & Lawrence, 2015; Truchet & Honvo-Houéto, 2017). Full mammogenesis occurs only during pregnancy (around week 16) when the amount of breast adipose tissue reduces in contrary to the increase of glandular tissues (~ 1:2) (Fig. 1.2.) (Geddes, 2007; Lawrence & Lawrence, 2015; Truchet & Honvo-Houéto, 2017).

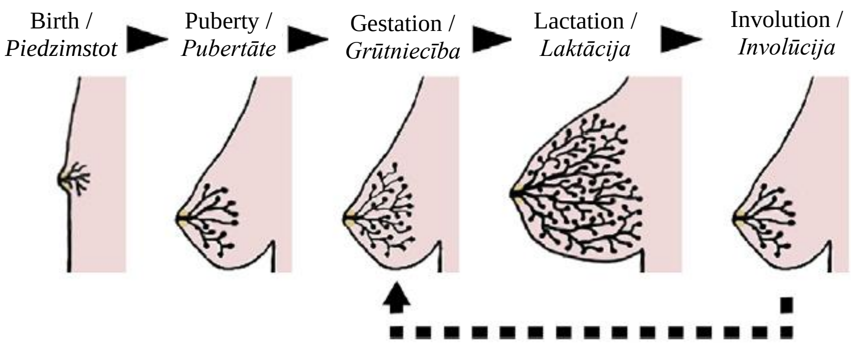

Fig. 1.2. **Development of mammary glands /** *1.2. att.* ***Piena dziedzeru attīstība***

Reprinted from the article Physiology of milk secretion, Truchet & Honvo-Houéto, Best Practice & Research Clinical Endocrinology & Metabolism, Vol. 31 (2017), p. 367–384. Copyright obtained in 2019, with the permission from Elsevier / *Attēls ņemts no raksta Physiology of milk secretion, Truchet & Honvo-Houéto, Best Practice & Research Clinical Endocrinology & Metabolism, Vol. 31 (2017), p. 367–384. Atļauja izmantot attēlu iegūta 2019. gadā no Elsevier*.

As pregnancy progresses, glandular tissues mature and become able to produce milk (lactogenesis I). However, the placenta during pregnancy ensures a high level of hormone progesterone and oestrogen, therefore inhibiting a significant secretion of milk (Lawrence & Lawrence, 2015; Truchet & Honvo-Houéto, 2017).

Mature glandular tissues are composed of 15–20 lobes that are located radially around the nipple. Lobes are further subdivided into lobules that each contain 10–100 alveoli. Alveoli are grape-like structures lined with secretory epithelial cells (lactocytes) and are encircled by myoepithelial cells and surrounded by blood capillaries (Geddes, 2007).

Insignificant milk synthesis is happening on an ongoing basis, yet most of the milk is made during a breastfeeding session in the influence of nipple stimulation (during suckling or pumping). The nipple is encircled by the areola – a darker pigmented area to help an infant latch onto the breast more easily. When an infant starts to suckle, it activates mechanoreceptors in the nipple. Substances for the synthesis of milk diffuse from the maternal blood to the lactocyte, and milk is created. The hormone oxytocin is released from the hypothalamus and initiates the contraction of myoepithelial cells helping to eject the milk from the lactocytes to the lumen of the alveolus and into the milk duct – a pathway that carries milk. Milk ducts link to larger milk ducts than unite into a major distended duct – lactiferous sinus (milk reservoir) that narrows towards the openings in the nipple (nipple pores) (Geddes, 2007; Lawrence & Lawrence, 2015).

Colostrum is the milk, produced by mammary glands in the first days postpartum (0–5 days). It is produced in small quantities (~ 90 ml per day), but it is enough to nurture the newborn (Lawrence & Lawrence, 2015; Truchet & Honvo-Houéto, 2017). Birthing and the removal of the placenta results in the drop of progesterone and oestrogen levels (4 to 6 days after delivery). The prolactin level in the maternal blood after the delivery stays high resulting in voluminous secretion of transitional milk (lactogenesis II) (Lawrence & Lawrence, 2015; Truchet & Honvo-Houéto, 2017).

During the first few weeks (10–15 days after delivery), lactation establishes to accommodate the needs of an infant. Synthesis of copious mature human milk starts around the second week after delivery and lasts as long as frequent milk expression is continued (lactogenesis III) (Lawrence & Lawrence, 2015; Truchet & Honvo-Houéto, 2017).

When weaning is started (usually 4 to 6 months postpartum) and therefore breastfeeding frequency decreases, milk production lowers resulting in the involution of glandular tissue and increase of breast adipose tissues (lactogenesis IV) (Lawrence & Lawrence, 2015; Truchet & Honvo-Houéto, 2017).

Yet, mammary glands are unique organs and can undergo repeated rounds of functional differentiation. Therefore, with a new pregnancy, mammary glands start to mature again and once again become able to produce milk (Fig. 1.2.) (Lawrence & Lawrence, 2015; Truchet & Honvo-Houéto, 2017).

1.3. Human milk composition / *Mātes piena sastāvs*

Milk is a secretion from mammary glands to provide nourishment to the offspring (Hale & Hartmann, 2017). Milk from all mammals contains macronutrients (fat, protein, lactose) as well as essential elements, vitamins, and other bioactive substances, but in different proportions adapting to the growth rates, environmental conditions, and feed of the particular mammal (Hale & Hartmann, 2017). Compared to other mammals, human milk contains quite high lactose content to ensure a sufficient amount of energy for the brain (Fig. 1.3.) (Andreas, Kampmann & Le-Doare, 2015).

Human milk components are either directly transferred from maternal blood (vitamins, essential elements, long-chain fatty acids) or synthesized in lactocytes (fat, protein, lactose). Mammary glands are constantly regulating the content of different components in milk to guard an infant against insufficient or excess intake of nutrients (Lawrence & Lawrence, 2015; Montalbetti et al., 2014).

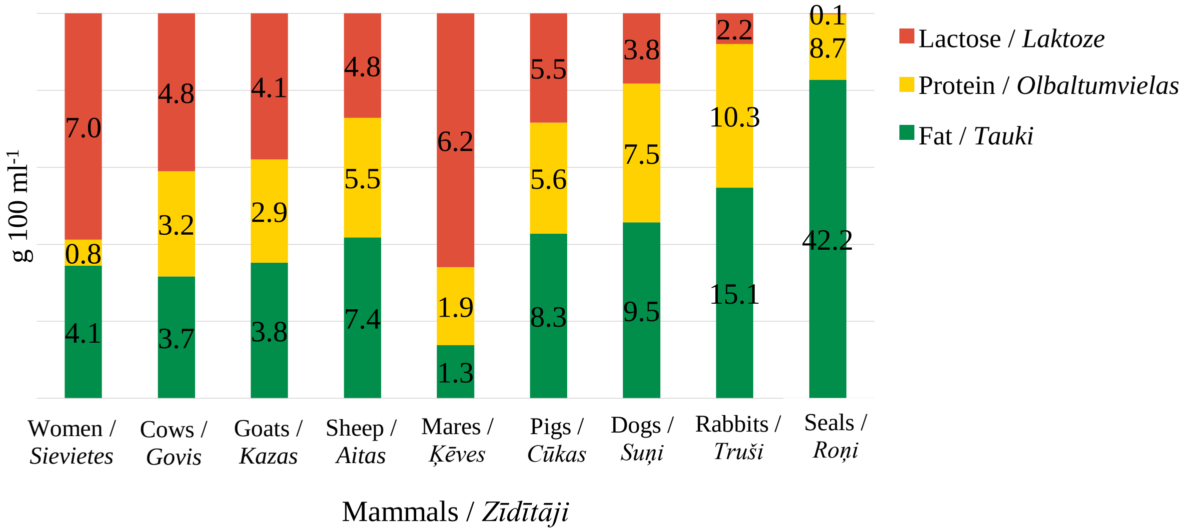

Fig. 1.3. **Macronutrient content in different mammal milk /** *1.3. att.* ***Makrouzturvielu saturs dažādu zīdītāju pienā*** (Hale & Hartmann, 2017)

Water accounts for the largest proportion of human milk (~ 87 %). Other components in human milk are dispersed in the water. Water helps to regulate the temperature of the infant via evaporation of water from lungs and skin, as well as is needed for the excretion of solutes via urine and faeces. Water from human milk can solely secure an infant's needs in the first six months of life, even in a hot and humid climate. Additional fluid intake for the infant during the first six months of life is not needed (European Food Safety Authority, 2010a; European Food Safety Authority, 2013; Lawrence & Lawrence, 2015).

The **fat** content of mature human milk is around 4 g 100 ml^{-1} (Andreas, Kampmann & Le-Doare, 2015) providing about the half of total energy in the milk (Hale & Hartmann, 2017). Dominating lipids in human milk are triacylglycerols (~ 98 %). The remaining 2 % is composed of mono- and diacylglycerols, nonesterified fatty acids, cholesterol, and phospholipids (Hale & Hartmann, 2017). Triacylglycerols also serve in the delivery of essential fatty acids and fat-soluble vitamins for the infant (Hale & Hartmann, 2017). Around 85 % of human milk triacylglycerols are principally composed of medium-chain (C10–C14) and long-chain fatty acids (C16–C24). Short-chain fatty acids (C6–C8) can be found only in insignificant amounts (Hale & Hartmann, 2017).

There are two sources for fatty acid synthesis in human milk depending on the length of fatty acids:

- fatty acids up to 14 carbon atoms are synthesized in lactocyte's endoplasmic reticulum from the glucose via pentose phosphate cycle and compose around 15 % of total fatty acids in human milk;
- longer fatty acids (≥C16) cannot be synthesized in the lactocytes and are derived from the maternal bloodstream. Sources are:
    - fatty acids from the recent meal;
    - a mobilisation of endogenous stores (adipose tissues) or
    - release from the liver (Hale & Hartmann, 2017; Lawrence & Lawrence, 2015).

Fatty acids are then esterified in the endoplasmic reticulum to compose triacylglycerols. Triacylglycerols agglomerate to compose the bigger fat droplets coated by a membrane made of proteins, phospholipids and cholesterol, fat-soluble vitamins, and other compounds. As fat droplets increase in size, they move closer to the tip of a lactocyte and form a milk fat globule (Hale & Hartmann, 2017; Lawrence & Lawrence, 2015).

Dominating fatty acids in human milk are palmitic acid (C16:0), oleic acid (C18:1 cis-9), and linoleic acid (C18:2 cis-6) (Hale & Hartmann, 2017). This possibly helps to retain the human milk fluidity (Roy et al., 2013).

Essential fatty acids – linoleic acid and α-linolenic acid levels in human milk significantly vary – from 10 % to 20 % of total fatty acids for linoleic acid and 0.10 % to 2.0 % for α-linolenic acid (Leotsinidis, Alesopoulos & Kostopoulo-Farri, 2005; Samur, Topcu & Turan, 2009). The arachidonic acid level in human milk ranges from 0.35 % to 0.70 % but docosahexaenoic acid level – from 0.17 % to 1.00 % of total fatty acid level in human milk (Koletzko et al., 2008).

Although some studies (Mosley et al., 2006; Turpeinen et al., 2002) have shown that a small portion (<10 %) of *cis*-9, *trans*-11 conjugated linoleic acid can be synthesized from the vaccenic acid in lactating women, overall *trans* fatty acid composition found in human milk, reflects maternal dietary intake of *trans* fatty acid from the previous days (Larqué, Zamora, & Gil, 2001).

There are two **nitrogen sources** in human milk – proteins and non-protein nitrogen compounds (Hale & Hartmann, 2017). Mature human milk contains approximately 0.8 g to 1.2 g 100 ml^{-1} of proteins. Proteins in human milk are represented as casein, whey, and milk fat globule membrane proteins (Hale & Hartmann, 2017).

Casein is a colloidal complex of proteins and salts (dominantly calcium phosphate) Therefore, casein delivers calcium and phosphorus that are vital for bone mineralisation on an infant. In total, casein compiles 20 % to 40 % of the total protein in human milk (Hale & Hartmann, 2017; Lönnerdal et al., 2017).

Major **whey proteins** found in human milk are α-lactalbumin, lactoferrin, secretory immunoglobulins, etc. α-lactalbumin composes ~ 10 % to 20 % of total protein content in human milk (Hale & Hartmann, 2017). The majority of iron in human milk is bound in lactoferrin, therefore aiding iron absorption. Immunoglobulins provide immunity against pathogens. Dominating immunoglobulins in human milk are secretory immunoglobulins A (~ 90 %) (Golinelli et al., 2014; Hale & Hartmann, 2017; Lönnerdal, 2003; Golinelli et al., 2014; Hale & Hartmann, 2017; Lönnerdal, 2003).

The smallest fraction of protein in human milk (~ 4 %) composes of **fat globule membrane proteins** (also called mucins) (Hale & Hartmann, 2017; Lönnerdal, 2003).

The majority of proteins (80 % to 90 %) in human milk are synthesised within lactocytes from amino acids, then packed into the secretory vesicles, and exocytosed into the milk. Albumins, enzymes, hormones derive from maternal blood via endocytosis and then are either directly transported through the lactocytes and secreted into the milk or secreted by exocytosis with other milk proteins (Hale & Hartmann, 2017; Lönnerdal, 2003; Matos, Ribeiro & Guerra, 2015).

Non-protein nitrogen compounds compile about 25 % of total nitrogen (Andreas, Kampmann, & Le-Doare, 2015; Hale & Hartmann, 2017). Non-protein nitrogen compounds in human milk constitute of free amino acids (8 % to 22 % of non-protein nitrogen), small peptides, nucleic acids, nucleotides, creatine, creatinine, carnitine, urea, uric acid, amino sugars, etc. nitrogen sources (Hale & Hartmann, 2017).

Human milk contains all essential **amino acids** for the infant – histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, valine (Hale & Hartmann, 2017). Free amino acids compose 8 % to 22 % of non-protein nitrogen compounds, and glutamic acid, glutamine, and taurine are the dominant free amino acids in human milk. Free amino acids are more easily absorbed than protein-bounded amino acids (Zhang et al., 2013).

Lactose is the main carbohydrate found in human milk (~ 6.7 g to 7.8 g 100 ml^{-1}) (Andreas, Kampmann & Le-Doare, 2015). Lactose is synthesized from glucose and galactose (originating from the glucose-6-phosphate) with the help of lactose synthase within the Golgi apparatus. Glucose is derived from the maternal blood, and glucose utilization rises by 30 % during lactation (Hale & Hartmann, 2017; Lawrence & Lawrence, 2015).

Lactose is an osmole, and its synthesis in mammary glands is allied to the total volume of milk generated. In total, lactose provides ~ 40 % of the total energy of human milk (Hale & Hartmann, 2017).

Besides lactose, human milk contains more than 130 different oligosaccharides in a total amount similar to protein content in human milk (~ 1.0 g 100 ml^{-1}) (Andreas, Kampmann & Le-Doare, 2015; Hale & Hartmann, 2017). Oligosaccharides do not provide a significant amount of energy for the infant, but acts as prebiotics and promote the growth and maintenance of the infant's microbiome (for example, *Bifidobacterium bifidum*) (Andreas, Kampmann & Le-Doare, 2015; Hale & Hartmann, 2017).

Different **essential elements** in human milk are mainly found as ions. Calcium, potassium, sodium, and magnesium are dominant cations. Phosphates, chlorides, and citrates are the dominant anions. Potassium, sodium, and chloride are monovalent ions, but calcium, magnesium, citrates, phosphates, sulphates – divalent ions. Ions travel freely through the lactocyte cell membrane to the lumen and vice versa. The sum of the content of monovalent ions in human milk is inversely related to the lactose content. This maintains the osmolality of human milk close to that of maternal serum (de la Guardia & Garrigues, 2015; Lawrence & Lawrence, 2015).

Calcium is an essential component of bones and teeth. Calcium content in human milk (20 mg to 30 mg 100 ml^{-1}) is relatively stable and insensitive to maternal diet (Butte, Lopez-Alarcon & Garza, 2002; European Food Safety Authority, 2013; Olausson et al., 2012).

Phosphorus together with calcium is needed for the development of the skeletal system as well as involved in energy metabolism (adenosine triphosphate). The average content of phosphorus in human milk is 12 mg 100 ml^{-1} (European Food Safety Authority, 2013).

Magnesium is a part of several enzymes, therefore involved in different reactions in the human body. The median content in human milk is reported to be 3.1 mg 100 ml^{-1} (European Food Safety Authority, 2013).

Sodium is the dominant extracellular but **potassium** – intracellular cation. Interacting together, they provide a concentration gradient (Na/K ratio) for muscle contractions, neural transmission, and vascular tone. Like in other intracellular fluids, potassium content in human milk is significantly higher than sodium content (~ 3/1) (Lawrence & Lawrence, 2015). The average content of sodium in human milk is 15 mg 100 ml^{-1} but potassium – 50 mg 100 ml^{-1} (European Food Safety Authority, 2013).

Chloride is the dominant extracellular anion, and is a component of gastric juice (hydrochloric acid). The median content of chloride in human milk is approximately 40 mg 100 ml^{-1} (European Food Safety Authority, 2013).

Iron is the oxygen carrier in the body, therefore involved in cell respiration (European Food Safety Authority, 2013; Friel, Qasem & Cai, 2018). Lactocytes do not secrete iron into the milk, therefore human milk provides only trace amounts of iron to the infant (0.04 mg to 0.10 mg 100 ml^{-1}) which is not be enough to fulfil the infant's requirements for iron (0.30 mg per day). Nevertheless, the bioavailability of iron from human milk is high (20 % to 50 %) (European Food Safety Authority, 2013). To ensure a sufficient serum level of iron, infants have accumulated iron reserves during gestation which is enough for the first four to six months postpartum (Friel, Qasem & Cai, 2018).

Copper, zinc, manganese, selenium, chromium are involved in diverse biochemical functions in the body. Therefore, the above-mentioned elements are essential for the growth and development of an infant (European Food Safety Authority, 2013; Lawrence & Lawrence, 2015). **Zinc** content in human milk rapidly declines during lactation (from 0.30 mg 100 ml^{-1} in the first month to 0.12 mg 100 ml^{-1} in the sixth month). The mean value for **copper** in human milk varies from 0.03 to 0.04 mg 100 ml^{-1}. **Selenium** content in human milk among lactating women from Europe significantly differs – from 0.30 µg to 8.4 µg 100 ml^{-1} with a mean content of 1.6 µg 100 ml^{-1}. The mean content of **manganese** and **chromium** in human milk is around

0.4 µg to 0.6 µg 100 ml^{-1} and 0.05 µg 100 ml^{-1}, respectively (European Food Safety Authority, 2013; Lawrence & Lawrence, 2015).

Iodine is needed for the synthesis of thyroid hormones and therefore a normal function of the thyroid gland. Iodine content in mature human milk among lactating women in Europe range from 5 µg to 10 µg 100 ml^{-1} (European Food Safety Authority, 2013).

Potentially toxic elements (cadmium, arsenic, lead, tin, aluminium, nickel, antimony, mercury) are dispelled all over the environment and can be ingested via food by a woman and excreted during lactation through human milk (de la Guardia & Garrigues, 2015).

Since lactocytes cannot synthesize **water-soluble vitamins**, they must derive from external sources. The human body does not have significant internal stores of water-soluble vitamins, accordingly, their content in human milk is directly related to current maternal dietary intake (Montalbetti et al., 2014).

Following **water-soluble vitamins** are found in human milk in subsequent forms:

- **Vitamin B_1** as:
  - thiamin (~ 30 %) and
  - thiamin monophosphate (~ 70 %). Vitamin B_1 participates as a coenzyme for pyruvate dehydrogenase, therefore, is involved in carbohydrates metabolism. The average content of vitamin B_1 in human milk is 0.02 mg 100 ml^{-1} (de la Guardia & Garrigues, 2015; Dror & Allen, 2018; European Food Safety Authority, 2013; Lawrence & Lawrence, 2015);
- **Vitamin B_2** as:
  - flavin adenine dinucleotide (54 %);
  - riboflavin (39 %) and
  - other flavins. Vitamin B_2 is the precursor for coenzymes (flavin mononucleotide and flavin adenine dinucleotide) which are involved in energy production. The average content of vitamin B_2 in human milk is ~ 0.035 mg 100 ml^{-1} (de la Guardia & Garrigues, 2015; Dror & Allen, 2018; European Food Safety Authority, 2013; Lawrence & Lawrence, 2015);
- **Vitamin B_6** as:
  - pyridoxal (75 %);
  - pyridoxal phosphate (9 %) and
  - pyridoxamine and pyridoxine. Vitamin B_6 is a coenzyme for glycogen phosphorylase which is involved in glycogenolysis. Vitamin B_6 content in mature human milk is ~ 100 µg 100 ml^{-1} (Dror & Allen, 2018; European Food Safety Authority, 2013; Lawrence & Lawrence, 2015);
- **Vitamin B_{12}** as:
  - methylcobalamin and
  - 5-deoxyadenosylcobalamin. Vitamin B_{12} is vital for normal erythrocyte formation and neurological functions. Vitamin B_{12} content in human milk ranges from 0.03 µg to 0.04 µg 100 ml^{-1} (Dror & Allen, 2018; European Food Safety Authority, 2013);
- **Folate** (vitamin B_9) is a term for a group of compounds that includes folic acid and derivatives having nutritional properties similar to folic acid. Vitamin B_9 is needed for normal cell division, especially erythrocyte formation, and neurological functions. Vitamin B_9 content in human milk is ~ 8 µg 100 ml^{-1} (Dror & Allen, 2018; European Food Safety Authority, 2013);
- **Niacin** (vitamin B_3) is a precursor for coenzymes nicotinamide adenine dinucleotide and nicotinamide adenine dinucleotide phosphate, therefore essential for intracellular respiratory reactions. The average vitamin B_3 content in mature human milk is 150 µg 100 ml^{-1} (European Food Safety Authority, 2013; Lawrence & Lawrence, 2015);

- **Pantothenic acid** (vitamin B_5) is a part of coenzyme A, which is involved in the β-oxidation of fatty acids. The vitamin B_5 content in human milk is around 0.25 mg 100 ml^{-1} (European Food Safety Authority, 2013);
- **Biotin** (vitamin B_7) is involved in the metabolism of carbohydrates, fat, and amino acids. Vitamin B_7 content in human milk is ~ 0.5 µg 100 ml^{-1} (European Food Safety Authority, 2013);
- **Vitamin C** is needed for the synthesis of collagen and carnitine and is involved in the conversion of cholesterol to bile acids. Vitamin C content in human milk is around 4 mg 100 ml^{-1} (European Food Safety Authority, 2013; Lawrence & Lawrence, 2015).

Fat-soluble vitamins transfer via placenta during gestation is limited. Accordingly, infants are born with low fat-soluble vitamin stores. Therefore, human milk can be a significant source of fat-soluble vitamins for an infant during the first months of life (Matos, Ribeiro & Guerra, 2015):

- **Vitamin A** is a term for fat-soluble compounds – retinoids (retinol, retinal, retinoic acid) and represents antioxidant properties. Vitamin A is needed for the vision, immune system, growth, and development. Average A vitamin content in human milk is ~ 45 µg to 75 µg 100 ml^{-1} (European Food Safety Authority, 2013; Lawrence & Lawrence, 2015; Matos, Ribeiro & Guerra, 2015);
- **Vitamin E** (the dominant form is α-tocopherol) also acts as an antioxidant by protecting cell membranes (more specifically – lipids) against peroxidation. Human milk contains ~ 0.35 mg 100 ml^{-1} of vitamin E (European Food Safety Authority, 2013; Matos, Ribeiro & Guerra, 2015);
- **Vitamin D** affects the metabolism of calcium and phosphorus, therefore, is essential for the development of the skeletal system. D vitamin content in human milk ranges from 0.03 µg to 0.20 µg 100 ml^{-1}. Vitamin D also is synthesized in the skin from 7-dehydrocholesterol under the impact of ultraviolet B light (European Food Safety Authority, 2013). In human milk D vitamin is found in the following forms:
    - 25-hydroxyvitamin D;
    - ergocalciferol and
    - cholecalciferol (European Food Safety Authority, 2013; Matos, Ribeiro & Guerra, 2015);
- The dominant form of **vitamin K** in human milk is phylloquinone, and its main function is related to the coagulation of blood. K vitamin content in human milk is low ~ 0.25 µg 100 ml^{-1} (European Food Safety Authority, 2013).

1.4. Time associated changes in human milk composition / *Piena sastāva izmaiņas laktācijas periodā*

Human milk contains protein, fat, and carbohydrates which content changes over a single feed, single day, as well as over lactation (Andreas, Kampmann & Le-Doare, 2015; Garwolińska et al., 2018). Depending on the time postpartum, there are three stages – **colostrum**, **transitional** and **mature human milk** – each with disparate characteristics (Andreas, Kampmann, & Le-Doare, 2015; Hale & Hartmann, 2017).

Colostrum is the milk, produced in the first days after birth (0–5 days). The primary function of colostrum is not nutritional but immunological – to prevent the colonisation of pathogens in an infant's gastrointestinal tract (Andreas, Kampmann & Le-Doare, 2015; Golinelli et al., 2014). Colostrum has a lower lactose (5.70 %) and fat (2.95 %), but a higher protein content (2.90 %) compared to mature human milk (Garwolińska et al., 2018). The whey/casein ratio in colostrum is ~ 80/20, and most of the whey proteins in colostrum are secretory immunoglobulins A (Andreas, Kampmann & Le-Doare, 2015; Garwolińska et al., 2018).

After the first few days postpartum, the progesterone level in maternal blood decreases, tight junctions close between mammary epithelial cells. The sodium/potassium ratio declines, but lactose content increases, initiating the synthesis of transitional milk. During the next ten days, human milk slowly matures. About half a month postpartum, human milk is considered almost mature (Ballard & Morrow, 2013; Truchet & Honvo-Houéto, 2017). Fully mature human milk is after one month postpartum, and it contains a lower protein (~ 1.50 %), but a higher lactose (~ 7.00 %) and fat content (~ 4.00 %) compared to colostrum (Garwolińska et al., 2018) (Fig. 1.4.).

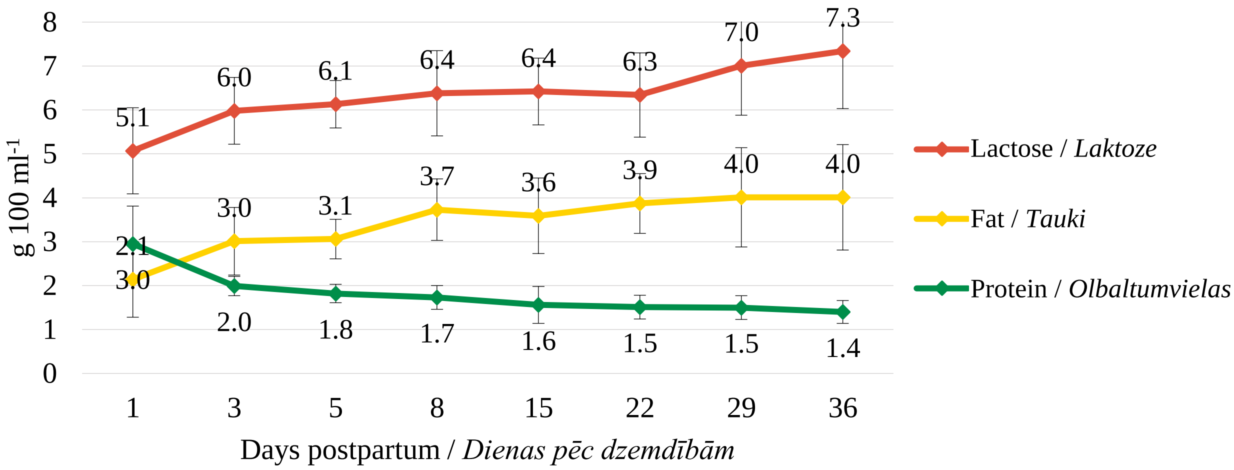

Fig. 1.4. **Variation in the composition of human milk during the first days postpartum /**
1.4. att. ***Mātes piena sastāva izmaiņas pirmajās dienās pēc dzemdībām***
(Lawrence & Lawrence, 2015)

If the main significance of colostrum is immune security, then the main function of mature human milk is to provide sufficient energy to the growing infant (Andreas, Kampmann & Le-Doare, 2015; Hale & Hartmann, 2017). Protein content lowers over time – from 2.06 g 100 ml^{-1} in the colostrum to 1.10 g 100 ml^{-1} after three months postpartum (Lönnerdal et al., 2017). The whey/casein ratio also decreases with time – from 80/20 in colostrum to 60/40 in mature human milk (Golinelli et al., 2014).

Sala-Vila et al. (2005) have observed that level of saturated fatty acids and α-linolenic acid increases from colostrum to mature human milk. On the opposite, total monounsaturated, n-6 polyunsaturated and n-3 polyunsaturated fatty acid, as well as individually – oleic acid, arachidonic acid, eicosapentaenoic acid, and docosahexaenoic acid level decreases over time (Sala-Vila et al., 2005).

The free amino acids content in human milk depending on time postpartum can:

- increase (glutamic acid, glycine, alanine, cysteine);
- decrease (taurine, proline, isoleucine, leucine, tyrosine, ornithine, lysine, arginine, valine) or
- remain constant (phenylalanine, aspartic acid, threonine, methionine, histidine) (Yamawaki et al., 2005).

An essential element, like calcium, phosphorus, zinc, potassium, sodium, and iron, content in human milk lowers, but magnesium content increases as lactation progresses (Lawrence & Lawrence, 2015).

B group vitamin content in mature human milk is higher in mature human milk compared to colostrum (Ren et al., 2015). On contrary, fat-soluble vitamin A and E content in colostrum are higher than in mature human milk (Matos, Ribeiro & Guerra, 2015) (Fig. 1.5.).

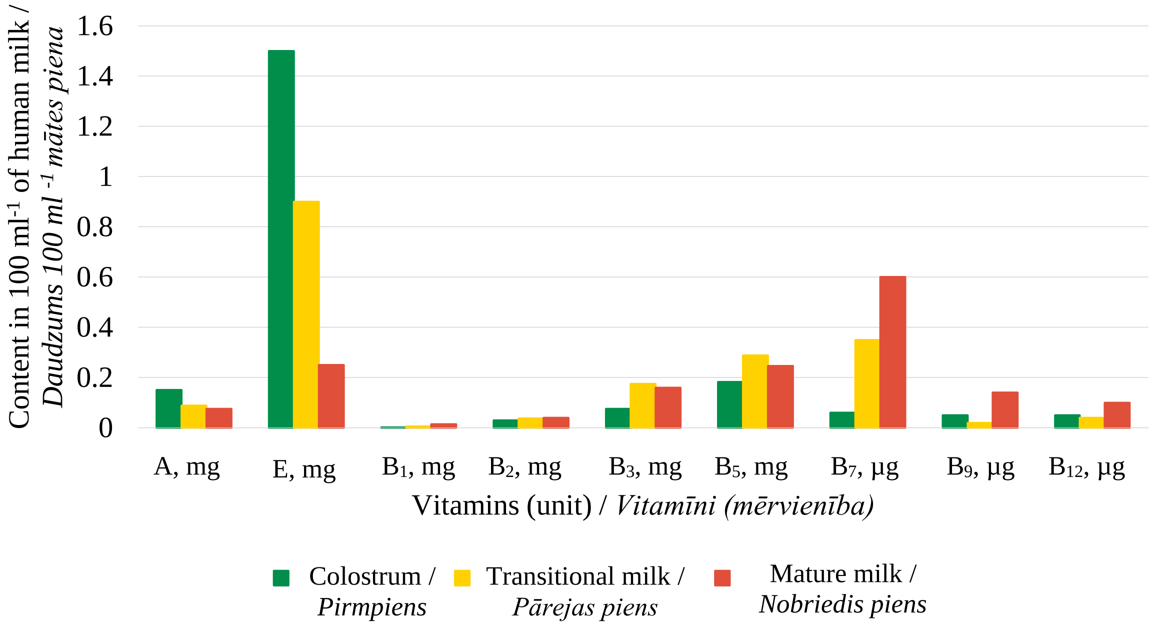

Fig. 1.5. **Vitamins in human milk /** *1.5. att.* ***Vitamīni mātes pienā***
(Lawrence & Lawrence, 2015)

Depending on the time of a single feed, milk can be divided into **foremilk** and **hindmilk**. Foremilk is secreted at the beginning of a feed. It contains a lower amount of fat (~ 2.00 %), but a higher lactose content (~ 7.50 %). Hindmilk is secreted at the end of a feed and contains approximately two and half times higher amount of fat comparing to foremilk (~ 5.00 %) and a lower lactose content (~ 7.20 %) (Fig. 1.6.) (Saarela, Kokkonen & Koivisto, 2005). Higher fat content in hindmilk is due to the increased number of milk fat globules released into the milk flow as the breast is emptied (Mizuno et al., 2009).

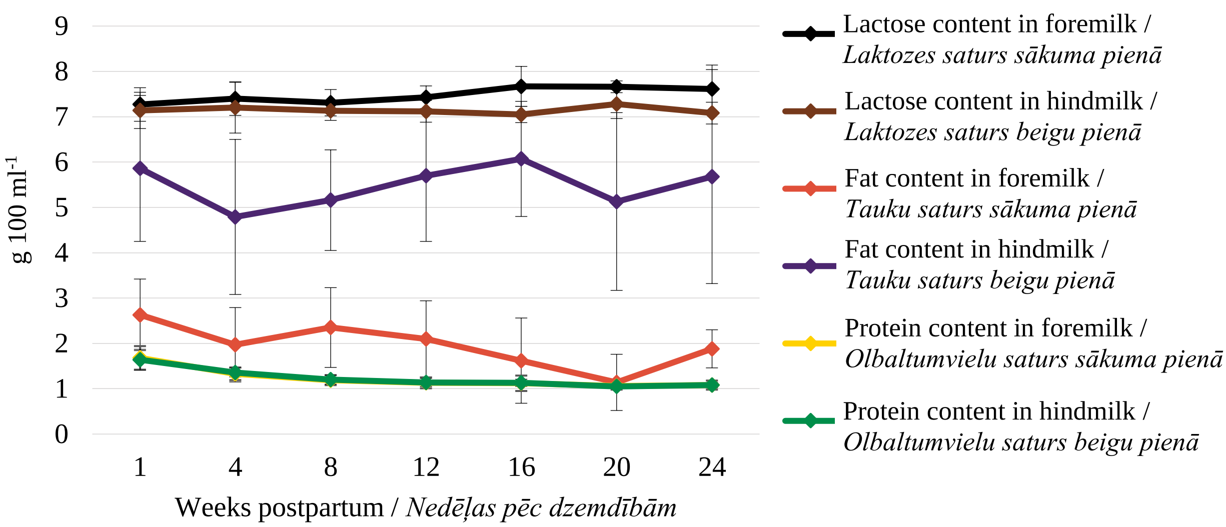

Fig. 1.6. **Variation in the macronutrient content in foremilk and hindmilk /** *1.6. att.* ***Makrouzturvielu satura izmaiņas sākuma un beigu pienā*** (Saarela, Kokkonen & Koivisto, 2005)

Also, considerable diurnal variations are observed in fat content. Breasts are more drained from milk during the daytime, but fewer breastfeeding sessions are usually during the night. Therefore, fat content during the day and evening is higher (~ 4.3 %) compared to night and morning feedings (~ 3.7 %) (Mizuno et al., 2009; Saarela, Kokkonen & Koivisto, 2005).

1.5. Maternal and child's characteristics affecting human milk composition / *Mātes un bērna parametri, kas var ietekmēt mātes piena sastāvu*

Human milk composition could be affected by the **child's sex** due to different nutritional requirements (Galante et al., 2018). However, the results are inconclusive. There have been reports that human milk from mothers with male infants is more energy-dense and contains significantly higher lipid and calcium content (Dafaallah et al., 2018; Powe, Knott & Conklin-Brittain, 2010).

Maturity can also impact human milk composition. Human milk from mothers with preterm infants (born before 37 gestation weeks) contains a higher level of medium-chain fatty acids (22 %) compared to milk from mothers with term infants (10 % to 15 %) (Hale & Hartmann, 2017). It could be an adaption to the immaturity of a preterm infant's digestive tract, because shorter chain fatty acids are easier absorbed. Other explanation – immaturity of the mammary gland and lack of ability to incorporate longer chain fatty acids from the maternal blood (Hale & Hartmann, 2017). The nitrogen content in human milk from mothers having a preterm infant is higher compared to women delivering in term (Lawrence & Lawrence, 2015). Also, the average content of free amino acids is higher in the colostrum of mothers with preterm infants to tailor the needs for the rapid growth (Zhang et al., 2013). Sodium and chloride content in human milk from mothers with preterm infants is lower (de la Guardia & Garrigues, 2015).

It seems that macronutrient content in human milk is not affected by **maternal age** (Feng et al., 2016). However, oleic acid, total monounsaturated fatty acid, and total polyunsaturated fatty acid levels in human milk could be higher for younger mothers compared to older lactating women (Antonakou et al., 2013; Grote et al., 2016).

Human milk from mothers with a higher **BMI** could have a higher protein and fat content, and therefore a higher energetic value (Grote et al., 2016).

It has been noted that **parity** can affect the fat content of human milk – primiparous women having a higher fat content than multiparous women (Lawrence & Lawrence, 2015). On contrary, Antonakou et al. (2013) have reported a positive correlation between fat content in human milk and parity. Jensen (1995) reported that human milk from primiparous may have a higher protein content, but more recent data show that total protein content is not affected by parity (Feng et al., 2016).

Breastfeeding **frequency** is not associated with increased milk production or fat content of human milk. Exclusively breastfed infants can breastfeed from 6 to 18 times per day (on average 11±3 times) and the amount of milk, consumed during one feeding is ~ 76.0 ± 12.6 g (Kent et al., 2006). An infant who breastfeeds for shorter intervals, but does it more frequently, receives the same amount of fat as an infant who breastfeeds for a longer period, but does it infrequently (Kent et al., 2006). Therefore, infants should be breastfed on request regardless of the time of the day (Kent, 2007; World Health Organization, 2018).

When breastfeeding is paired, an infant consumes more milk. However, fat intake does not depend on **breastfeeding manner**, because a more productive breast is usually offered first to the infant (Kent et al., 2006).

Depending on the **feeding pattern** – breastfeeding can be exclusive or partial. Exclusive breastfeeding means that an infant receives only human milk and no other foods or liquids, not even water (except for nutrient supplements or medicines). Partial breastfeeding/mixed feeding means that an infant apart from human milk also receives infant formula and / or complementary feeding (World Health Organization, 2018). Human milk composition can change during gradual weaning – protein, and sodium content increases, but lactose content decreases (Lawrence & Lawrence, 2015).

Milk expression manner also can influence human milk composition. The use of a breast pump can alter the composition of human milk by evaporating water content (Miller et al., 2013).

Various nutrients for the synthesis of human milk derives from **maternal nutrition**, therefore insufficient or excessive intake of some nutrients could potentially affect human milk composition (Lawrence & Lawrence, 2015; Montalbetti et al., 2014).

It seems that lactose and fat content in human milk is only affected if the mother is significantly malnourished (Segura et al., 2016). Insufficient protein intake during lactation could lead to a lower casein content in human milk, therefore can impact the absorption of calcium and phosphorus for the infant, respectively (Segura et al., 2016).

Maternal diet has a great influence on fatty acid composition in human milk (Hale & Hartmann, 2017). Human milk fatty acid composition mimics the composition of maternal dietary fat sources of the last two to three days (Francois et al., 1998). Women consuming a low-fat diet has a higher level of lauric acid (C12:0) and myristic acid (C14:0), but a lower level of stearic acid (C18:0) and oleic acid (C18:1) level in human milk, indicating that a higher carbohydrate intake is associated with a higher level of medium-chain fatty acids in human milk (Lawrence & Lawrence, 2015).

About 30 % of milk linoleic acid is directly transferred to human milk from the maternal diet, whereas only ~ 1.20 % of arachidonic acid found in human milk originates from endogenous conversion of dietary linoleic acid (Demmelmair et al., 1998).

Humans have a limited ability to synthesise *trans* fatty acids, therefore their source in human milk is maternal diet (Lawrence & Lawrence, 2015). Specific *trans* fatty acid isomers found in the human milk reflect dietary *trans* fatty acid sources from the mother's diet (Mueller et al., 2010).

The content of essential elements (calcium, magnesium, potassium, etc.) is not affected by maternal diet, but a woman's body adapts to the additional nutrient loss via human milk by adjusting metabolism (for example, increased absorption from the duodenum, decreased excretion via kidneys, mobilisation of nutrients from body stores). Yet, selenium and iodine content in human milk could be potentially affected by maternal diet (Lawrence & Lawrence, 2015; Olausson et al., 2012).

The content of water-soluble vitamins in human milk is affected by the maternal intake of these vitamins, respectively (Segura et al., 2016; Lawrence & Lawrence, 2015). Fat-soluble vitamins' content in human milk is less affected by maternal diet (Segura et al., 2016).

Infant's needs come first, therefore if not received from the food, the nutritional stores of woman's body will be used to maintain a sufficient amount of nutrients in human milk. Therefore, a lactating mother can become deficient if nutritional needs are not covered via food for the enhanced demands. Malnourished women can benefit by increasing their intake of nutrient-rich food products (Segura et al., 2016; Mohrbacher, 2010).

Although it is recommended that lactating women should obtain all the nutrients through a diverse diet, some women may benefit from the use of dietary supplements – for example, vegans may be advised to consume vitamin $B_{12,}$ or women who avoid dairy products should consume dietary supplements containing calcium (Picciano & McGuire, 2009). Women in Latvia during the gestation and lactation period are also advised to consume 10 µg of vitamin D per day, but during winter, vitamin D intake should reach 15–20 µg per day (Veselības ministrija, 2017a; Veselības ministrija, 2017b). In the United States, dominant dietary supplements used among lactating women are vitamins B, C, and D, essential elements – calcium, iron, selenium, and zinc (Jun et al., 2020).

1.6. Nutrient adequacy of breastfed infants / *Uzturvielu nodrošinājums ar mātes pienu*

The overall opinion from the international authorities (World Health Organization, European Food Safety Authority, etc.) is that human milk fulfils exclusively breastfed infant nutrient requirements for the first six months of life. The exception is vitamin D and K (Butte, Lopez-Alarcon & Garza, 2002; European Food Safety Authority, 2013; World Health Organization, 2018).

K vitamin content in human milk is low ~ 0.25 µg 100 ml^{-1}. Placental transfer of vitamin K during gestation is also low, therefore it is advised that all new-borns after the delivery receive vitamin K externally to prevent new-born haemorrhagic disease (de la Guardia & Garrigues, 2015; European Food Safety Authority, 2013; Ministru kabineta noteikumi Nr. 611, 2006; World Health Organization, 2017).

Taking into account that human milk contains only trace amounts of vitamin D (0.05 µg 100 ml^{-1}), and based on geographical location, there might be a need to externally provide an infant with vitamin D (Butte, Lopez-Alarcon & Garza, 2002; European Food Safety Authority, 2013). Latvian Paediatric Association recommends that infants till six months of age should externally receive 400 international units (equal to 10 µg) of vitamin D per day, but infants from six to twelve months – 400 to 600 international units or 10 µg to 15 µg of vitamin D per day (depending on how much vitamin D is consumed via food). It is recommended that the family doctor should be consulted on the dose of vitamin D for older children (Latvijas Pediatru Asociācija, 2018).

Both linoleic acid and α-linolenic acid are essential fatty acids and must be consumed via human milk. Linoleic acid is a precursor for the synthesis of arachidonic acid, but α-linolenic acid is a precursor for the synthesis of eicosapentaenoic acid and docosahexaenoic acid (European Food Safety Authority, 2013; Innis, 2014; Koletzko et al., 2008; Lauritzen et al., 2016). Although conversion rates for linoleic acid to arachidonic acid and α-linolenic acid to docosahexaenoic acid are higher for infants than adults (~ 4/1), it is recommended that both essential fatty acids (linoleic acid and α-linolenic acid) and long-chain polyunsaturated fatty acids (arachidonic acid and docosahexaenoic acid) are be consumed via human milk (European Food Safety Authority, 2013; Lin et al., 2010).

Arachidonic acid and docosahexaenoic acid are dominant fatty acids found in the human brain, therefore essential for normal cognitive development. At birth, a neonate's brain compiles ~ 10 % of the bodyweight (~ 350 g). By the first half of the year, the weight of the brain doubles ~ 660 g. By the end of the first year, an infant's brain weights ~ 925 g which is about 70% of the adult brain weight (1300 to 1400 g or ~ 2% of the bodyweight). Therefore, to ensure a child's proper neurological development, both arachidonic acid and docosahexaenoic acid must be deposited in the brain in adequate amount during infancy (Innis, 2014; Lauritzen et al., 2016).

It is recommended that the daily intake of docosahexaenoic acid and arachidonic acid for infants till six months of age should be 100 mg and 140 mg, respectively (European Food Safety Authority, 2010b). To ensure recommended intake, studies suggest that docosahexaenoic acid levels in human milk should be ~ 0.30 %, but arachidonic acid level around 0.40 % of total fatty acids (Brenna & Lapillonne, 2009; Jackson Harris & Harris, 2016)

European Food Safety Authority states that infants' requirements for zinc and iron in Europe are fully covered via human milk for the first four to six months (European Food Safety Authority, 2013). However, zinc could be the first limiting nutrient in human milk because of the considerable decline in content, comparing colostrum (0.54 mg 100 ml^{-1}) to mature human milk (0.12 mg 100 ml^{-1}) (Lawrence & Lawrence, 2015). Although iron content in human milk is low (~ 0.04 mg 100 ml^{-1}), together with iron stores accumulated during the prenatal period, it should be enough to match up infant's iron requirements for the first four to six months postpartum (~ 0.3 mg per day) (European Food Safety Authority, 2013).

Current national recommendations suggest that infants in Latvia should be exclusively breastfed till six months of age. Weaning should be started with vegetables and fruits, but rich source of iron and zinc – the meat, should be introduced in an infant's diet around eight months of age (Veselības ministrija, 2003). Bearing in mind that human milk ensures a sufficient amount of zinc and iron only for the first four to six months of life, it should be emphasized that exclusively breastfed infants in Latvia after the first half of a year could consume an insufficient amount of zinc and iron. Therefore, by some sources (Sirina et al., 2018) it is suggested to start complementary feeding around six months of age, and one of the first complementary foods should be meat.

Overall, evaluation of nutrient adequacy for infants (≤6 months) at a national level is currently impossible, because guidelines developed by the Ministry of Health of the Republic of Latvia setting recommended energy and nutrient intakes for the Latvian population (Veselības ministrija, 2017a) currently lack data regarding adequate nutrient intake for infants (≤6 months). European Food Safety Authority has given a scientific opinion on nutrient requirements and dietary intakes of infants and toddlers in the European Union (European Food Safety Authority, 2013) (Annex I). Nevertheless, the European Food Safety Authority states that dietary intake of unsaturated fatty acids (α-linolenic acid and docosahexaenoic acid, respectively), iodine, and D vitamin in some European countries could be insufficient for infants and toddlers (European Food Safety Authority, 2013). Therefore, evaluation of nutrient intake via human milk among infants in Latvia should be conducted.

1.7. Maternal dietary requirements during lactation / *Ieteikumi uzturam zīdīšanas periodā*

During lactation, nutrients from food and body stores are primary used for the synthesis of human milk. Accordingly, insufficient or excessive intake of nutrients during lactation can affect the welfare both of the mother and the infant. Therefore, a woman during lactation should pay special attention to the quality of her diet (Krešić et al., 2012; Segura et al., 2016).

For women to be better educated about their nutritional needs during the postpartum period, national authorities can adopt applicable nutritional guidelines. According to the data from the World Health Organization survey, only 33 out of 50 countries of the European region, have existing national guidelines on nutrition for pregnant and lactating women and only 38 countries have developed national recommended nutrient intakes for pregnant and lactating women (World Health Organization, 2016). In Latvia, currently, there are guidelines for healthy nutrition during gestation (Veselības ministrija, 2017b), but no guidelines for lactating women.

Healthy nutrition recommendations for pregnant women from the Ministry of Health of the Republic of Latvia (Veselības ministrija, 2017b) recommends vegetable (at least 300 g per day), fruit, berry, whole-grain cereal, milk & dairy product, egg, lean meat consumption on daily basis. Two times per week, fish should be consumed (150–300 g per week). At least once a week, fatty fish (salmon, herring, trout, etc.) should be consumed (Veselības ministrija, 2017b). Unfortunately, currently, no guidelines for healthy nutrition during lactation are developed in Latvia. Nevertheless, the best option for lactating women to meet increased energy and nutrient needs is to consume a well-balanced diet that includes both plant- and animal-based products:

- cereals & cereal products provide energy, dietary fibre, and B group vitamins (except for vitamin B_{12});
- potatoes also provide energy, potassium, and vitamin C;
- vegetables, fruits, and berries contain vitamins C and K, folates as well as potassium. Juices contain most of the nutrients found in vegetables, fruits, and berries, apart from fibre;

- pulses are a good source of protein, essential elements – iron, zinc, magnesium, potassium, and B group vitamins (apart from vitamin B_{12}).
- nuts and seeds depending on the variety, contain monounsaturated fatty acids and polyunsaturated fatty acids, as well as protein, potassium, magnesium, zinc, copper, vitamins E, B_6, and B_3;
- plant oils, depending on the source, provide both monounsaturated (olive oil) and polyunsaturated fatty acids, including essential fatty acids – linoleic acid and α-linolenic acid (rapeseed and flaxseed oil), as well as fat-soluble vitamins (mostly vitamin E);
- meat is a good source of protein, iron, zinc, selenium, and vitamins B_6 and B_{12}, but can also contain a high amount of saturated fat. Red meat (pork, beef, lamb, and game meat) is a better source of iron than white meat (chicken, turkey);
- eggs contain protein, fat, iodine, vitamin B_2, A, and D;
- milk and dairy products provide protein, calcium, vitamins A, B_2, B_{12}, and iodine;
- fish and seafood are a good source of protein, selenium, and iodine. Fatty fish (salmon, trout, herring, etc.) contain also n-3 long-chain polyunsaturated fatty acids (eicosapentaenoic and docosahexaenoic acid), as well as vitamins A and D (Mohrbacher, 2010; Nordic Council of Ministers, 2014; Segura et al., 2016).

Specific recommended nutrient intakes for lactating women are mostly based on calculations taking into account nutrient needs for non-lactating women and knowledge about the nutrient content in human milk (Moran, et al., 2010).

Guidelines developed by the Ministry of Health of the Republic of Latvia setting recommended energy and nutrient intakes for the population of Latvia were updated in year 2017, including readjusted nutrient intakes for lactating women (Veselības ministrija, 2017a). New guidelines have been adopted from the recommendations for Nordic countries (Nordic Council of Ministers, 2014). Based on the Nordic Nutrition recommendations, new Latvian guidelines include lowered recommended intakes for most of the nutrients (except vitamin B_9, Annex II).

Requirements for **energy** during lactation raise to an extra 500 kcal (2092 kJ) per day to compensate for the milk production. Therefore, depending on the maternal age, daily intake of energy during lactation varies from 2200 to 3110 kcal (9205 to 13012 kJ) (Hale & Hartmann, 2017; Veselības ministrija, 2017a).

It is not necessary to highly increase **protein** intake during lactation, but it should remain between 10 % to 20 % of total energy intake (Veselības ministrija, 2017a). Due to increased energy intake, additional protein intake (+13 g to 25 g per day) can be met by consuming protein-rich products like cottage cheese, eggs, and cheese (Segura et al., 2016).

Proportional intake for **fat** and **carbohydrate** during lactation also does not differ from recommendations for non-lactating women (25 % to 30 % of total energy for fat and 45 % to 60 % for carbohydrate, respectively) (Veselības ministrija, 2017a). Additional fat (+14 g to 16 g per day) and carbohydrate (+56 g to 75 g per day) intake during lactation can be achieved by consuming whole-grain products and fat sources like fatty fish, nuts, and seeds (Nordic Council of Ministers, 2014).

Dietary sources of **saturated fatty acids** are meat, dairy products, eggs, palm and coconut oil, and products containing mentioned ingredients – bakery goods (pastries, crackers, etc.) and fast food (French fries, hamburgers, etc.) (Jagodic et al., 2020). High saturated fatty acid intake is associated with obesity and coronary heart disease, therefore, national guidelines and guidelines at the European level recommend that saturated fat intake should be lower than 10 % of the total energy intake (European Food Safety Authority, 2019a; Nordic Council of Ministers, 2014; Veselības ministrija, 2017).

Excess intake of sugar is associated with overweight and increased risk of type 2 diabetes (Nordic Council of Ministers, 2014). Therefore, it is recommended that **sugar** intake should be lower than 10 % of the total energy intake (Nordic Council of Ministers, 2014; Veselības ministrija, 2017a). This guideline applies for free sugar intake – monosaccharides and disaccharides added to foods and beverages by the manufacturer, cook or consumer, and sugars naturally present in honey, syrups, fruit juices and fruit juice concentrates (Veselības ministrija, 2017a; World Health Organization, 2015a).

Potassium is a dominant osmotic element found in the cells but **sodium** – a dominant osmotic element found outside the cells. Both are needed for normal water distribution in the body (European Food Safety Authority, 2016b; European Food Safety Authority, 2019b). According to the national guidelines, there is no need to increase potassium and sodium intake during lactation (Veselības ministrija, 2017a). On average, lactating women should consume 3100 mg per day of potassium and no more than 2000 mg of sodium per day (Veselības ministrija, 2017a).

Calcium and **phosphorus** are vital elements needed for healthy bones and teeth (Nordic Council of Ministers, 2014). During lactation, women need to increase their daily intake of calcium by an additional 100 mg and phosphorus intake should be increased by an additional 300 mg (Veselības ministrija, 2017a). Milk and dairy products are a good source of calcium and phosphorus in the diet. Phosphorus can be consumed also via meat, cereal products, and pulses (Nordic Council of Ministers, 2014).

Magnesium and **manganese** are involved in many biological functions in the body (Nordic Council of Ministers, 2014). According to the guidelines, there is no need to increase daily magnesium or manganese intake during the lactation period. Daily intake for magnesium should be 280 mg per day, but manganese intake – 3 mg per day (European Food Safety Authority, 2019a; Veselības ministrija, 2017a).

Iron is the vital part of haemoglobin – a protein that transports oxygen in the body. Red meat is a good source of iron and can be found also in other animal sources like poultry and fish, as well as in plant-based products. However, iron deficiency is widely common across the globe, especially among women of reproductive age (Nordic Council of Ministers, 2014). National nutrition guidelines for women of reproductive age recommends consuming 15 mg of iron per day. Also, during lactation iron intake should remain 15 mg per day (Veselības ministrija, 2017a).

Zinc is a part of many enzymes in the body, therefore, actively involved in diverse biochemical reactions in the body. Zinc is also important for the normal function of the immune system (Nordic Council of Ministers, 2014). Requirements for zinc during lactation are increased from 7 mg to 11 mg per day (Veselības ministrija, 2017a).

Iodine content in foodstuff depends on iodine content in the soil (Nordic Council of Ministers, 2014). To retain maternal thyroid gland functions and to compensate for iodine loss via human milk, iodine intake during lactation should reach 150 to 250 µg per day (Veselības ministrija, 2017a; Nordic Council of Ministers, 2014).

Selenium is a co-factor in enzymes with antioxidant properties (glutathione peroxidases etc.), as well as needed for the normal function of the thyroid gland. Daily selenium intake during lactation should be increased by an additional 10 µg (in total 60 µg per day). Increased need for selenium can be easily achieved by consuming fish and seafood, eggs, or offal (Nordic Council of Ministers, 2014).

Copper, similar to selenium, is an important co-factor for enzymes involved in energy metabolism. Intake of copper during lactation is increased (from 0.9 to 1.3 mg per day), but, taking into account, that copper is widely found in different foodstuff, sufficient copper intake for women during the lactation period should not be a problem (Nordic Council of Ministers, 2014; Veselības ministrija, 2017a).

Vitamin A is needed for the vision, upkeep of epithelial surface, immunity, growth, and development (Nordic Council of Ministers, 2014). Vitamin A can be consumed by carotenoid-rich food sources like vegetables, fruits, and berries. National guidelines recommend that vitamin A intake during lactation should be raised by an additional 400 µg (up to 1100 µg per day) (Veselības ministrija, 2017a).

Vitamin D is essential for bone mineralization and immunity. Vitamin D is synthesized in the skin under the influence of ultraviolet B light. Although foods like fatty fish, milk & dairy products, mushrooms contain some vitamin D, food is not considered as the dominant source of vitamin D (Nordic Council of Ministers, 2014). Overall, the recommendations are that women during lactation should consume 10 µg of vitamin D per day (Veselības ministrija, 2017a).

Plant oils, nuts, and seeds are a good source of **vitamin E**. This fat-soluble vitamin has antioxidant properties in the human body. Vitamin E inactivates free radicals that damage cell membrane lipoproteins (Nordic Council of Ministers, 2014). Guidelines recommend that vitamin E intake during lactating should be increased – from 8 to 11 mg per day, to cover extra vitamin E losses via human milk (Veselības ministrija, 2017a).

Vitamin K is vital for normal blood clotting, and green leafy vegetables are the main source of vitamin K in the diet (Nordic Council of Ministers, 2014). Only the European Food Safety Authority has set adequate intake for vitamin K, and it is 70 µg per day during lactation period (European Food Safety Authority, 2019a).

Vitamin C has antioxidant properties in the human body, as well as it is a co-factor for enzymes responsible for collagen synthesis, therefore essential for healthy skin and joints (Nordic Council of Ministers, 2014). To cover vitamin C loss via human milk, women during lactation should increase their vitamin C intake up to 100 mg per day (Veselības ministrija, 2017a). This should not be difficult, because vitamin C is widely found in many vegetables, fruits, and berries (Nordic Council of Ministers, 2014).

Vitamin B_1 (also known as thiamine) is needed for the metabolism of carbohydrates and amino acids. The main sources of vitamin B_1 in the diet are cereals, meat and meat products, milk & dairy products (Nordic Council of Ministers, 2014). Vitamin B_1 from the maternal blood is transported to the milk. Therefore, to cover the losses of vitamin B_1 via human milk, women during lactation should increase their intake of vitamin B_1 up to 1.6 mg per day (Veselības ministrija, 2017a).

Vitamin B_2 (also known as riboflavin) is assisting in the energy metabolism in the body (Nordic Council of Ministers, 2014). Offal, cereal products, dairy products are a good source of vitamin B_2 (National Institute for Health and Welfare of Finland, 2019). Women during lactation are advised to increase their riboflavin intake up to 1.7 mg per day (Veselības ministrija, 2017a).

Niacin (**vitamin B_3**) is involved in the metabolism of glucose, fatty acids, and amino acids. Vitamin B_3 can be found in both animal and plant-based foodstuff (meat, milk & dairy products, pulses) (Nordic Council of Ministers, 2014). Latvian national nutrition guidelines do not provide recommended intake for vitamin B_3 (Veselības ministrija, 2017a), but Nordic Nutrition recommendations advise women during lactation to increase intake of vitamin B_3 up to 20 mg per day.

Vitamin's B_6 main function is involvement in amino acid metabolism. Vitamin B_6 is mainly found in animal-based food sources (meat, offal, fish, milk & dairy products) (Nordic Council of Ministers, 2014). Additional intake of vitamin B_6 during lactation is recommended and should reach 1.5 mg per day (Veselības ministrija, 2017a).

Sufficient **vitamin B_9** (folic acid & folate) intake is vital for normal development of the neural tube of a foetus during pregnancy and also important after – in the postpartum period – for normal cognitive functions of an infant (Nordic Council of Ministers, 2014). Therefore, vitamin B_9 intake not only during pregnancy (400 µg per day), but also during lactation (500 µg per day) is significantly increased (Veselības ministrija, 2017a). Good sources of folate are liver, green leafy vegetables, and pulses (Nordic Council of Ministers, 2014). Nevertheless, it should be taken into account that vitamin B_9 is very thermo-unstable, and its content during cooking significantly decreases (United States Department of Agriculture, 2007).

Vitamin B_{12} is needed for the production of erythrocytes and normal neurological functions. On average, women during lactation should consume 2 µg of vitamin B_{12} per day

(Veselības ministrija, 2017a). Vitamin B_{12} is found only in animal-based food sources, except for fortified plant-based products (Nordic Council of Ministers, 2014). Vegetarians and vegans should pay special attention to adequate vitamin B_{12} intake, especially during lactation, and supplement the diet if needed (Allen, 2012).

Overall, it should be emphasized that the requirements of some nutrients during lactation are even higher than during gestation (for K, P, Zn, Cu, Se, vitamins A, C, B_1, B_2, B_{12}, B_5, B_7, and B_9) (Annex III). Therefore, women during lactation should pay special attention to the quality of their diet (Segura et al., 2016; European Food Safety Authority, 2019a; Veselības ministrija, 2017a).

Dietary reference values from the European Food Safety Authority (European Food Safety Authority, 2019a) and Nordic nutrition recommendations (Nordic Council of Ministers, 2014) are more comprehensive, and also include reference values for **fibre, alcohol,** and **unsaturated fatty acid** intake.

Fibre intake during lactation remains the same – 25 g to 35 g per day, and it could be achieved by consuming whole-grain products, vegetables, fruits, and berries. Adequate fibre intake protects from constipation and decreases the risk for colorectal cancer (Nordic Council of Ministers, 2014).

According to the guidelines, **alcohol** intake for women should not exceed 10 grams per day (including the intake for lactating women). Nevertheless, it should be noted that level of alcohol excreted in human milk is similar to the alcohol level in maternal blood. Exposure to alcohol via human milk can lead to behavioural changes in infant, therefore women should avoid alcohol consumption during lactation completely or keep the alcohol intake to the minimum (Bruun, Pottegård & Damkier, 2013).

Monounsaturated fatty acids should provide 10 % to 20 % of total energy intake, but **polyunsaturated fatty acids** – 5 % to 10 % of total energy intake (European Food Safety Authority, 2019a; Nordic Council of Ministers, 2014).

Mammals lack enzymes Δ-12 and Δ-15 desaturases, needed to synthesize linoleic acid and α-linolenic acid; therefore, these fatty acids must be consumed via food. **Linoleic acid** intake should not exceed 4 % of total energy intake, but **α-linolenic acid** should reach at least 0.5 % of total energy intake (Nordic Council of Ministers, 2014).

Both linoleic acid and α-linolenic acid require enzymes Δ-6 and Δ-5 desaturases for the synthesis of long-chain polyunsaturated fatty acids in the body (arachidonic acid, eicosapentaenoic acid, and docosahexaenoic acid, respectively) (Fig. 1.7.) (Innis, 2013).

Both linoleic acid and α-linolenic acid, as well as their long-chain derivatives, are components of cell membranes and are needed for the synthesis of eicosanoids with inflammatory (from n-6 polyunsaturated fatty acids) or anti-inflammatory effects (from n-3 polyunsaturated fatty acids) (European Food Safety Authority, 2010b; Innis, 2013). Both n-6 and n-3 polyunsaturated fatty acids are widely distributed in the food, but in different proportions. Main sources for linoleic acid and other n-6 polyunsaturated fatty acids are sunflower oil, corn oil, soybean oil, and rapeseed oil, nuts (hazelnuts, walnuts, and almonds). The main sources for α-linolenic acid and other n-3 polyunsaturated fatty acids are flaxseed oil and seeds (flaxseeds, chia seeds) (National Institute for Health and Welfare of Finland, 2019).

When diet is high in n-6 polyunsaturated fatty acids, accordingly more n-6 polyunsaturated fatty acids are incorporated in cell membranes and more inflammation initiating eicosanoids (prostaglandins, thromboxane, leukotrienes, etc.) are synthesized (Simopoulos, 2002). To evaluate the polyunsaturated fatty acid status in the body, the n-6 / n-3 polyunsaturated fatty acid ratio and the linoleic acid / α-linolenic acid ratio of dietary intakes are calculated. n-6 /n-3 polyunsaturated fatty acid and linoleic acid / α-linolenic acid ratios above 5/1 initiates the predominance of arachidonic acid content and inhibits the synthesis of n-3 long-chain polyunsaturated fatty acids – eicosapentaenoic acid and docosahexaenoic acid in the body (Gibson, Muhlhausler & Makrides, 2011; Innis, 2013;

Simopoulos, 2002). Therefore, it is recommended that **n-3 fatty acids** intake should reach at least 1 % of total energy intake (Nordic Council of Ministers, 2014).

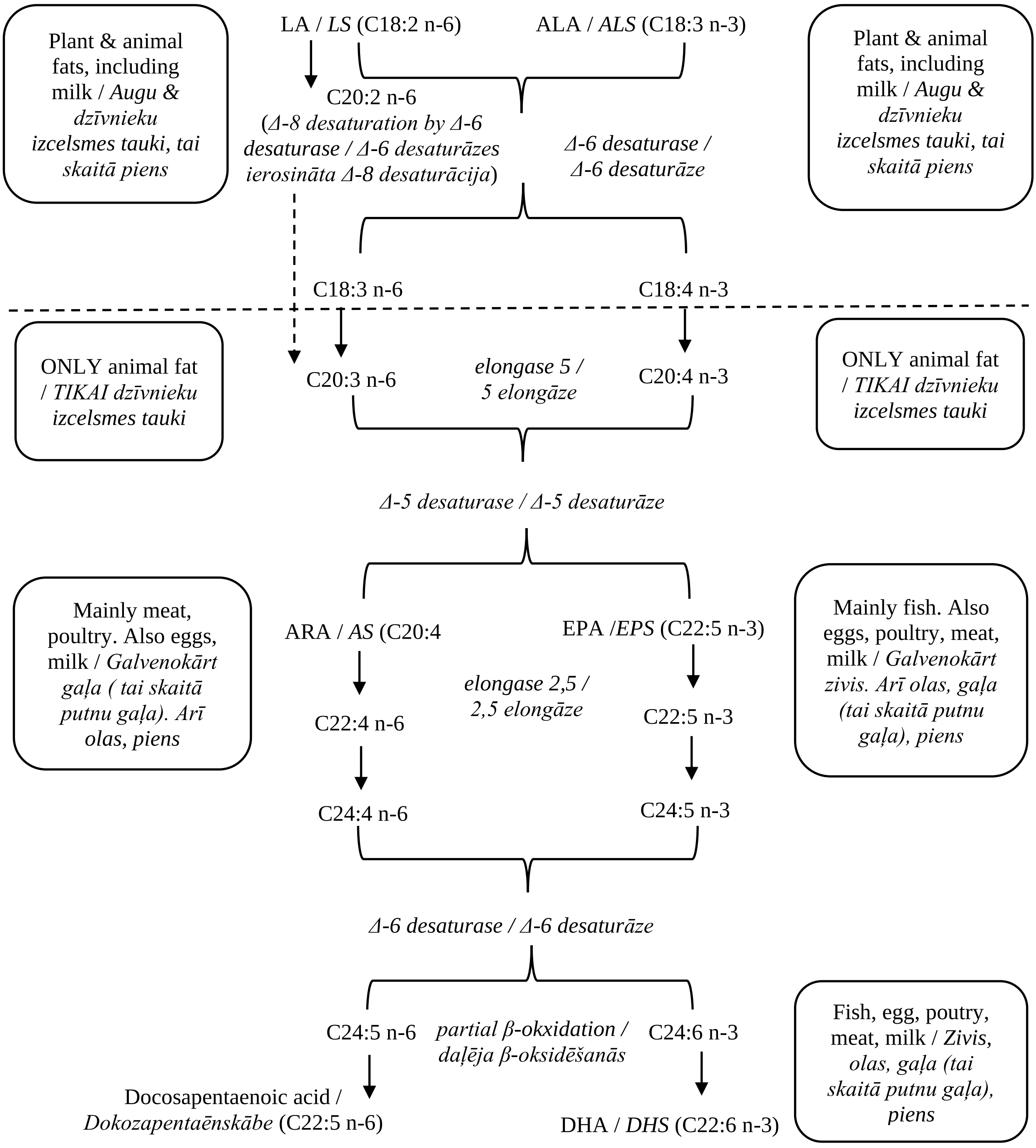

Fig. 1.7. **n-6 and n-3 polyunsaturated fatty acid desaturation and elongation. Food sources of polyunsaturated fatty acids /** *1.7. att.* ***n-6 un n-3 polinepiesātināto taukskābju desaturācija un elongācija. Polinepiesātināto taukskābju avoti uzturā.***
Figure made by the author, based one scheme from Innis (2013) / *Attēlu veidojis autors, balstoties uz shēmu, kas pieejama Innis (2013) publikācijā.*

Although **docosahexaenoic acid** synthesis from the precursor α-linolenic acid is possible, it is not enough effective to provide a sufficient amount of docosahexaenoic acid via human milk, if direct docosahexaenoic acid sources are excluded from the maternal diet (Francois et al., 2003). Overall, maternal intake of docosahexaenoic acid during lactation should be at least 200 mg per day (Nordic Council of Ministers, 2014). Other recommendations (European Food Safety Authority, 2005) state that women during pregnancy and lactation are advised to weekly consume one to two portions of fatty fish (150 to 300 grams). Fish like salmon, trout, or herring are a good source of docosahexaenoic acid (National Institute for Health and Welfare of Finland, 2019).

Unfortunately, fatty fish also can contain a significant amount of persistent organic pollutants, but the European Food Safety Authority states that with a serving of two portions per week it is unlikely that pregnant or lactating women would exceed the acceptable upper limit of contaminant methylmercury (toxic to the nervous system and the developing brain of a foetus or an infant) as long as predatory fish like bluefin tuna or albacore tuna are avoided (European Food Safety Authority, 2005). European Food Safety Authority also states that bluefin tuna or albacore tuna fish is unlikely to be found in canned tuna, sold in Europe. Also, swordfish, sharks, pike should be avoided, as well as salmon and herring from the Baltic Sea, because of high contamination with dioxins and dioxin-like polychlorinated biphenyls (cancerogenic to humans) (European Food Safety Authority, 2005).

***Trans* fatty acids** are actively involved in the metabolism and therefore incorporated into the biological fluids (also, human milk) (Larqué, Zamora & Gil, 2001). *Trans* fatty acids come from two sources:

- natural – via biological hydrogenation in the stomach of a ruminant;
- industrially produced (frying, grilling, and hydrogenation of oils).

Major food sources of natural *trans* fatty acids are ruminant fat – milk and dairy products, meat (Larqué, Zamora & Gil, 2001), containing 1 % to 8 % of *trans* fatty acids (Craig-Schmidt, 2006). Dominant *trans* fatty acids from natural food sources are vaccenic acid (C18:1 n11*t*) and conjugated linoleic acids (mostly rumenic acid, C18:2 n9*c*, n11*t*) (Krešić et al., 2013; Lindmark Månsson, 2008; Precht & Molkentin, 1999). Intake of *trans* fatty acids from ruminant fat is not associated with increased cardiovascular disease risk (Mozaffarian, Aro & Willett, 2009).

Margarine, baking shortenings, and frying fats contain 40 % to 50 % of *trans* fatty acids. These *trans* fatty acid sources are used in the preparation of foodstuffs like baked goods, confectionery, and deep-fried food (Craig-Schmidt, 2006; Larqué, Zamora & Gil, 2001). Dominant *trans* fatty acids from hydrogenated fats are elaidic acid (C18:1 n9*t*) and linolelaidic acid (C18:2 n9*t*, n12*t*) (Bahrami & Rahimi, 2005; Brouwer, Wanders & Katan, 2010). *Trans* fatty acids from partially hydrogenated oils have a detrimental effect on blood lipoprotein profile – they increase the level of low-density lipoprotein cholesterol, but lowers the level of high-density lipoprotein cholesterol. That results in an increased risk of cardiovascular diseases. Considering the detrimental effect of industrially produced *trans* fatty acids on health, their intake should be kept as low as possible (European Food Safety Authority, 2019a; Nordic Council of Ministers, 2014).

Summary of the problem statement / *Problemātikas raksturojuma kopsavilkums*

Human milk composition around the world has been comprehensively analysed (Hale & Hartmann, 2017; Lawrence & Lawrence, 2015). However, there is basically no data regarding human milk composition among lactating women in Latvia, and this raises a need to conduct a research in this area.

Human milk composition is also quite variable and can be influenced by numerous factors like maternal and child characteristics as well as maternal nutrition (Andreas, Kampmann & Le-Doare, 2015; Hale & Hartmann, 2017), therefore, women should pay special attention to the quality of diet and adequate nutrient intake during lactation.

It should be emphasised that requirements for some nutrients (phosphorus, zinc, vitamins A, C, B_1, B_2, B_9) during lactation are even higher than during pregnancy (European Food Safety Authority, 2019a; Nordic Council of Ministers, 2014; Veselības ministrija, 2017a), but dietary habits and nutrient intake among lactating women in Latvia also have not been comprehensively evaluated before, therefore it would be a novelty to carry a research in this area.

Mātes piens pasaulē ir plaši pētīts (Hale & Hartmann, 2017; Lawrence & Lawrence, 2015), *bet visaptverošu datu par mātes piena sastāvu Latvijā gandrīz nav, un tas norāda uz nepieciešamību veikt pētījumu šajā jomā.*

Mātes piena sastāvs ir ļoti mainīgs, un to var ietekmēt mātes un bērna parametri vai uzturs (Andreas, Kampmann & Le-Doare, 2015; Hale & Hartmann, 2017), tādēļ sievietēm zīdīšanas periodā būtu īpaši jāpievērš uzmanība savai diētai, lai tā nodrošinātu pietiekamu uzturvielu uzņemšanu.

Jāuzsver, ka nepieciešamība pēc dažām uzturvielām (fosfors, cinks, A, C, B_1*,* B_2*,* B_9 *vitamīns) zīdīšanas periodā ir pat augstāka nekā grūtniecības laikā (European Food Safety Authority, 2019a; Nordic Council of Ministers, 2014; Veselības ministrija, 2017a). Uztura paradumi un uzturvielu nodrošinājums sievietēm zīdīšanas periodā Latvijā nav plaši pētīts, tādēļ tas ir arī pamatojums izvēlētā promocijas darba izstrādei šajā jomā.*

2. MATERIALS AND METHODS / *MATERIĀLI UN METODES*

2.1. Design, time, venue of the research and sample size / *Pētījuma dizains, laiks, vieta un paraugu atlase*

This comparative cross-sectional study was carried out from November 2016 till March 2021. To evaluate whether nutrient intakes among lactating women and therefore human milk composition in Latvia have changed in recent years, study was divided into two intervals:

- the first study period was from November 2016 till December 2019 (human milk sampling organised from November 2016 till December 2017);
- the second study period was from January 2020 till March 2021 (human milk sampling organised from January 2020 till December 2020).

To calculate the minimum sample size for the study period, an online calculator was used (Viechtbauer et al., 2015). With a probability of 0.05 and a confidence level of 95 %, it calculated that at least 59 participants were needed in each study period. In total 71 lactating women participated in the first study period, but 70 participants – in the second study period.

In both study periods, women were invited to participate in the study via a poster published on social media member groups for lactating mothers.

Participants were from all regions of Latvia, however, mainly from Riga and Pierīga (Table 2.1.).

2.1. Table / *2.1. tabula*

Division of the study participants by the statistical regions of the Republic of Latvia / *Dalībnieču sadalījums pa Latvijas Republikas statistiskajiem reģioniem* (n=141)

Statistical regions of the Republic of Latvia / *Latvijas Republikas statistiskie reģioni*	**First study period / *Pirmais pētījuma posms***	**Second study period / *Otrais pētījuma posms***
Riga / *Rīga*	n=41	n=36
Pierīga / *Pierīga*	n=18	n=15
Vidzeme / *Vidzeme*	n=4	n=5
Zemgale / *Zemgale*	n=4	n=9
Latgale / *Latgale*	n=1	n=3
Kurzeme / *Kurzeme*	n=3	n=2

2.2. Inclusion and exclusion criteria for the participants/ *Iekļaušanas un izslēgšanas kritēriji dalībai pētījumā*

The inclusion criteria for the participants were:

1) signed consent form;
2) reside in Latvia;
3) singleton pregnancy;
4) at least 28 days postpartum;
5) exclusively breastfeeding or partially breastfeeding (human milk and infant formula or complementary food);
6) mother and child apparently healthy (without metabolic disorders, no acute illnesses, etc.).

Exclusion criteria were:

1) unsigned consent form;
2) noncompliance with the inclusion criteria.

2.3. Ethical considerations / *Ētiskie apsvērumi*

Before the study, the approval from Riga Stradiņš University Ethics Committee was received (No. 4/28.7.2016.). To continue the study, ethical approval was renewed in year 2020 (No. 6-1/01/6) (Annex IV). The study was conducted according to the guidelines laid down in the:

- Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Subjects (World Medical Association, 2013);
- Convention for the protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine: Convention on Human Rights and Biomedicine (Council of Europe, 1997).

The signed consent form was obtained from all women before the study. The privacy rights of the participants were ensured throughout the study under the General Data Protection Regulation (Regulation No. 2016/679 of the European Parliament and the Council, 2016) and Personal Data Processing Law (Latvijas Republikas Fizisko personu datu apstrādes likums, 2018). Human milk samples, as well all documentation, were marked using a unique three-digit code to replace all personal information (name, surname, etc.).

2.4. Description of the study process / *Pētījuma apraksts*

The study process was similar in both study periods. For those women who had responded to the invitation to participate in the study, the researcher (the author of this *Ph.D* thesis or Master study programme Nutrition student Alīna Beluško who helped during the year 2020) sent an e-mail with more detailed information about the study. If the woman agreed to participate, the researcher arranged how and in which format (electronically or in the paper) to transfer the study materials to the participant.

Meetings between the participant and researcher to speak out the vague questions and to transfer study materials were mostly on-site. However, if it was more convenient for the participant or due to epidemiological safety issues raised by the Covid-19 pandemic (on the year 2020), all the necessary information was provided via e-mail and consent form, food diary, other questionnaires, instructions (if in paper format) and containers for human milk sampling were sent to the participant using parcel machines or via Institute of Food Safety, Animal Health and Environment BIOR Customer Service Division cabinets in Riga or other regions.

Each participant received:

- a consent form to sign that also included information about the human milk sample collection procedure (paper format) (Annex V);
- a 72-hour food diary (electronic or paper format – depending on what was more convenient for the participant) (Annex VI);
- a food atlas in electronic format (Food Control Authority, 2014) could be used by the participant to make it easier to complete a 72-hour food diary;
- a food frequency questionnaire (electronic or paper format – depending on what was more convenient for the participant) (Annex VII);
- a questionnaire about characteristics like maternal age, BMI, parity, etc. (electronic or paper format – depending on what was more convenient for the participant) (Annex VIII);
- prelabelled (three-digit code used) non-sterile propylene containers – total volume 50 ml, with a graduated mark for 40 ml (Plastiques Gosselin, France).

During the first study period participants received four containers, but in the second study period – two containers (explanation provided in the subsection 2.5.).

After receiving the study materials, participants were instructed to choose four convenient consecutive days to carry out the study. Participants were asked to write a food diary for three consecutive days (72-hour food diary) and then to obtain a pooled human milk sample within the next 24-hour period. Human milk sampling could happen in any convenient place for the participant. It was allowed to collect the milk using either manual expression, a breast pump, or a combination of both methods. After, the participant completed the study, they were asked to get in touch with the researcher.

Then the researcher agreed with the participant on how and when to collect the signed consent form, food diary & other questionnaires (if in paper format), and human milk samples.

2.5. Human milk sampling and storage procedure / *Mātes piena paraugu ievākšanas un uzglabāšanas process*

A specific sampling procedure was used to reduce possible nutritional undue and to ensure minimal interference with the infant's feeding behaviour. A few millilitres of milk were expressed after the end of nursing from the feeding breast. If the nursing session was paired (the infant had been feeding on both breasts), participants were asked to collect milk from the breast that has been suckled for a longer period.

Sampling frequency was not defined, but taking into account possible diurnal variations, the pooled sample had to include milk from the morning, mid-day, evening and night feedings. During the sampling process, human milk was stored in the refrigerator (~ 4 °C), in the bottle. After, human milk from the bottle was poured into labelled propylene containers.

During the first study period, participants were asked to collect in total 100 ml of pooled human milk and pour it into four containers:

- ~ 40 ml of milk in one container (for the determination of fat and protein);
- ~ 40 ml of milk in another container (for the determination of essential and potentially toxic elements);
- ~ 10 ml of milk in another container (for the determination of lactose);
- ~ 10 ml of milk in another container (for the qualitative and quantitative determination of fatty acids).

During the second study period, sample collection and storage was the same, except that due to time limit and financial reasons we were not able to determine essential and potentially toxic element content in human milk and chose a less expensive method for macronutrient (fat, protein, lactose) determination in human milk. Therefore, participants were asked to collect in total only 50 ml of pooled human milk and pour it into two containers:

- ~ 40 ml of milk in one container (for the determination of fat, protein, lactose);
- ~ 10 ml of milk in another container (for the qualitative and quantitative determination of fatty acids).

Afterwards, in both study periods, participants were asked to place all containers in the household freezer (approximately -18 °C).

2.6. Sample collection and transportation to the laboratory / *Paraugu saņemšana un transportēšana uz laboratoriju*

Due to specific transportation conditions for the frozen human milk samples, they together with the signet consent form and food diary & other questionnaires (if in paper format), were collected from the participants in two ways:

- during the on-site meeting. A researcher used a bag with ice packs to transport frozen samples to the laboratory's freezer (-18±3 °C);
- if it was more convenient for the participant, she could deliver the frozen human milk samples herself to:
  - the Faculty of Food Technology of Latvia University of Life Sciences and Technologies (Jelgava). In this case, an ice pack was also given before to the participant, together with the containers for human milk to safely transport the frozen human milk samples;
  - Institute of Food Safety, Animal Health and Environment BIOR Customer Service Division cabinet in Riga or another region. In this case, also an ice pack was given prior to the participant, together with the containers for human milk to safely transport the frozen human milk samples. If the participant was outside of Riga, an employee from the Customer Service Division cabinet handed frozen human milk samples over to the driver from the Institute BIOR Transport Division, and samples were transported to the Riga in a special bus, providing the necessary temperature for the transportation (-18±3 °C).

Afterwards, the researcher sorted the human milk samples based on the compound to be analysed and delivered samples to the laboratory:

- Chemistry Laboratory of the Institute of Food Safety, Animal Health and Environment BIOR, where the analysis for the fat, protein, lactose, essential and potentially toxic elements (only in the first study period), and qualitative and quantitative determination of fatty acids was conducted (in both study periods). Chemistry Laboratory of the Institute of Food Safety, Animal Health and Environment BIOR is accredited in accordance with LVS EN ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories;
- Faculty of Food Technology of Latvia University of Life Sciences and Technologies, where the analysis for the fat, protein, and lactose content in human milk was conducted in the second study period (the year 2020).

In the laboratory, samples were thawed only once, before the analysis, and all samples were tested no later than six months after arrival to the laboratory (in this case samples were kept in frozen state).

2.7. Possible limitations of the study regarding sampling and sample storage / *Iespējamie pētījuma ierobežojumi, ievācot un uzglabājot paraugus*

Few possible limitations should be declared:

- currently, there is no standard procedure for human milk sampling. We chose the sampling method which reduces possible nutritional undue and ensures minimal interference with the infant's feeding behaviour. With our chosen method we took into account possible diurnal variation of human milk composition, but participants collected only hindmilk (milk from the end of feeding) which, according to the literature, has a higher fat content (Saarela, Kokkonen & Koivisto, 2005). Other nutrient content in human milk could also fluctuate from foremilk to hindmilk;

- participants were instructed to collect milk from the morning, mid-day, and evening feedings. However, sampling frequency was not specified. We also did not collect the information from the participants about breastfeeding frequency, count of unpaired & unpaired breastfeeding, etc. which all could be potential cofounders;
- analyses of the human milk were not conducted immediately after collection. Human milk samples were kept frozen, and analyses were conducted no later than six months after collection. According to the literature (Miller et al., 2013), human milk samples can be kept frozen at -18±3 °C for up to 12 months with insignificant nutrient losses.

2.8. Methods used for the analysis of human milk composition / *Pētījumā izmantotās metodes mātes piena sastāva analizēšanai*

2.8.1. Determination of fat content in human milk samples */ Tauku satura noteikšana mātes piena paraugos*

Fat content (%) in human milk samples during the first study period was analysed in the Chemistry Laboratory of the Institute of Food Safety, Animal Health and Environment BIOR according to the standard LVS ISO 2446:2008 (Gerber method). Proteins were dissolved using sulfuric acid and a small quantity of *iso*-amyl alcohol. After, the milk fat in a butyrometer was separated by centrifuging. Graduated butyrometers were used to directly read the fat content of human milk samples. All samples were analysed with three parallel repetitions. The mean value of parallel repetitions was accepted as the final result.

In the second study period, fat content (%) in human milk was analysed in the Faculty of Food Technology of Latvia University of Life Sciences and Technologies using MilkoScan^{TM} Mars (Foss analytical, Denmark), according to the standard ISO 9622:2013 (Fourier transform infrared spectroscopy). After homogenization of human milk sample, measurement of the quantity of radiation absorbed by the carbonyl groups of the ester bonds of the glyceride at approximately 5.7 µm, and by the CH groups at approximately 3,5 µm with an infrared spectrometer was made. The increased absorbance in the specific waveband is directly related to the fat content in the sample. All samples were analysed with three parallel repetitions. The mean value of parallel repetitions was accepted as the final result.

2.8.2. Determination of protein content in human milk samples / *Olbaltumvielu satura noteikšana mātes piena paraugos*

Protein content in human milk samples during the first study period was determined in the Chemistry Laboratory of the Institute of Food Safety, Animal Health, and Environment BIOR according to the standard LVS EN ISO 8968-1:2014 (Kjeldahl method). The test portion of human milk was digested with a mixture of concentrated sulfuric acid and potassium sulfate. Copper sulfate (II) was used as a catalyst to convert any organic nitrogen present in the sample to ammonium sulfate. Potassium sulfate was used helping to elevate the boiling point of sulfuric acid and to ensure a stronger oxidizing mixture for digestion. After the digest was cooled, sodium hydroxide was added to the released ammonia. Released ammonia was still distilled into the excess boric acid solution and titrated with a hydrochloric acid standard volumetric solution. The nitrogen content was calculated based on the amount of ammonia produced. Total protein content in human milk (%) was calculated using the following formula (2.1.):

$$W_p = W_n \times 6.25, \quad (2.1.)$$

where: W_p – total protein content, expressed as a percentage mass fraction, %;
W_n – the nitrogen content of the sample expressed as the percentage mass fraction, %.

All samples were analysed with three parallel repetitions. The mean value of parallel repetitions was accepted as the final result.

Nevertheless, it should be noted that human milk has a high non-protein nitrogen content (~ 25 % of total nitrogen) (Hale & Hartmann, 2017). To calculate true protein in human milk, non-protein nitrogen content should be determined and subtracted from total nitrogen content and then multiplied by conversion factor 6.25 (Lönnerdal et al., 2017). In this study, we did not separately determine non-protein nitrogen content in the samples, therefore our obtained values include non-protein nitrogen.

During the second study period, the protein content (%) in human milk samples was analysed in the Faculty of Food Technology of Latvia University of Life Sciences and Technologies using MilkoScan^{TM} Mars (Foss analytical, Denmark), according to the standard ISO 9622:2013 (Fourier transform infrared spectroscopy). After homogenization of human milk sample, measurement of the quantity of radiation absorbed by the secondary amide groups of the peptide bonds at approximately 6.5 μm with an infrared spectrometer was made. The increased absorbance in the specific waveband is directly related to the protein content in the sample. All samples were analysed with three parallel repetitions. The mean value of parallel repetitions was accepted as the final result.

However, it should be noted that true protein content can also be overestimated by approximately 20 % to 30 % using a milk analyser due to the high non-protein nitrogen content found in human milk (Perrin et al., 2019).

2.8.3. Determination of lactose content in human milk samples / *Laktozes satura noteikšana mātes piena paraugos*

Lactose content (%) in human milk samples during the first study period was determined in the Chemistry Laboratory of the Institute of Food Safety, Animal Health, and Environment BIOR according to the standard ISO 22662:2007 (UltiMate 3000 high performance liquid chromatography with an on-line solid phase extraction system, Thermo Scientific, the United States). An internal standard [D(+)-melezitose] was added to a weighed volume of human milk sample and the lactose standard. A chemical reagent (Biggs-Szijarto solution) was added to separate the fat and protein. The sample was filtered twice before injection, first via a paper filter and then via a 0.45 μm nylon filter. The lactose and the internal standard were separated by a cation exchange column in the lead form and detected by a differential refractometer detector. As a mobile phase, high-performance liquid chromatography grade water was used. All samples were analysed with two parallel repetitions. The mean value of parallel repetitions was accepted as the final result.

Nevertheless, it should be noted that standard ISO 22662:2007 declares that the method does not apply to the milk which contains oligosaccharides. Human milk contains ~ 1.0 g of oligosaccharides per 100 millilitres of milk, and almost all oligosaccharides in human milk have a terminal lactose molecule (Andreas, Kampmann & Le-Doare, 2015; Fusch et al., 2015; Hale & Hartmann, 2017). Therefore, actual lactose content in human milk using this method could be overestimated.

During the second study period, the lactose content (%) in human milk samples was analysed in the Faculty of Food Technology of Latvia University of Life Sciences and

Technologies using MilkoScan™ Mars (Foss analytical, Denmark), according to the standard ISO 9622:2013 (Fourier transform infrared spectroscopy). After homogenization of human milk sample, measurement of the quantity of radiation absorbed by the hydroxyl groups of lactose at approximately 9.6 μm with an infrared spectrometer were made. The increased absorbance in the specific waveband is directly related to the lactose content in the sample. All samples were analysed with three parallel repetitions. The mean value of parallel repetitions was accepted as the final result.

However, it should be noted that the measurement range for lactose using MilkoScan™ Mars is 0 % to 6% (FOSS Analytics, 2018). Human milk usually contains approximately 7 % of lactose (Hale & Hartmann, 2017), as well as human milk contains oligosaccharides that have a terminal lactose molecule. Its spectral absorption cannot be differentiated from that of free lactose. Therefore, the determination of lactose with this equipment may lead to overestimated lactose values (Fusch et al., 2015).

2.8.4. Determination of essential and potentially toxic element content in human milk samples / *Esenciālo un potenciāli toksisko elementu noteikšana mātes piena paraugos*

Essential (Ca, Mg, Na, K, Zn, Se, Mn, Fe, Cu, Co, Cr) and potentially toxic element (Al, Ni, As, Sr, Cd, Sn, Sb, Pb) content in human milk samples was determined in the Chemistry Laboratory of the Institute of Food Safety, Animal Health, and Environment BIOR according to the ICP-MS Agilent 7700x (Agilent Technologies, Japan) instructions – atomic elements were lead through a plasma source where they become ionized. Then, these ions were sorted on account of their mass (in house method BIOR-T-012-148-2013 which was developed based on standards LVS EN ISO 17294-1:2006 and LVS EN ISO 17294-2:2016).
Blank and quality control samples were used to monitor the accuracy of the ICP-MS analysis. The detection limit of each element was calculated based on the standard deviation of 20 blank samples (2.5 ml analytical portion and 50 ml analytical solution).

The results from the ICP-MS analysis were expressed as mg or μg 100 mg^{-1}. To make our data comparable to the results from other studies, we converted data to mg or μg 100 ml^{-1}, using the following equation (2.2.):

$$a = b \times 1.03 \tag{2.2.}$$

where: a – mg or μg of a specific element in 100 ml of human milk;
b – mg or μg of a specific element in 100 g of human milk;
1.03 – density (g ml^{-3}) for human milk (United States Environmental Protection Agency, 2011).

All samples were analysed in two parallel repetitions. The mean value of parallel repetitions was accepted as the final result.

Latest technologies like ICP-MS allow us to ascertain elements even in small quantities. Nevertheless, we faced difficulties to detect content above detection limit for most of the analysed elements in human milk. Some modifications should be considered if further research is conducted:

- at the moment, there is no applicable reference material to check the accurateness of elaborated essential elements and potentially toxic element values in human milk. Potentially, an infant formula with declared values on the label could be used as an alternative;
- possible adjustments are needed for the element analysis in human milk using ICP-MS because we faced difficulties to determine essential element like iron and selenium values in human milk above the detection limit. The possible reasons are listed below:

- selection of sample preparation method – acid digestion was used in this study. Levi et al. (2018) have explored that sample preparation before ICP-MS analysis could influence specific element values in human milk samples. Selenium content is about 15 % higher with the alkali dilution method, but iron content is about 28 % higher with acid digestion, respectively;
- the purity of analytical reagents, technical parameters, etc. factors can influence the values of detection limits for ICP-MS analysis;
- our elaborated detection limits for the analysed elements were significantly higher compared to values reported by Björklund et al. (2012). Although it should be noted that their limit of detection was based only on five blank samples, while ours – on 20 blank samples;
- detection of some isotopes like selenium (^{78}Se), iron (^{56}Fe) etc. can be affected by spectrometric interferences with other polyatomic ions, most often argon ions (de la Guardia & Garrigues, 2015). Argon was used as a carrier gas for ICP-MS analysis in this study.

2.8.5. Qualitative and quantitative fatty acid analysis in human milk samples / *Kvalitatīvā un kvantitatīvā taukskābju analīze mātes piena paraugos*

Qualitative and quantitative fatty acid composition of human milk samples was determined in the Chemistry Laboratory of the Institute of Food Safety, Animal Health and Environment BIOR using an in-house method BIOR-T-012-131-2011 (developed based on standards LVS EN ISO 12966-1:2015, including amending corrigendum, LVS EN ISO 12966-2:2017 and LVS EN ISO 12966-4:2015). Method principle was following: fat from human milk sample was extracted using solvent and after transesterified. Fatty acid methyl esters were identified using gas chromatography with flame ionization detection instrument (Agilent 6890N, Agilent Technologies Incorporated, the United States) equipped with an autosampler (Agilent 7683 Series, Agilent Technologies Incorporated, the United States), comparing fatty acid methyl esters relative retention times with authentic standards (Supelco 37 component FAME mix, Supelco Incorporated, Germany and additionally vaccenic and conjugated linoleic acid standards from Sigma Aldrich Company, the United States). The sum of all fatty acid peak areas was calculated, and the relative proportion of each fatty acid was determined, expressing it as a mass ratio from the sum of all peaks (%). All samples were analysed in two parallel repetitions. The mean value of parallel repetitions was accepted as the final result.

Compared to the first study period, the in-house method was updated on the year 2020 – for transesterification of fatty acids, an isooctane (2,2,4-trimethylpentane) was used instead of methanol and solid-phase extraction column was changed to column Discovery® Ag-Ion SPE, 750 mg / 6 ml (Sigma Aldrich Company, United States), ensuring better separation of C18 fatty acid isomers. Following enhancements should be taken into account, when explaining differences found comparing fatty acid composition in both study periods.

In total, 37 different fatty acids in human milk samples were determined during the first study period:

- Saturated fatty acids:
  - Caproic acid (C6:0);
  - Caprylic acid (C8:0);
  - Capric acid (C10:0);
  - Undecanoic acid (C11:0);
  - Lauric acid (C12:0);
  - Tridecanoic acid (C13:0);
  - Myristic acid (C14:0);

    - Pentadecanoic acid (C15:0);
    - Palmitic acid (C16:0);
    - Heptadecanoic acid (C17:0);
    - Stearic acid (C18:0);
    - Arachidic acid (C20:0);
    - Heneicosanoic acid (C21:0);
    - Behenic acid (C22:0);
    - Tricosanoic acid (C23:0);
    - Lignoceric acid (C24:0).
- Monounsaturated fatty acids, *cis*:
    - Myristoleic acid (C14:1);
    - *cis*-10-pentadecenoic acid (C15:1);
    - Palmitoleic acid (C16:1);
    - *cis*-10-heptadecenoic acid (C17:1);
    - Oleic acid (C18:1 n-9*c*);
    - *cis*-11-eicosenoic acid) (C20:1);
    - Erucic acid (C22:1);
    - Nervonic acid (C24:1).
- Polyunsaturated fatty acids, *cis*:
    - Linoleic acid (C18:2 n6*c*);
    - Linolelaidic acid (C18:2 n9*t*, n12*t*) ;
    - α-linolenic acid (C18:3 n3);
    - γ-linolenic acid (C18:3 n6);
    - *cis*-11,14-eicosadienoic acid (C20:2 n6);
    - *cis*-11,14,17-eicosatrienoic acid (C20:3 n3);
    - *cis*-8,11,14-eicosatrienoic acid (C20:3 n6);
    - arachidonic acid (C20:4 n6);
    - *cis*-5,8,11,14,17-eicosapentaeonic acid (C20:5 n3);
    - *cis*-13,16-docosadieonic acid) (C22:2 n6);
    - *cis*-4,7,10,13,16,19-docosahexaenoic acid) (C22:6 n3).
- *trans* fatty acids:
    - Elaidic acid (C18:1 n-9*t*) ;
    - Vaccenic acid (C18:1 n-11*t*);
    - Linolelaidic acid (C18:2 n9*t*, n12*t*).

In the second study period, in addition to previously analysed 37 fatty acids, a conjugated linoleic acid – rumenic acid (C18:2 n9*c*, n11*t*) was added.

2.9. Evaluation of nutritional data using 72-hour food diary and food frequency questionnaire / *Uztura datu izvērtējums, izmantojot 72-stundu uztura dienasgrāmatu un pārtikas produktu lietošanas biežuma anketu*

To evaluate current energy and nutrient intake among the participants, a self-administered 72-hour food diary was used. A food diary was completed for three consecutive days prior to the milk sampling on the fourth day. To avoid an unnecessary burden, on the milk sampling day (fourth day of the study), participants did not have to fill the food diary.

A 72-hour food diary was chosen because studies show that a single meal can impact the fatty acid composition of human milk up to 72 hours (Francois et al., 1998). Participants were allowed to consume diet *ad libitum* (no food restrictions were applied).

A 72-hour food diary included example page on how to write a diary, participants were also encouraged to use an electronic food atlas (Food Control Authority, 2014) to determine the size of a food product or a food portion size. Measurements like spoons, cups were also used by participants to facilitate the determination of the food portion sizes.

Unfortunately, due to a lack of information regarding the fatty acid composition of different foodstuff, we were not able to use the national food composition database of Latvia. Instead, we used the Finnish food composition database Fineli (National Institute for Health and Welfare of Finland, 2019) to calculate the total energy and nutrient intake among the participants.

All data from the food database were exported to Microsoft Excel, 2019 (Microsoft Corp.). Nevertheless, it should be noted that due to geographical differences, and therefore differences in the nutrient content of some food products, calculated values of total energy and nutrients could be over- or underestimated. Also, it should be noted that individual values of total daily polyunsaturated fatty acid intake exported from the Fineli Food Composition database (National Institute for Health and Welfare of Finland, 2019) sometimes were lower than the total sum of individual polyunsaturated fatty acids due to differences in the measurement units used in the food database for each parameter. A measurement unit "gram" is used as a measurement unit for the total polyunsaturated fatty acid amount in the Fineli Food Composition database (National Institute for Health and Welfare of Finland, 2019). Therefore, if the total sum of polyunsaturated fatty acids of a specific foodstuff was <0.1 grams, after export to Microsoft Excel, 2019 (Microsoft Corp.), the value in this case, was displayed as 0.0 grams (even if the product actually may contain less than 100 milligrams of polyunsaturated fatty acids). A measurement unit "milligram" is used for individual polyunsaturated fatty acids in the Fineli Food Composition database (National Institute for Health and Welfare of Finland, 2019), therefore exact value in milligrams was also exported to Microsoft Excel, 2019 (Microsoft Corp.).

When food composition databases lacked information regarding a cooked form of a specific product, the raw food ingredients were chosen from the Fineli Food Composition database (National Institute for Health and Welfare of Finland, 2019) and nutrient retention factors were applied (United States of Department of Agriculture, 2007) to calculate the actual essential element and vitamin content after heat treatment (boiling, frying, baking etc.).

Nutritional information about dietary supplements was taken into account and added to the nutrient calculations from the food database. Natural food folates have a lower bioavailability than folic acid. Therefore, if a participant was consuming a dietary supplement containing folic acid, the dietary folate equivalents were computed using the following formula (2.3.):

$$\text{Total DFE} = \text{FF} + (1.7 \times \mu\text{g of FA}), \qquad (2.3.)$$

where: DFE – dietary folate equivalents, μg;
FF – food folate, μg;
FA – folic acid, μg.

A self-administered food frequency questionnaire – a modified protocol from World Health Organization (2007) was used to assess participants' habitual diet. The aim of the food frequency questionnaire was to rank different foodstuff intake according to the consumption frequency during the past four weeks before the study. The food frequency questionnaire consisted of 74 food & drinks (Annex IX). The response options in the food frequency questionnaire were ranged into six categories:

- "never" (0 points);
- "less than once a week" (1 point);
- "once a week" (2 points);
- "twice a week" (3 points);
- "more than twice a week but not every day" (4 points);
- "every day" (5 points).

Both 72-hour food diary and food frequency questionnaire were cross-checked for completeness by a registered nutritionist with an experience in similar nutrition research.

2.10. Characteristics of the participants / *Pētījuma dalībnieku raksturojums*

Participants were asked to complete a questionnaire about the maternal and child characteristics. The obtained information is summarized in Table 2.2.

Table 2.2. / *2.2. tabula*

Characteristics of the participants / *Pētījuma dalībnieku raksturojums*

Parameter (unit) / *Parametrs (mērvienība)*	**First study period / *Pirmais pētījuma posms* (n=69)***		**Second study period / *Otrais pētījuma posms* (n=70)**	
	Median (IQR) / *Mediāna (SKI)*	**Range / *Diapazons***	**Median (IQR) / *Mediāna (SKI)***	**Range / *Diapazons***
Maternal characteristics / *Dalībnieču raksturojums*				
Age (years) / *Vecums (gadi)*	31 (5)	23–39	31 (7)	23–45
BMI / *ĶMI* (kg m^{-2})	21.72 (4.46)	17.63–32.18	22.28 (3.79)	18.51–36.57
Parity / *Bērnu skaits*	2 (1)	1–4	2 (1)	1–5
Feeding pattern / *Ēdināšanas veids*	40 – exclusively breastfeeding / *ekskluzīvā zīdīšana* 2 – human milk + infant formula / *mātes piens + mātes piena aizstājējs* 27 – human milk + complementary feeding / *mātes piens + papildudzturs*		48 – exclusively breastfeeding / *ekskluzīvā zīdīšana* 3 – human milk + infant formula / *mātes piens + mātes piena aizstājējs* 19 – human milk + complementary feeding / *mātes piens + papildudzturs*	
Milk expression manner / *Piena noslaukšanas veids*	21 – manual expression / *noslaukšana ar roku* 39 – breast pump / *piena pumpis* 9 – both methods / *abas metodes*		31 – manual expression / *noslaukšana ar roku* 26 – breast pump / *piena pumpis* 13 – both methods / *abas metodes*	
Characteristics of the children / *Bērnu raksturojums*				
Age (months) / *Vecums (mēneši)*	4.0 (4.5)	1.5–21.0	3.0 (4.0)	1.0–27.0
	64 – Infants / *Zīdaiņi* (≤12 months / *≤12 mēneši*) 5 – Toddlers / *Mazi bērni* (1 to 2 years old / *1 līdz 2 gadus veci*)		68 – Infants / *Zīdaiņi* (≤12 months / *≤12 mēneši*) 2 – Toddlers / *Mazi bērni* (1 to 2 years old / *1 līdz 2 gadus veci*)	
Birth weight / *Dzimšanas svars* (kg)	3.49 (0.64)	1.60–5.36	3.61 (0.64)	1.63–5.50
Birth length / *Dzimšanas garums* (cm)	53.0 (5.0)	42–61	54.0 (3.0)	42–61
Sex / *Dzimums*	34 – girls / *meitenes* 35 – boys / *zēni*		34 – girls / *meitenes* 36 – boys / *zēni*	

*two out of 71 participants did not complete a questionnaire about maternal & child characteristics. / *divas no pētījuma dalībniecēm neiesniedza anketas par mātes & bērna parametriem.*

BMI was calculated based on the information given by participants. Anthropometric measurements using calibrated scales and tape measure were not carried out during this study. According to BMI categories set by World Health Organization (2018), the majority of participants were within the normal weight range (see Table 2.3.).

Table 2.3. / *2.3. tabula*

Assessment of the participants' body mass according to the categories set by the World Health Organization / *Pētījuma dalībnieču ķermeņa masas izvērtējums atbilstīgi Pasaules Veselības organizācijas izstrādātajām kategorijām*

BMI category / *ĶMI kategorija*	**First study period / *Pirmais pētījuma posms* (n=69)***	**Second study period / *Otrais pētījuma posms* (n=70)**
Underweight / *Pazemināts svars* (<18.5 kg m^{-2})	n=6	n=0
Normal weight / *Normāls svars* (18.5–24.9 kg m^{-2})	n=52	n=54
Pre-obesity / *Liekais svars* (25.0–29.9 kg m^{-2})	n=9	n=13
Obesity class I / *Aptaukošanās 1. pakāpe* (30.0–34.9 kg m^{-2})	n=2	n=2
Obesity class II / *Aptaukošanās 2. pakāpe* (35.0–39.9 kg m^{-2})	n=0	n=1

*two out of 71 participants did not complete a questionnaire about maternal & child characteristics. / *divas no pētījuma dalībniecēm neiesniedza anketas mātes & bērna parametriem.*

In the first study period:

- 65 out of 71 participants were able to donate enough human milk for the determination of macronutrients content analysis (~ 40 ml for fat and protein analysis and ~ 10 ml for lactose analysis);
- all participants (n=71) were able to donate enough human milk for the fatty acid composition analysis (~ 10 ml);
- 69 out of 71 participants were able to donate enough human milk (~ 40 ml) for essential and potentially toxic elements analysis.

In the second study period all participants (n=70) were able to donate enough human milk for macronutrient content analysis (~ 40 ml for fat, protein, and lactose analysis) as well as fatty acid composition analysis (~ 10 ml).

2.11. Data statistical analysis / *Datu statistikā analīze*

All elaborated data were summed up using Microsoft Excel, 2019 (Microsoft Corp.), and statistical analyses were performed using IBM SPSS Statistics, version 22.0 (SPSS Incorporated).

The results were expressed as average (standard deviation), median (interquartile range) and range (min–max values). The Kruskal-Wallis H-test was used to spot statistically significant differences between continuous or ordinal dependent variables and independent nominal variables. Spearman's rank correlation (ρ) was selected to measure the strength and direction of the association between continuous or ordinal variables. Non-parametric partial Spearman's rank correlations were conducted while controlling the following covariates:

- maternal age;
- maternal BMI;
- child's age;
- child's birth weight and length;
- child's sex;
- parity;
- feeding pattern;
- milk expression manner.

A principal component analysis was conducted to identify different dietary patterns and human milk fatty acid composition patterns among the participants. The count of patterns was identified based on the eigenvalue (≥1). Values with the factor loading ≥|0.5| were considered to contribute significantly to the identified components.

Stepwise multiple regression was used to predict a specific nutrient content in human milk based on three sequential day intake of this nutrient.

If needed, data were transformed to follow a normal distribution (log-transformation or square root transformation) before the specific statistical test.

A *p*-value of ≤0.05 was considered statistically significant.

3. RESULTS AND DISCUSSION / *REZULTĀTI UN DISKUSIJA*

3.1. Characteristics of the participants / *Pētījuma dalībnieku raksturojums*

There was no significant statistical difference (p>0.05) between the characteristics of the participants comparing both study periods. Therefore, further evaluation of the characteristics of the participants was conducted combining both study periods.

Child's birth weight significantly correlated with the length of birth (ρ=0.744, p<0.0005). Girls had a lower birth weight (median 3.45 kg, IQR = 0.55 kg) and length (median = 53.0 cm, IQR = 4.6 cm) compared to boys (median 3.66 kg, IQR = 0.56 kg, median = 54.00 cm, IQR = 3.3 cm) (p=0.003 for weight and p=0.003 for length).

Parity positively correlated with maternal age (ρ=0.507, p<0.0005), but maternal BMI negatively correlated with the child's age (ρ=-0.198, p=0.023).

The feeding pattern was influenced by the child's age (p<0.0005). The majority of the participants (n=88) were exclusively breastfeeding an infant (1 to 6 months old) which is according to the national and global recommendations (European Food Safety Authority, 2013; Veselības ministrija, 2003; World Health Organization, 2018).

Netika konstatētas statistiski nozīmīgas atšķirības starp dalībniekiem abos pētījuma posmos (p>0.05). *Kopumā bērna dzimšanas svars korelēja ar dzimšanas garumu, meitenēm bija mazāks dzimšanas svars un garums, zēniem – liekāks. Bērna ēdināšanas veids bija atkarīgs no bērna vecuma – lielākā daļa pētījumā iesaistīto zīdaiņu (1 līdz 6 mēneši) tika ekskluzīvi zīdīti, kas atbilst nacionālajām un pasaules rekomendācijām (European Food Safety Authority, 2013; Veselības ministrija, 2003; World Health Organization, 2018).*

3.2. Composition of human milk / *Mātes piena sastāvs*

3.2.1. Macronutrients (fat, protein, lactose) */ Makrouzturvielas (tauki, olbaltumvielas, laktoze)*

Obtained results about **macronutrient** content in obtained human milk samples are summarized in Table 3.1.

Table 3.1. / *3.1. tabula*

Fat, protein, and lactose content in human milk / *Tauku, olbaltumvielu un laktozes saturs mātes pienā*

Macronutrients / ***Makrouzturvielas*** **(%)**	**First study period /** ***Pirmais pētījuma posms*** **(n=65)***		**Second study period /** ***Otrais pētījuma posms*** **(n=70)**	
	Median (IQR) / ***Mediāna (SKI)***	**Range /*Diapazons***	**Median (IQR) /** ***Mediāna (SKI)***	**Range /*Diapazons***
Fat / *Tauki*	4.40 (2.00)	1.00–7.70	4.32 (1.75)	0.92–7.56
Protein / *Olbaltumvielas*	1.09 (0.19)	0.75–1.82	1.23 (0.21)	1.00–1.99
Lactose / *Laktoze***	6.53 (0.49)	5.94–7.70	7.18 (0.29)	6.24–7.54

*six out of 71 participants were not able to donate enough human milk for the analysis / *sešas no pētījuma dalībniecēm nevarēja noslaukt pietiekami daudz mātes piena analīžu veikšanai.*
** two significant outliers among lactose values were detected in the first study period and one significant outlier in the second study period / *divas izlecošās vērtības laktozes skaitļiem tika konstatētas pirmajā pētījuma posmā, bet viena izlecošā vērtība – otrajā posmā.*

Median fat content in human milk did not significantly differ between both study periods (p=0.771), but a significantly higher median protein and lactose content in human milk were noted among the second study period (p<0.005 for both). Obtained differences are probably due to different analytical methods used in each study period (see subsection 2.8.).

The median values for fat (4.40 %) and lactose (6.53 %) content in human milk from the first study period were similar to data previously reported in Latvia from Broka et al. (2016) – 4.42 % and 6.50 %, respectively. Elaborated median content for protein in both study periods (1.09 % and 1.23 %, respectively) was lower than data reported from Broka et al. (2016) – 1.46 %. The difference could be related to the sampling time. Our samples were collected at least 28 days postpartum, therefore it was mature human milk. Broka et al. (2016) analysed human milk samples collected 5 to 28 day postpartum, therefore it was transitional milk which contains a higher protein content compared to mature human milk (Garwolińska et al., 2018).

Large variance for fat content in human milk which was observed in both study periods (1.00–7.70 % and 0.92–7.56 %, respectively) could be explained by the sampling process (paired / unpaired breastfeeding sessions). Although we asked participants to collect only hindmilk, the sampling of human milk is complex. Breastfeeding sessions, depending on the needs of the infant, can be unpaired or paired. Therefore, provided pooled samples from the participants could potentially contain both hindmilk and foremilk. Overall, foremilk contains a two and a half times lower amount of fat (~ 2.00 %), compared to hindmilk (~ 5.00 %) (Saarela, Kokkonen & Koivisto, 2005).

Lactose content in human milk among participants from the first study period negatively correlated with protein ($\rho=-0.417$, $p=0.002$) and fat content ($\rho=-0.293$, $p=0.030$) in human milk. Protein content in human milk among participants from the second study period positively correlated with fat content in human milk ($\rho=0.302$, $p=0.012$).

Protein content in human milk among the participants from the first study period negatively correlated with the child's age ($\rho=-0.351$, $p=0.008$), while fat and lactose content in human milk was not affected ($p>0.05$ for both). A decline in protein content in relation to time has been noted also by other researchers (Grote et al., 2016; Lönnerdal et al., 2017), and this could be an adaptive change to infant's protein requirements (Lönnerdal et al., 2017).

Protein content in human milk among the study participants from the second study period correlated with the parity ($\rho=0.259$, $p=0.043$) and maternal BMI ($\rho=-0.383$, $p=0.002$).

Other maternal or child characteristics did not affect macronutrient content in human milk in neither of study periods ($p>0.05$).

3.2.2. Fatty acids */ Taukskābes*

Results regarding the **fatty acid composition** of analysed human milk samples are summarized in Annex X.

Dominating fatty acids in human milk among the participants from both study periods was oleic acid, followed by palmitic acid and linoleic acid. These three fatty acids are marked also as dominant fatty acids from studies around the world (Annex XI). The superiority of unsaturated fatty acids over saturated fatty acids ensures the mean melting point of human milk lipids around 34 °C which is lower than the body core temperature (~ 37 °C), therefore ensuring the fluidity of human milk (Roy et al., 2013).

The levels of fatty acids compared between both study periods were significantly different. Participants from the first study period overall had a higher palmitic acid and total saturated fatty acid level in human milk, but participants from the second study period had a significantly higher mono- and polyunsaturated, as well as *trans* fatty acid level in human milk (Annex X). Obtained differences, especially significant differences related to different *trans* C18:1 isomer level in human milk, could be explained by the fact that gas-chromatography method used to determine fatty acid composition were modified in year 2020 and now allows a better separation of *trans* C18:1 isomers.

Overall, median levels of saturated fatty acids and medium-chain fatty acids were 42.30 % and 12.20 %, respectively, which is similar to values reported from Spain (Annex XI).

Similar to data from Germany (Precht & Molkentin, 1999), median monounsaturated and polyunsaturated fatty acid level in human milk in this study was around 40.00 % and 16.00 % (Annex XI).

A median linoleic acid level in human milk (12.80 %) from this study was similar to values reported from Germany – 10.60 % and Greece – 14.95 % (Antonakou et al., 2013; Precht & Molkentin, 1999), but α-linolenic acid level in human milk from this study compiled with data from Croatia – 1.39 % (Krešić, Dujmović, Mandić & Delaš, 2013). Our elaborated linoleic acid / α-linolenic acid ratio of ~ 9 / 1 was one of the lowest reported values compared to data globally (Annex XI).

Similarly, n-6 / n-3 polyunsaturated fatty acid ratio (~ 7 / 1) in human milk in this study was lower compared to data from other countries (ratio of 11 / 1 for Croatia and Spain, 18 / 1 for Greece, 32 / 1 for Turkey) (Antonakou et al., 2013; Krešić et al., 2013; Luna, Juárez & de la Fuente, 2007; Samur, Topcu & Turan, 2009) (Annex XI).

Our elaborated median docosahexaenoic acid level in human milk (0.30 %) was lower than the mean docosahexaenoic acid value reported worldwide (0.37 %), and our obtained arachidonic acid level (0.30 %) in human milk was significantly lower than reported globally (0.55 %) (Fu et al., 2016). Globally, the docosahexaenoic acid level in human milk significantly varies – from 0.06 % in Pakistan to 1.40 % in Canadian Artic (Brenna et al., 2007). The arachidonic acid level in human milk also varies among the countries – from 0.24 % in France to 1.79 % in Switzerland (Brenna et al., 2007; Fu et al., 2016) which could be explained by varied dietary patterns among the countries, mainly due to fish consumption frequency, which among this study participants was low.

Our elaborated median level for total *trans* fatty acids (1.70 %) was the third-lowest reported value compared to data from other countries (Annex XI). Lower levels of total *trans* fatty acids in human milk have only been reported from Spain and Nigeria (Glew et al., 2006; Luna, Juárez & de la Fuente, 2007).

For, the example in Canada *trans* fatty acid level in human milk declined after introducing the requirements to indicate *trans* fatty acid content on the food label (from 7.1 % to 4.6 %) (Friesen & Innis, 2006). Therefore, we speculate that the low total *trans* fatty acid level observed in human milk samples in this study could be explained by low maternal intake of *trans* fatty acids due to the current Cabinet regulations of the Republic of Latvia to control the amount of industrially produced *trans* fatty acids found in foodstuff (Ministru kabineta noteikumi Nr. 301, 2016).

Significantly higher elaidic acid level in human milk was observed among the participants from the second study period (Annex X). This was probably due to the modified analytical method used for the fatty acid composition analysis in the second study period which allows better separation of *trans* C18:1 isomers.

Our obtained level of vaccenic acid (1.40 %) was one of the highest, if compared to results reported from other countries (Annex XI). Similar values for vaccenic acid in human milk (above 1 %) have been reported only from the United States (1.10 %) and Brazil (1.68 %) (Mosley et al., 2005; Nishimura et al., 2013) (Annex XI).

The conjugated linoleic acid level in human milk among this study participants was significantly lower (~ 0.10 %), if compared to data from other countries (Annex XI).

Using principal component analysis, we identified six human milk fatty acid profiles among the participants, explaining 85.12 % of total fatty acid profile variance (Table 3.2.):

- first profile associated with high polyunsaturated fatty acid level but low saturated fatty acid level (explaining 28.22 % of total variance);
- second profile associated with high monounsaturated and *trans* fatty acid levels, but low n-6 / n-3 polyunsaturated fatty acid ratio (explaining 20.46 % of total variance);
- third profile associated with high n-3 polyunsaturated fatty acid level, but low monounsaturated fatty acid level (explaining 13.95 % of total variance);

- fourth profile associated with high *trans* fatty acid level, but low monounsaturated fatty acid level (explaining 9.37 % of total variance);
- fifth profile associated with high long chain fatty acid – eicosapentaenoic and docosahexaenoic acid levels in human milk (explaining 7.86 % of total variance);
- sixth profile associated with low docosahexaenoic acid and medium chain fatty acid levels in human milk (explaining 5.27 % of total variance).

Table 3.2. / *3.2. tabula*

Human milk fatty acid profiles among the participants / *Mātes piena taukskābju profili pētījuma dalībniecēm* (n=141)

Fatty acids / *Taukskābes*	**1st profile / *1. modelis* (eigenvalue/ *eigenvērtība*=5.361)**	**2nd profile / *2. modelis* (eigenvalue / *eigenvērtība*=3.887)**	**3rd profile / *3. modelis* (eigenvalue / *eigenvērtība*=2.650)**	**4th profile / *4. modelis* (eigenvalue / *eigenvērtība*=1.780)**	**5th profile / *5. modelis* (eigenvalue / *eigenvērtība*=1.494)**	**6th profile / *6. modelis* (eigenvalue / *eigenvērtība*=1.001)**
PA / *PS*	**-0.852**	-0.081	-0.126	0.063	-0.014	0.331
MCFA / *VGĶT*	-0.383	-0.172	0.468	0.253	0.110	**-0.596**
SFA / *PT*	**-0.954**	-0.123	0.123	0.203	0.005	-0.010
OA / *OS*	0.373	**0.562**	-0.497	-0.444	-0.171	-0.113
MUFA / *MNT*	0.217	**0.596**	**-0.503**	**-0.546**	-0.036	-0.075
LA / *LS*	**0.839**	**-0.514**	0.095	0.059	-0.009	0.039
ARA / *AS*	0.326	0.190	-0.150	0.236	0.286	-0.195
n-6 PUFA / *n-6 PNT*	**0.853**	-0.493	0.081	0.078	0.011	0.034
ALA / *ALS*	**0.505**	0.248	**0.627**	-0.026	-0.444	0.171
EPA / *EPS*	0.119	0.230	0.190	-0.278	**0.705**	-0.066
DHA / *DHS*	-0.079	0.268	0.426	-0.230	**0.703**	**-0.596**
n-3 PUFA / *n-3 PNT*	0.430	0.375	**0.761**	-0.156	0.024	0.162
n-6 / n-3 PUFA ratio / *n-6 / n-3 PNT attiecība*	0.295	**-0.782**	-0.486	0.043	0.122	0.049
LA / ALA ratio / *LS / ALS attiecība*	0.160	**-0.751**	-0.425	-0.052	0.347	0.050
PUFA / *PNT*	**0.880**	-0.381	0.252	0.036	0.016	0.085
TFA / *TT*	0.301	**0.624**	-0.259	**0.610**	0.136	0.177

*rotated component matrix coefficients above 0.5 or less than -0.5 bolded as statistically significant values / *rotētā komponenta matricas koeficienti, kas ir lielāki par 0.5 vai mazāki par -0.5, iezīmēti ar trekninājumu kā statistiski nozīmīgas vērtības*.

Significant correlations between fatty acids in human milk are summarized in Annex XII. Overall, participants with a higher palmitic acid level in their milk had also a higher level of linolelaidic acid (ρ=-0.545, p<0.0005), but lower levels of linoleic acid (ρ=-0.688, p<0.0005), α-linolenic acid (ρ=-0.598, p<0.0005) and elaidic acid (ρ=-0.511, p<0.0005) in human milk.

Participants who had a higher medium-chain fatty acid level in human milk accordingly had a lower level of total monounsaturated fatty acids (ρ=-0.530, p<0.0005) in human milk, but participants who had a higher total saturated fatty acid level in human milk accordingly had a lower level of oleic acid (ρ=-0.611, p<0.0005), linoleic acid (ρ=-0.752, p<0.0005), α-linolenic acid (ρ=-0.554, p<0.0005) and total polyunsaturated fatty acid level (ρ=-0.779, p<0.0005) in human milk.

The linoleic acid level in human milk positively correlated with α-linolenic acid level (ρ=0.504, $p<0.0005$) in human milk.

The docosahexaenoic acid level in human milk was lower for the participants with a higher n-6 / n-3 polyunsaturated fatty acid ratio in human milk (ρ=-0.574, $p<0.0005$).

Elaidic acid level in human milk positively correlated with the vaccenic acid level in human milk (ρ=0.582, $p<0.0005$).

trans fatty acids compete with n-6 and n-3 polyunsaturated fatty acids for the place in the metabolism (Innis & King, 1999). In this study observed a significant negative correlation between *trans* fatty acids and n-6 / n-3 polyunsaturated fatty acid ratio, as well as linoleic acid / α-linolenic acid ratio in human milk (Annex XII).

Total n-3 polyunsaturated fatty acid level in human milk was positively associated with maternal age (ρ=0.252, $p=0.037$). Opposite observations have been reported from Antonakou et al. (2013) and Grote et al. (2016).

Analysing the data from the first study period, the following associations were found – child's age positively correlated with myristic acid (ρ=0.482, $p<0.0005$), medium-chain fatty acid levels in human milk (ρ=0.307, $p=0.010$), but negatively with oleic acid (ρ=-0.305, $p=0.011$), monounsaturated fatty acid (ρ=-0.268, $p=0.026$) levels in human milk.

In the second study period, there was a positive association between medium-chain fatty acid level (ρ=0.265, $p=0.037$) in human milk and child's age, but a negative association for vaccenic acid level in human milk and child's age (ρ=-0.256, $p=0.045$). Similar observations that specific fatty acid levels in human milk change as a breastfed child gets older have been also reported from Sala-Vila et al. (2005).

Participants from the first study period, who were exclusively breastfeeding their infants, had a lower level of myristic acid in human milk (5.90 %) compared to participants who were only partially breastfeeding (7.00 %) ($p=0.018$). This observation is probably related to the above-mentioned association that myristic acid level increases as a breastfed child gets older, because partial breastfeeding in this study was mostly noted among the participants with older infants.

Analysing the data from the second study period, the following associations were found – maternal age negatively correlated with conjugated linoleic acid (ρ=-0.335, $p=0.008$) and total *trans* fatty acid (ρ=-0.262, $p=0.040$) level in human milk, but maternal BMI positively correlated with docosahexaenoic acid (ρ=0.380, $p=0.002$) and vaccenic acid (ρ=0.262, $p=0.040$) levels in human milk. Parity was negatively affecting n-3 polyunsaturated fatty acid level in human milk (ρ=-0.274, $p=0.031$). The docosahexaenoic acid level in human milk was influenced by the child's birth weight (ρ=-0.323, $p=0.011$) and length (ρ=0.278, $p=0.029$). The child's birth length was also a negative factor for α-linolenic acid level in human milk (ρ=-0.262, $p=0.039$).

However, it should be noted that all of the above-mentioned associations were weak ($<0.1 \mid \rho \mid < 0.3$) or moderate correlations ($<0.3 \mid \rho \mid < 0.5$). Other researchers also report weak and inconsistent associations regarding maternal and child characteristics and different fatty acid level in human milk (Scholtens et al., 2009).

Therefore, we conclude that maternal and child characteristics are not the main contributors to the differences in the fatty acid composition of human milk and other factors, like the impact of maternal diet, should be further evaluated.

3.2.3. Essential and potentially toxic elements */ Esenciālie un potenciāli toksiskie elementi*

Results regarding **essential and potentially toxic element** analysis are summarized in Table 3.3.

Our elaborated median values for the following essential elements – selenium, manganese, iron, copper, cobalt, and chromium were below the detection limit. In the majority of analysed human milk samples, potentially toxic element content was also below the detection limit. Only two individual human milk samples contained potentially toxic element content above detection limit – one sample with an arsenic content of 0.93 µg 100 ml^{-1} and one sample with a lead content of 4.84 µg 100 ml^{-1}, respectively.

Table 3.3. / *3.3. tabula*

Essential and potentially toxic element content of human milk /
Esenciāli un potenciāli toksisko elementu saturs mātes pienā* (n=69)

Element, Symbol (unit) / *Elementa nosaukums, simbols (mērvienība)*	**Detection limit / *Noteikšanas robeža***	**Median (IQR) / *Mediāna (SKI)***	**Range / *Diapazons***
Essential elements / *Esenciālie elementi*			
Calcium / *Kalcijs*, Ca (mg 100 ml^{-1})	0.20	27.40 (9.43)	17.30–59.23
Magnesium / *Magnijs*, Mg (mg 100 ml^{-1})	2	3.89 (1.02)	2.52–5.63
Sodium / *Nātrijs*, Na (mg 100 ml^{-1})	2	12.67 (6.35)	5.00–42.54
Potassium / *Kālijs*, K (mg 100 ml^{-1})	2	60.59 (12.71)	40.99–75.88
Zinc / *Cinks*, Zn (mg 100 ml^{-1})	0.01	0.10 (0.11)	BDL / *ZNR*–0.34
Selenium / *Selēns*, Se (µg 100 ml^{-1})	2	BDL / *ZNR*	BDL / *ZNR*
Manganese / *Mangāns*, Mn (µg 100 ml^{-1})	200	BDL / *ZNR*	BDL / *ZNR*
Iron / *Dzelzs*, Fe (µg 100 ml^{-1})	100	BDL / *ZNR*	BDL / *ZNR*
Copper / *Varš*, Cu (µg 100 ml^{-1})	50	BDL / *ZNR*	BDL / *ZNR*–64.99
Cobalt / *Kobalts*, Co (µg 100 ml^{-1})	1	BDL / *ZNR*	BDL / *ZNR*
Chromium / *Hroms*, Cr (µg 100 ml^{-1})	1	BDL / *ZNR*	BDL / *ZNR*–1.44
Potentially toxic elements / *Potenciāli toksiskie elementi*			
Aluminium / *Alumīnijs*, Al (µg 100 ml^{-1})	500	BDL / *ZNR*	BDL / *ZNR*
Nickel / *Niķelis*, Ni (µg 100 ml^{-1})	50	BDL / *ZNR*	BDL / *ZNR*
Arsenic / *Arsēns*, As (µg 100 ml^{-1})	0.5	BDL / *ZNR*	BDL / *ZNR*–0.93
Strontium / *Stroncijs*, Sr (µg 100 ml^{-1})	50	BDL / *ZNR*	BDL / *ZNR*
Cadmium / *Kadmijs*, Cd (µg 100 ml^{-1})	0.5	BDL / *ZNR*	BDL / *ZNR*
Tin / *Alva*, Sn (µg 100 ml^{-1})	50	BDL / *ZNR*	BDL / *ZNR*
Antimony / *Antimons*, Sb (µg 100 ml^{-1})	50	BDL / *ZNR*	BDL / *ZNR*
Lead / *Svins*, Pb (µg 100 ml^{-1})	1	BDL / *ZNR*	BDL / *ZNR*–4.84

* the number of the participants from the first study period who were able to donate human milk for the determination of essential and potentially toxic element content / *Dalībnieču skaits no pirmā pētījuma posma, kuras ziedoja mātes pienu esenciālo un potenciāli toksisko elementu satura noteikšanai.*

A study from Sweden (Björklund et al., 2012) is one of the latest study providing data about essential and potentially toxic elements in human milk from Europe, using a sensitive analytical method ICP-MS, which was also used in this study. A comparison of data can be found in Table 3.4.

Overall, our elaborated data for calcium, potassium and magnesium content in human milk were similar, but data for sodium and zinc were lower compared to data from Sweden (Björklund et al., 2012).

There were few positive associations between essential elements in human milk. Sodium content in human milk positively correlated with calcium, magnesium, and potassium content.

There was also a positive association between calcium and potassium content in human milk (Table 3.5.).

Table 3.4. / *3.4. tabula*

Comparison of essential element content in human milk / *Esenciālo elementu satura salīdzinājums mātes pienā*

Element / *Elements* (mg 100 ml^{-1})	**This study, Latvia / *Šis pētījums, Latvija* (n=69)**		**Björklund et al. (2012), Sweden / *Zviedrija* (n=60)**	
	Median / *Mediāna*	**Range / *Diapazons***	**Median / *Mediāna***	**Range / *Diapazons***
Calcium / *Kalcijs*	27.40	17.30–59.23	30.70	19.60–41.60
Magnesium / *Magnijs*	3.89	2.52–5.63	2.80	2.10–4.30
Sodium / *Nātrijs*	12.67	5.00–42.54	19.20	13.60–48.00
Potassium / *Kālijs*	60.59	40.99–75.88	63.6	54.90–72.90
Zinc / *Cinks*	0.10	<0.01–0.34	0.35	0.12–0.57

Table 3.5. / *3.5. tabula*

Correlations between essential elements in human milk / *Korelācijas starp esenciālo elementu saturu mātes pienā* (n=67) *

Elements / *Elementi*	**Calcium / *Kalcijs***	**Magnesium / *Magnijs***	**Sodium / *Nātrijs***	**Potassium / *Kālijs***	**Zinc / *Cinks***
Calcium / *Kalcijs*	NA / *NP*	ρ=0.241 (*p*=0.063)	ρ=0.380 (*p*=0.003)	ρ=0.337 (*p*=0.009)	ρ=0.163 (*p*=0.214)
Magnesium / *Magnijs*	ρ=0.241 (*p*=0.063)	NA / *NP*	ρ=0.291 (*p*=0.024)	ρ=0.164 (*p*=0.210)	ρ=-0.178 (*p*=0.175)
Sodium / *Nātrijs*	ρ=0.380 (*p*=0.003)	ρ=0.291 (*p*=0.024)	NA / *NP*	ρ=0.303 (*p*=0.019)	ρ=-0.112 (*p*=0.395)
Potassium / *Kālijs*	ρ=0.337 (*p*=0.009)	ρ=0.164 (*p*=0.210)	ρ=0.303 (*p*=0.019)	NA / *NP*	ρ=-0.109 (*p*=0.407)
Zinc / *Cinks*	ρ=0.163 (*p*=0.214)	ρ=-0.178 (*p*=0.175)	ρ=-0.112 (*p*=0.395)	ρ=-0.109 (*p*=0.407)	NA / *NP*

* In total 69 participants donated human milk for essential element analysis, but two of them did not submit a questionnaire about maternal & child characteristics. Controlling variables for this partial correlation analysis were – maternal age, maternal BMI, child's age, child's birth weight & birth length, child's sex, parity, feeding pattern, milk expression manner / *Kopā 69 pētījuma dalībniece ziedoja mātes pienu esenciālo elementu analīzēm, bet divas no šīm dalībniecēm neiesniedza anketu par dalībnieces & bērna raksturpazīmēm. Šīs daļējās korelācijas analīzes kontroles mainīgie parametri bija – mātes vecums, mātes ĶMI, bērna vecums, bērna dzimšanas svars & garums, bērna dzimums, kopējais bērnu skaits mātei, ēdināšanas veids bērnam, piena noslaukšanai izvēlētā metode.*

0.1 < | ρ | < 0.3 – weak correlation / *vāja sakarība*;

0.3 < | ρ | < 0.5 – moderate correlation / *vidēji cieša sakarība*;

| ρ | ≥ 0.5 – strong correlation / *cieša sakarība* (Laerd Statistics, 2017).

The potassium/sodium ratio in this study was 4.5 / 1 which is higher than reported in the literature (3 / 1) (Lawrence & Lawrence, 2015). This is due to the lower sodium content in human milk observed in this study.

To maintain the osmolality of human milk close to maternal plasma, lactose content in milk should be inversely related to the sum of monovalent ions ($Na^{+} + K^{+}$) (de la Guardia & Garrigues, 2015; Lawrence & Lawrence, 2015), and it was also observed in this study (Table 3.6.).

Table 3.6. / *3.6. tabula*

Correlations among essential element and macronutrient content in human milk /
Korelācijas starp esenciālo elementu un makrouzturvielu saturu mātes pienā* (n=65)

Nutrients / *Uzturvielas*	**Calcium / *Kalcijs***	**Magnesium / *Magnijs***	**Sodium / *Nātrijs***	**Potassium / *Kālijs***	**Sodium + Potassium / *Nātrijs + Kālijs***	**Zinc / *Cinks***
Fat / *Tauki*	ρ=0.139 (*p*=0.306)	ρ=-0.048 (*p*=0.724)	ρ=0.235 (*p*=0.081)	ρ=0.245 (*p*=0.069)	ρ=0.294 (*p*=0.028)	ρ=0.042 (*p*=0.759)
Protein / *Olbaltum-vielas*	ρ=0.342 (*p*=0.010)	ρ=0.308 (*p*=0.021)	ρ=0.603 (*p*<0.0005)	ρ=0.275 (*p*=0.040)	ρ=0.451 (*p*<0.0005)	ρ=0.175 (*p*=0.197)
Lactose / *Laktoze*	ρ=-0.262 (*p*=0.051)	ρ=-0.213 (*p*=0.115)	ρ=-0.590 (*p*<0.0005)	ρ=-0.279 (*p*=0.037)	ρ=-0.500 (*p*<0.0005)	ρ=-0.067 (*p*=0.623)

* In total 65 participants from the first study period were able to donate human milk both for macronutrient and essential element analysis, as well submitted questionnaire about maternal & child's characteristics. Controlling variables for this partial correlation analysis were – maternal age, maternal BMI, child's age, child's birth weight & birth length, child's sex, parity, feeding pattern, milk expression manner / *Kopā 65 dalībnieces no pirmā pētījuma posma ziedoja mātes pienu makrouzturvielu un esenciālo elementu satura noteikšanai mātes pienā, kā arī iesniedza anketu par dalībnieces & bērna raksturpazīmēm. Šīs daļējās korelācijas analīzes kontroles mainīgie parametri bija – mātes vecums, mātes ĶMI, bērna vecums, bērna dzimšanas svars & garums, bērna dzimums, kopējais bērnu skaits mātei, ēdināšanas veids bērnam, piena noslaukšanai izvēlētā metode.*

0.1 < | ρ | < 0.3 – weak correlation / *vāja sakarība*;
0.3 < | ρ | < 0.5 – moderate correlation / *vidēji cieša sakarība*;
| ρ | ≥ 0.5 – strong correlation / *cieša sakarība* (Laerd Statistics, 2017).

Both calcium, sodium, potassium and zinc content in human milk negatively correlated with child's age (ρ=-0.325, *p*=0.006 for calcium, ρ=-0.253, *p*=0.036 for sodium, ρ=-0.317, *p*=0.008 for potassium and ρ=-0.250, *p*=0.039 for zinc). It is also noted in the literature, that calcium and zinc content in human milk decreases over time of lactation (Lawrence & Lawrence, 2015; Yamawaki et al., 2005). A possible explanation for this phenomenon regarding decreasing zinc content in human milk has been given by Kelleher, Seo & Lopez (2009) – prolactin affects the secretion of zinc from the mammary gland – the circulating prolactin level depletes as lactation proceeds, and, correspondingly, zinc content in human milk depletes as well.

Both potassium and zinc content in human milk was higher among the women who were still exclusively breastfeeding – 62.99 mg 100 ml^{-1} compared to 57.61 mg 100 ml^{-1} for potassium (*p*=0.044) and 0.13 mg 100 ml^{-1} compared to 0.08 mg 100 ml^{-1} for zinc (*p*=0.035).

The maximum level for arsenic, cadmium, tin, and lead in the infant foodstuff and formulas are defined in Commission Regulation (CE) No. 1881/2006 (European Commission, 2006). Comparing the maximum levels of potentially toxic elements set in legislation with our obtained median values for arsenic, cadmium, tin, and lead, we conclude that human milk among lactating women in Latvia contains only trace amounts of potentially toxic elements and does not raise concern (Table 3.7.).

Table 3.7. / *3.7. tabula*

Potentially toxic element content in human milk in comparison with maximum levels set in legislation / *Potenciāli toksisko elementu saturs mātes pienā, salīdzinot ar normatīvajos aktos noteiktajiem maksimāli pieļaujamajiem daudzumiem* (n=69)*

Element / *Elements*	**Median value / *Mediāna* (µg 100 mg^{-1})**	**Range / *Diapazons* (µg 100 mg^{-1})**	**Maximum level defined in legislation (µg 100 mg^{-1} wet weight) / *Maksimāli pieļaujamā koncentrācija (µg 100 mg^{-1} mitra svara)*** (European Commission, 2006)
Arsenic / *Arsēns*	<0.5	<0.5–0.90	Rice destined for the production of food for infants and toddlers / *Rīsi, kas paredzēti pārtikas ražošanai zīdaiņiem un maziem bērniem* – **10 µg 100 mg^{-1}**.
Cadmium / *Kadmijs*	<0.5	<0.5	Powdered infant formulae and follow on-formulae manufactured from cows' milk proteins or protein hydrolysates / P*ulverveida maisījumi zīdaiņiem un papildu ēdināšanas maisījumi, kas ražoti no govs piena olbaltumvielām vai olbaltumvielu hidrolizātiem* – **1 µg 100 mg^{-1}**. Liquid infant formulae and follow on-formulae manufactured from cows' milk proteins or protein hydrolysates / Š*ķidrie maisījumi zīdaiņiem un papildu ēdināšanas maisījumi*, kas r*ažoti no govs piena olbaltumvielām vai olbaltumvielu hidrolizātiem* – **0.50 µg 100 mg^{-1}**.
Tin / *Alva*	<50	<50	Canned infant formulae and follow-on formulae (including infant milk and follow-on milk), excluding dried and powdered products / *Konservēts mātes piena aizstājējs zīdaiņiem un piebarošanas pārtika (arī piens zīdaiņiem un piena maisījumi piebarošanai), izņemot žāvētus un pulverveida produktus* – **5000 µg 100 mg^{-1}**.
Lead / *Svins*	<1	<1–4.70	Infant formulae and follow-on formulae / *Maisījumi zīdaiņiem un papildu ēdināšanas maisījumi zīdaiņiem*: • marketed as powder / *tiek pārdoti kā pulveris* – **5.0 µg 100 mg^{-1}**; • marketed as liquid / *tiek pārdoti šķidrā veidā* – **1 µg 100 mg^{-1}**.

* the number of the participants from the first study period who were able to donate human milk for the determination of essential and potentially toxic element content / *Dalībnieču skaits no pirmā pētījuma posma, kuras ziedoja mātes pienu esenciālo un potenciāli toksisko elementu satura noteikšanai.*

Summary of Chapter 3.2. / *3.2. nodaļas kopsavilkums*

Elaborated results for macronutrients (fat, protein, and lactose) and essential element (calcium, magnesium, and potassium) content in human milk were similar to data found in the literature, but we report lower results for zinc, sodium content in human milk.

Also, similar to the data reported around the globe, dominating fatty acids in human milk among lactating women in this study were palmitic acid, oleic acid, and linoleic acid, compiling ~ 71 % of the total fatty acid level in human milk. Compared to other countries, we report a higher vaccenic acid level in human milk, but overall total *trans* fatty acid level in human milk was low (<2 %).

Although obtained median docosahexaenoic acid level (0.30 %) in human milk corresponds to the target level (Jackson Harris & Harris, 2016), large variance of docosahexaenoic acid level in obtained human milk samples was observed (from 0.10 % to 4.30 % of the total fatty acid level).

Human milk contained only trace amounts of arsenic, cadmium, tin, and lead which did not exceed the maximum levels of potentially toxic elements defined in legislation for the infant formulas and foodstuff destined for infants and toddlers.

Iegūtie rezultāti par makrouzturvielu (tauku, olbaltumvielu, laktozes) un esenciālo elementu (kalcija, magnija un kālija) saturu mātes pienā bija salīdzināmi ar literatūrā atspoguļotajiem datiem, bet cinka un nātrija saturs zemāks nekā citu valstu pētījumos.

Līdzīgi kā citur pasaulē, dominējošās taukskābes mātes pienā ir palmitīnskābe, oleīnskābe un linolskābe, kopā veidojot ~ 71 % no kopējā taukskābju satura mātes pienā. Salīdzinot ar citām valstīm, sievietēm Latvijā mātes pienā ir augstāks vakcēnskābes saturs, bet kopumā kopējais trans taukskābju saturs bija zems (<2 %).

Lai gan dokozaheksaēnskābes saturs mātes pienā sasniedza rekomendēto robežvērtību (0.30 %) (Jackson Harris & Harris, 2016), tas krasi atšķīrās analizētajos mātes piena paraugos (no 0.10 % līdz 4.30 % no kopējā taukskābju satura).

Mātes piens saturēja nenozīmīgu arsēna, kadmija, alvas un svina daudzumu, nepārsniedzot maksimāli pieļaujamo saturu, kas noteikts normatīvajos aktos mātes piena aizstājējiem un pārtikai, kas paredzēta zīdaiņu un mazu bērnu ēdināšanai.

3.3. Dietary habits and nutrient intake among the study participants / *Uztura paradumi un uzturvielu uzņemšana pētījuma dalībniecēm*

To evaluate dietary patterns and nutrient intake among the participants, we collected nutritional data using a food frequency questionnaire and a 72-hour food diary. In the first study period, we were able to obtain a food frequency questionnaire from 68 participants and 72-hour food diary from 69 participants. In the second study period, we were able to obtain a food frequency questionnaire and 72-hour food diaries from all participants (n=70).

Habitual food intake using food frequency questionnaire is summarised in Annex XIII, but information about total energy and nutrient intake from 72-hour food diary is summarized in Annex XIV.

The majority of the participants of this study noted the use of at least one dietary supplement (34 participants from the first study period and 46 participants from the second study period). The following nutrients were most commonly taken via dietary supplements:

- vitamin D (23 participants from the first study period and 36 participants from the second study period);
- vitamin C (13 participants from the first study period and 22 participants from the second study period);
- n-3 polyunsaturated fatty acids (14 participants from the first study period and 21 participants from the second study period);
- vitamin B_9 (14 participants from the first study period and 18 participants from the second study period);
- iron (15 participants from the first study period and 17 participants from the second study period);
- zinc (10 participants from the first study period and 22 participants from the second study period);
- vitamin E (10 participants from the first study period and 20 participants from the second study period);
- vitamin B_6 (12 participants from the first study period and 18 participants from the second study period);

- vitamin B_{12} (12 participants from the first study period and 16 participants from the second study period);
- calcium (12 participants from the first study period and 15 participants from the second study period).

3.3.1. Evaluation of food frequency questionnaire data / *Pārtikas produktu lietošanas biežuma anketas datu izvērtējums*

Diversity in the diet is essential to meet the requirements of nutrient intake, both during gestation and during lactation, and food consumption from different food groups is recommended (Food and Agriculture Organization of the United Nations, 2016; Veselības ministrija, 2017b). A high-quality diet is characterised by regular intake of foodstuff from different food groups like cereals, potatoes, milk and dairy products, vegetables, fruits, berries, and fats. Products like sweets, bakery goods, salty snacks, and fast food should be only consumed rarely (Food and Agriculture Organization of the United Nations, 2016).

Comparing habitual food frequency intake among both study periods, few significances were noted (Table 3.8.), but mostly habitual food intake did not differ among both study periods. Therefore, further described evaluation of the food frequency questionnaire will be combined results from both study periods.

Table 3.8. / *3.8. tabula*

Differences regarding habitual food intake among participants comparing both study periods / *Atšķirības pārtikas produktu lietošanas biežumā dalībniecēm, salīdzinot abus pētījuma posmus*

Foodstuff / *Pārtikas produkts*	**First study period / *Pirmais pētījuma posms* (n=68)***	**Second study period / *Otrais pētījuma posms (n=70)***	***p*-value / *p vērtība***
	Median intake / *Lietošanas biežums (mediāna)*	**Median intake / *Lietošanas biežums (mediāna)***	
Bread containing seeds / *Sēklu maize*	Once a week / *Vienreiz nedēļā*	More than twice a week but not every day / *Biežāk kā 2x nedēļā, bet ne katru dienu*	0.048
Milk / *Piens*	Every day / *Katru dienu*	Less than once a week / *Retāk kā reizi nedēļā*	0.026
Sour cream / *Skābais krējums*	More than twice a week but not every day / *Biežāk kā divreiz nedēļā, bet ne katru dienu*	Twice a week / *Divreiz nedēļā*	0.041
Fruit juices / *Augļu sulas*	Never / *Nekad*	Less than once a week / *Retāk kā reizi nedēļā*	<0.0005
Mayonnaise / *Majonēze*	Never / *Nekad*	Less than once a week / *Retāk kā reizi nedēļā*	0.001

* Three out of 71 participants from the first study period did not submit FFQ. / *Trīs no 71 dalībnieces no pirmā pētījuma posma neiesniedza pārtikas produktu lietošanas biežuma anketu.*

Cereal products are a good source of carbohydrates (especially starch), fibre, B group vitamins, and essential elements (Nordic Nutrition Recommendations, 2014). According to the data from the food frequency questionnaire, rye bread was the most consumed food product from the starchy food group – consumed more than twice a week by 31 % of the participants and every day by 28 % of the participants (Annex XIII). Often among the participants was also consumed bread containing seeds & grains – consumed at least twice times a week (26 % of the participants) or every day (16 % of the participants) and wholegrain oats – consumed at least twice times a week (15 % of the participants) or every day (11 % of the participants). Other types of cereals – rice, buckwheat etc. were consumed only rarely (Annex XIII).

Potatoes are the source of carbohydrates (especially starch), vitamin C, magnesium, and potassium. Boiled potatoes were mostly consumed once a week by ~ 32 % of the participants (Annex XIII). More than half of the participants (~ 52 %) also on a rare basis preferred consumption of baked, fried potatoes, or potatoes' mash (Annex XIII).

Overall, participants did not consume various types of starchy food, but preferred the consumption of specific products like potatoes and bread. Other starchy food products like quinoa, amaranth, couscous, bulgur was not popular among the participants.

Meat is a source of protein, vitamins B_6 and B_{12}, iron, and zinc, but could also contain a high amount of saturated fat (Nordic Council of Ministers, 2014). Meat from pork, beef, lamb is categorized as red meat due to higher content of protein and iron, but meat from chicken or turkey is classified as white meat. Meat products (bacon, salami, sausages etc.) are produced products using smoking, salting, and other treatment methods.

Participants in this study better preferred the intake of meat instead of meat products. Red meat was mostly consumed once a week by ~ 22 % of the participants, but white meat – mostly twice a week (29 % of the participants). Processed meat was mostly avoided (30 % of the participants) or only consumed on a rare basis (32 % of the participants) (Annex XIII).

Eggs are a good source of protein, fat, B group vitamins, vitamins A and D (National Institute for Health and Welfare of Finland, 2019) and were mostly consumed almost every day by 33 % of the participants (Annex XIII).

Fish and seafood are the sources of protein, selenium, iodine, vitamins B_{12} and D. Fatty fish are also a dominant dietary source of long-chain polyunsaturated omega-3 fatty acids – eicosapentaenoic and docosahexaenoic acid (Nordic Council of Ministers, 2014). The majority of the participants in this study were non-fish eaters (17 % of the participants) or noted fish consumption only rarely (46 % of the participants). Once a week fish was included in the diet by ~ 22 % of the participants, but only 15 % of the participants consumed fish at least two times a week. Also, seafood was consumed only rarely by 47% of the participants or avoided completely by ~ 46 % of the participants (Annex XIII).

Milk and dairy products are the major sources of calcium in the diet. This food product group also provides protein, fat, iodine, vitamins A and B_{12} to the human body (Nordic Council of Ministers, 2014). According to the data from the food frequency questionnaire, almost half of the participants consumed milk on daily basis (43 %) (Annex XIII). Cheese – a good source of calcium – was the second most frequently consumed dairy product, eaten almost every day by approximately 34 % of the participants (Annex XIII). A lot of cheese is consumed also by lactating women in France. Approximately 82 % of the lactating women who participated in the study conducted in France, noted the cheese consumption in the last seven days (Hébel et al., 2018).

Fourteen participants from the first study period and ten participants from the second study period in the food frequency questionnaire noted that they avoid milk and dairy products. The reasons for the exclusion of milk & dairy products were following – participant is a vegetarian (two from the first study period, one from the second study period) or a vegan (two participants in each study period), maternal health issues (two participants from the first study period), the infant has cow's milk protein allergy (eight participants from the first study period and seven participants from the second study period). Cow's milk protein is the main cause for allergy in infants and toddlers (Koletzko et al., 2012) and therefore exclusion of cow's milk and dairy products from the maternal diet is the only treatment if a woman wants to continue breastfeeding (Denis, Loras-Duclaux & Lachaux, 2012).

Although pulses are a good source of protein, fiber, vitamins B_2, and B_6 (Nordic Council of Ministers, 2014; Singh, 2017), more than half of the study participants did not consume pulses or ate them only rarely (Annex XIII). The reason why some people exclude pulses from the diet is that they contain oligosaccharides which are not digested in the small intestine, but are metabolized by the microorganisms located in the large intestine. Excess formation of gases in the large intestine can cause abdominal discomfort (Singh, 2017). Many women believe that maternal diet induces infant colic. Correspondingly, a lot of women during lactation avoid specific foods like pulses, onions, and cruciferous vegetables because they wrongly assume that consumption of these products will also cause flatulence for the infant (Kidd et al., 2019). Nether oligosaccharides or gases from the maternal digestive tract are transmitted to the human milk, and therefore there is no reason for women to exclude pulses from the diet during lactation (Jeong et al., 2017; Mohrbacher, 2010).

Vegetables, fruits, and berries are the major source of antioxidants, vitamins C, E, K, B_9, potassium, magnesium, and fibre (Nordic Council of Ministers, 2014). In a healthy diet, vegetables, fruits, and berries should be consumed on daily basis – at least 500 g or five portions per day. Half of the daily intake (250 g) should be provided by fresh vegetables, fruits, and berries (Veselības ministrija, 2017b). However, results from the food frequency questionnaire revealed that only about half of the participants in this study consumed fresh vegetables (52 %) and fresh fruits (49 %) on daily basis, but fresh berries on daily basis were consumed only by 13 % of the participants. Cooked vegetables on daily basis were consumed only by one-third of the participants (Annex XIII). Also, a study from France showed that women during lactation are not consuming enough vegetables, fruits, and berries – only 11 % of the participants consumed at least five portions of vegetables, fruits, and berries per day (Hébel et al., 2018).

Plant-based fat sources like plant oils, avocado, nuts, and seeds are a good source of unsaturated fatty acids and vitamin E (Nordic Council of Ministers, 2014). Dominant plant-based fat source among the participants was plant oils – consumed almost every or every day by approximately 83 % of the participants (Annex XIII).

Olive oil is a monounsaturated fatty acid source. Linseed oil and rapeseed oil dominantly contain n-3 polyunsaturated fatty acids, but sunflower oil – n-6 polyunsaturated fatty acids (Nordic Council of Ministers, 2014). According to the data from the food frequency questionnaire, olive oil was the most commonly consumed oil among the lactating women in this study – frequently used by 71 % of the participants. Sunflower oil was the second most commonly preferred oil – frequently used by 25 % of the participants, but canola oil – the third most commonly preferred oil (23 % of the participants).

Condiments are products used to enhance the flavour of food (Nordic Council of Ministers, 2014). Butter was the most commonly used condiment – consumed almost every or every day consumed by half of the participants. Other condiments – ketchup, mayonnaise, sauces, margarine, and blended fat spreads were mostly avoided by the participants or consumed rarely (Annex XIII).

Sweets and bakery goods are energy-dense products; however, they are not a good source of nutrients. Therefore, their intake should be limited (Food and Agriculture Organization of the United Nations, 2016; Nordic Council of Ministers, 2014). Chocolate was the most commonly preferred sweet – consumed almost every day or every day by ~ 32 % of the participants. Cookies were consumed every or almost every day by approximately 20 % of the participants (Annex XIII).

Due to the high amount of salt, saturated fatty acids, and *trans* fatty acids, salty snacks and fast-food intake should also be limited (Food and Agriculture Organization of the United Nations, 2016; Nordic Council of Ministers, 2014). Positive that habitual intake of these food products among the participants was low – almost all participants (~ 90 %) consumed salty snacks and fast food only rarely or never (Annex XIII).

Soft drinks usually contain a high amount of sugar and can also be a source of caffeine (for example, Cola) (Nordic Council of Ministers, 2014). Fortunately, among the participants, soft drinks were consumed only rarely or not at all (Annex XIII).

Tea, made from the plant *Camellia sinensis* leaves, and coffee, contains a stimulant – caffeine. Caffeine is rapidly transferred to human milk (peek in milk 1–2 hours after ingestion). However, only a small amount of maternal dose (about 1.5 %) is transferred to human milk (Mohrbacher, 2010). Therefore, the European Food Safety Authority states that a single caffeine dose of 200 mg or a total daily caffeine dose of 400 mg will not affect the breastfed infant, and it is safe for a lactating woman to drink up to three cups of coffee per day (European Food Safety Authority, 2015). More than half of the participants (~ 58 %) in this study, noted coffee consumption on daily basis. Also, according to the data from the food frequency questionnaire, caffeine-containing teas were consumed on daily basis by one-third of the participants (~ 30 %) (Annex XIII).

Almost half of the participants from this study (~ 42 %) on the food frequency questionnaire noted herbal tea use on daily basis. Herbal teas during lactation should be consumed with caution, because they contain biologically active substances that can influence milk production. For example, high consumption (>1 L per day) of sage or peppermint tea can reduce milk production. However, few cups of herbal tea per day are unlikely to cause problems with breastfeeding (Mohrbacher, 2010). On the opposite, fenugreek tea has been suggested for lactating mothers as a galactagogue that can improve milk production (Turkyılmaz et al., 2011). However, currently, there is a lack of scientific evidence to confirm the effectiveness of herbal galactagogues (Forinash et al., 2012).

Alcohol is rapidly absorbed in the body and affects the activity of all organs, including mammary glands, and therefore milk production (Hale & Hartmann, 2017; Nordic Council of Ministers, 2014). The alcohol level in human milk is equal to the alcohol level in blood ~ 30 minutes after ingestion. Alcohol is weakly metabolized by an infant; therefore, mothers are advised to avoid alcohol consumption during lactation or try to limit the exposure to the infant by delaying breastfeeding for at least two hours after alcohol consumption or store alcohol-free human milk for the infant if alcohol is intended to be consumed (Hale & Hartmann, 2017). According to the food frequency questionnaire, alcohol was completely avoided by approximately 70 % of the study participants but ~ 22 % of the participants noted the use of alcohol less than once a week. The rest of the participants drunk alcohol once (6 %), twice a week (1 %), or more frequently (1 %) (Annex XIII).

To classify current dietary patterns among the participants, we performed a principal components analysis on the data from the food frequency questionnaire. Principal components analysis revealed five components that had eigenvalues greater than one and which explained 18.83 %, 17.65 %, 9.65 %, 8.63 %, and 6.67 % of the total variance (61.43 % in total), respectively (Table 3.9.).

The first dietary pattern according to the data from the principal component analysis can be characterised as healthy due to high vegetable, fruit, berry, plant-based fat, pulses consumption but low animal-based protein intake. The second dietary pattern can be associated as unhealthy due to consumption of products that contain high carbohydrate (including sugar), fat, and salt content. The third dietary pattern can be associated with high milk & dairy product and sweets & baked goods intake and could potentially be associated with a higher *trans* fatty acid intake. The fourth dietary pattern is related to different drink intake, but the fifth dietary pattern – associated with high fish & seafood and vegetable intake (Table 3.9.).

Also, few associations were found between the habitual intake of different foodstuff and maternal characteristics. Participants with a higher BMI, according to the data from the food frequency questionnaire, reported more frequent consumption of milk & dairy products (ρ=0.186, p=0.03), but lower consumption of herbal teas (ρ=-0.212, p=0.015). Participants with more children were reporting more frequent consumption of sweets and bakery goods (ρ=0.185, p=0.035). A higher intake of plant-based fats (ρ=0.248, p=0.004), herbal teas (ρ=0.248, p=0.004), but lower intake of salty snacks & fast food (ρ=-0.182, p=0.038) and alcohol (ρ=-0.205, p=0.019) was noticed among older study participants. This could potentially indicate that older lactating women are paying more attention to their nutritional habits and overall try to eat healthier. Nevertheless, all obtained observations were weak correlations, indicating that other factors potentially affect habitual dietary habits among lactating women in Latvia.

Table 3.9. / *3.9. tabula*

Dietary patterns among the participants / *Uztura paradumu modeļi pētījuma dalībniecēm* (n=138)*

Food group / *Pārtikas produktu grupa*	**1st Dietary pattern / *1. uztura paradumu modelis* (eigenvalue / *eigenvērtība*=2.825)**	**2nd Dietary pattern / *2. uztura paradumu modelis* (eigenvalue / *eigenvērtība*=2.647)**	**3rd Dietary pattern / *3. uztura paradumu modelis* (eigenvalue / *eigenvērtība*=1.447)**	**4th Dietary pattern / *4. uztura paradumu modelis* (eigenvalue / *eigenvērtība*=1.295)**	**5th Dietary pattern / *5. uztura paradumu modelis* (eigenvalue / *eigenvērtība*=1.001)**
Cereals, cereal products & potatoes / *Graudaugi, graudaugu produkti & kartupeļi*	0.276	**0.707***	0.072	-0.240	0.143
Eggs, meat & meat products / *Olas, gaļa, gaļas izstrādājumi*	**-0.600**	0.272	0.217	0.093	0.427
Fish & seafood / *Zivis & jūras veltes*	0.055	-0.048	0.060	0.167	**0.823**
Milk & dairy products / *Piens & piena produkti*	-0.081	-0.049	**0.809**	0.115	0.166
Pulses / *Pākšaugi*	**0.764**	0.306	-0.054	-0.015	-0.134
Vegetables / *Dārzeņi*	**0.582**	0.019	-0.207	-0.148	**0.528**
Fruits & berries / *Augļi & ogas*	**0.671**	0.062	0.075	0.084	0.100
Plant based fats / *Augu izcelsmes taukvielas*	**0.765**	-0.009	0.010	-0.135	0.125
Condiments / *Piedevas ēdienam*	-0.086	**0.785**	0.080	0.168	0.004
Sweets & baked goods / *Saldumi & konditorejas izstrādājumi*	-0.003	0.363	**0.740**	0.095	-0.221
Salty snacks & fast food / *Sāļās uzkodas & "ātrās" uzkodas*	0.163	**0.739**	0.078	0.196	-0.054
Soft drinks / *Limonādes*	-0.326	0.420	-0.002	0.318	-0.162
Caffeine containing drinks / *Kofeīnu saturošie dzērieni*	-0.035	0.154	0.249	0.459	0.168
Herbal teas / *Zāļu tējas*	0.152	-0.008	0.416	**-0.664**	0.055
Alcohol / *Alkohols*	0.039	0.092	0.247	**0.721**	0.089

* three out of 141 participants did not submit FFQ. Rotated component matrix coefficients above 0.5 or less than -0.5 bolded as statistically significant values. / *trīs no 141 pētījuma dalībniecēm neiesniedza pārtikas produktu lietošanas biežuma anketu. Rotētā komponenta matricas koeficienti, kas ir lielāki par 0.5 vai mazāki par -0.5, iezīmēti ar trekninājumu kā statistiski nozīmīgas vērtības.*

3.3.2. Evaluation of 72-hour food diary / *72 stundu uztura dienasgrāmatu izvērtējums*

Production of human milk requires additional energy expenditure (~ 500 kcal / 2092 kJ per day) (Hale & Hartmann, 2017). Therefore, nutritional recommendations at the national and European level advise women during lactation to increase their energy intake by 500 kcal / 2092 kJ, accordingly (European Food Safety Authority, 2019a; Nordic Council of Ministers, 2014; Veselības ministrija, 2017a). According to the national recommendations, lactating women in Latvia, depending on age, should on average consume 2220 kcal to 3110 kcal / 9205 kJ to 12970 kJ per day (Veselības ministrija, 2017a), and the majority of the energy should be consumed by carbohydrates, followed by fats and proteins (Table 3.10.) (Nordic Council of Ministers, 2014; Veselības ministrija, 2017a).

According to the calculations from 72-hour food diaries, median **energy intake** among the participants in this study was lower than recommended – around 2000 kcal / 8368 kJ (Annex XIV). The median percentage of energy intake from carbohydrates among the participants of this study was lower, energy intake from fats higher, but energy intake from protein – within recommendations (Table 3.10.).

Table 3.10. / *3.10. tabula*

The median percentage of energy intake from macronutrients among the participants / *Mediānais makrouzturvielu uzņemšanas daudzums pētījuma dalībniecēm* (n=139)*

Nutrient / *Uzturviela*	**Median (IQR) / *Mediāna (SKI)***	**Range / *Diapazons***	**Guidelines for recommended daily energy intake during lactation / *Vadlīnijas par dienā ieteicamo enerģijas daudzumu zīdīšanas periodā* (E %)**
Carbohydrates / *Ogļhidrāti*	39.33 E % (10.19 E %)	11.90–56.62 E %	45–60 E % (Nordic Council of Ministers, 2014; Veselības ministrija, 2017a)
Sugars / *Cukuri*	18.74 E % (7.83 E %)	0.93–41.44 E %	≤10 E % (free sugars / "*brīvie" cukuri*) (Nordic Council of Ministers, 2014; Veselības ministrija, 2017a)
Protein / *Olbaltumvielas*	15.41 E % (5.48 E %)	8.01–43.08 E %	10–20 E % (Nordic Council of Ministers, 2014; Veselības ministrija, 2017a)
Fat / *Tauki*	41.63 E % (10.05 E %)	23.47–57.34 E %	25–30 E % (Veselības ministrija, 2017a) 25–40 E % (Nordic Council of Ministers, 2014)

* two out of 141 participants did not submit the 72-hour food diary / *divas no 141 pētījuma dalībniecēm neiesniedza 72 stundu uztura dienasgrāmatu.*

Like our elaborated results, other studies from Europe (Hegheș et al., 2018; Krešić et al., 2012; Hébel et al., 2018) report that women during lactation consume less energy, than recommended. However, Hanson et al. (2015) suggest that not all women during breastfeeding should increase their energy intake. Only women who are underweight or with low gestational weight gain should increase their energy intake during the lactation period by 500 kcal (2092 kJ) per day. On the contrary, women who are overweight or obese do not need additional energy intake during breastfeeding and can actually decrease the intake of energy by 500 kcal (2092 kJ) per day to lose weight without affecting milk production.

Although energy intake among the participants of this study was similar to data reported from Greece, Croatia, and United States (Table 3.11.), energy intake from carbohydrates among the participants from this study was the lowest, but energy intake from fat – the highest reported of the values, compared to data from other countries (Table 3.11).

Table 3.11. / *3.11. tabula*

Comparison of energy and macronutrients intake among lactating women in different countries / *Enerģijas un uzturvielu nodrošinājuma salīdzinājums sievietēm zīdīšanas periodā dažādās valstīs*

Daily intake / *Dienā uzņemtais daudzums*	**Latvia (this study) / *Latvija* (*šis pētījums*) (n=139)**	**Greece / *Grieķija* (Antonakou et al., 2013) (n=127)**	**France / *Francija* (Hébel et al., 2018) (n=250)**	**Poland / *Polija* (Bzikowska-Jura et al., 2018) (n=77)**	**Croatia / *Horvātija* (Krešić et al., 2013) (n=83)**	**Romania / *Rumānija* (Hegheș et al., 2018) (n=33)**	**Italy / *Itālija* (Giammarioli et al., 2002) (n=125)**	**The United States / *Amerikas Savienotās valstis* (Pratt, Durham & Sherry, 2014) (n=88)**
Energy / *Enerģija* (kcal / kJ)	2004 / 8385	2000 / 8368	1669 / 6983	1754 / 7339	2113 / 8841	1825 / 7636	2365 / 9886	1934 / 8092
Carbohydrates / *Ogļhidrāti* (E %)	39.33	44.70	47.80	51.20	50.60	47.13	52.00	49.00
Sugars / *Cukuri* (E %)	18.74	NI / *NI*	18.60	11.10	NI / *NI*	NI / *NI*	NI / *NI*	20.14
Fibre / *Šķiedrvielas* (g)	22.18	16.20	15.80	21.30	NI / *NI*	15.92	20.00	17.30
Protein / *Olbaltumvielas* (E %)	15.41	16.20	16.00	16.90	13.30	15.80	15.70	16.40
Fat / *Tauki* (E %)	41.63	38.50	35.70	31.00	36.00	37.80	31.80	34.40

Overall, a higher total energy intake among study participants was associated with fruits & berries (ρ=0.182, *p*=0.039), plant-based fat (ρ=0.199, *p*=0.024), sweets & bakery goods (ρ=0.229, *p*=0.009) intake. Plant-based fats, sweets & bakery goods are a rich source of fat, and this could explain why median energy intake from fat among the participants was higher than recommended (Table 3.10.). Low starchy food intake could explain why the median percentage of energy intake from carbohydrates among the participants was lower than recommended. Although a significant correlation between starchy food consumption and carbohydrate intake was not found (ρ=-0.001, *p*=0.993).

Median total **protein** intake among the participants positively correlated with habitual intake of eggs, meat & processed meat, fish & seafood, and milk & dairy products (ρ=0.281, *p*=0.001, ρ=0.279, *p*=0.001 and ρ=0.333, *p*<0.0005). These product groups naturally are a good source of protein in the diet (Nordic Council of Ministers, 2014).

Total **carbohydrates** intake weakly correlated with habitual fruit& berry consumption among the participants (ρ=0.258, *p*=0.003). It could be explained by the fact that dominant macronutrients found in fruit and berries are carbohydrates, mostly sugars (National Institute for Health and Welfare of Finland, 2019; Nordic Council of Ministers, 2014).

Sugar intake among the participants was high and provided approximately one-fifth of the total energy intake (Table 3.10.). If compared, then significantly higher sugar intake was noted among the first study period (Annex XIV). Overall, a higher sugar intake was noted among the study participants with a higher fruit & berries intake (ρ=0.257, *p*=0.003) which are a natural source of sugars in the diet (Nordic Council of Ministers, 2014).

Higher intake of **fructose**, **glucose,** and **sucrose** was noted among the participants from the first study period, but the intake of galactose, lactose, and maltose did not significantly differ among both study periods (Annex XIV). Overall, a higher fructose and glucose intake was noted among the participants who consumed more vegetables, fruits & berries, and plant-based fats (Annex XV). Above mentioned products, especially fruits and berries are a natural source of simple sugars in the diet (Nordic Council of Ministers, 2014). A higher intake of sucrose was noted among the participants who consumed more sweets & baked goods (Annex XV). A high amount of table sugar (also known as sucrose) is usually added to these products which explains the prior mentioned association (Nordic Council of Ministers, 2014).

Lactose is the main disaccharide found in milk; therefore, it is only evident that a more frequent milk and dairy product consumption was associated with a higher intake of lactose ($\rho=0.654$, $p<0.0005$). Also, a **galactose** (a moiety of the disaccharide lactose) intake was higher among the participants who more frequently consumed milk and dairy products ($\rho=0.436$, $p<0.0005$). Frequent caffeine-containing drink intake was also associated with a higher intake of galactose ($\rho=0.203$, $p=0.021$), probably explained by the fact that most participants were drinking coffee, cappuccino, latte, etc. drinks with added cow's milk.

Starch is the main complex carbohydrate that provides energy. Although cereals, cereal products, and potatoes are the dominant dietary source of starch (Nordic Council of Ministers, 2014), the results from partial correlation analysis revealed that higher intake of starch was among participants with higher habitual consumption of fruit & berries ($\rho=0.174$, $p=0.049$).

Lactating women on average should consume 25 to 35 g of **fibre** per day (Nordic Council of Ministers, 2014). Although median fibre intake (~ 22 g per day) among the participants of this study was slightly lower than recommended, it was the highest reported value compared to data from other countries (Table 3.11.). Plant-based products are the best source of fibre in the diet (Nordic Council of Ministers, 2014). Therefore, it is only self-evident that fibre intake among the participants positively correlated with pulses ($\rho=0.278$, $p=0.001$), vegetable ($\rho=0.313$, $p<0.0005$), fruit & berries ($\rho=0.317$, $p<0.0005$) and plant-based fat (food group that includes nuts, seeds, avocado) ($\rho=0.436$, $p<0.0005$) consumption. On the opposite, participants who reported more frequent consumption of animal-based products, were consuming less fibre (Annex XV).

Total energy intake from **fat** among the participants was higher than recommended (Table 3.10.). Participants who according to the data from FFQ consumed more frequently milk & dairy products ($\rho=0.199$, $p=0.024$), sweets & bakery goods ($\rho=0.279$, $p=0.001$) and salty snacks & fast food ($\rho=0.191$, $p=0.030$) were consuming more fat. Prior mentioned food products can contain a high amount of fat (Nordic Council of Ministers, 2014).

According to the data from the 72-hour food diary, participants of this study consumed more **saturated fatty acids** than recommended (Table 3.12.). Dietary sources of saturated fatty acids are animal products like eggs, meat, milk & dairy products, but plant-based products do not contain saturated fatty acids, except for coconut butter & oil, palm oil, and cocoa butter (National Institute for Health and Welfare of Finland, 2019). Also, a higher intake of saturated fatty acids was reported among the participants with a higher intake of animal-based food products and sweets & baked goods (may contain palm oil), but participants with a higher intake of plant-based products were consuming less of saturated fatty acids (Annex XV).

If compared to data from other countries, saturated fatty acid intake among lactating women in this study was similar to values reported from Croatia and Greece (Table 3.13.).

Table 3.12. / *3.12. tabula*

The median percentage of energy intake from fatty acids among the participants /
***Mediānais taukskābju uzņemšanas daudzums pētījuma dalībniecēm* (n=139)**

Fatty acids / *Taukskābes*	**Median (IQR) / *Mediāna (SKI)***	**Range / *Diapazons***	**Guidelines for the intake of fatty acids intake during lactation period / *Vadlīnijas par taukskābju uzņemšanu zīdīšanas periodā* (E %)**
SFA / *PT*	14.12 E % (6.18 E %)	4.69–25.17 E %	≤10 E % (Nordic Council of Ministers, 2014; Veselības ministrija, 2017a)
MUFA / *MNT*	14.78 E % (5.13 E %)	5.66–27.79 E %	10–20 E % (Nordic Council of Ministers, 2014)
PUFA / *PNT*	6.90 E % (3.81 E %)	2.59–19.01 E %	5–10 E % (Nordic Council of Ministers, 2014)
n-3 PUFA / *n-3 PNT*	1.10 E % (0.98 E %)	0.11–6.49 E %	At least / *Vismaz* 1 E % (Nordic Council of Ministers, 2014)
LA / *LS*	5.24 E % (3.12 E %)	1.81–17.46 E %	≤4 E % (European Food Safety Authority, 2019a)
ALA / *ALS*	0.99 E % (0.71 E %)	0.27–6.62 E %	At least / *Vismaz* 0.5 E % (European Food Safety Authority, 2019a)
LA + ALA/ *LS + ALS*	6.44 E % (3.81 E %)	2.01–18.77 E %	At least / *Vismaz* 5 E % (Nordic Council of Ministers, 2014)

Table 3.13. / *3.13. tabula*

Comparison of fatty acids intake among lactating women in different countries /
Taukskābju uzņemšanas daudzuma salīdzinājums sievietēm zīdīšanas periodā dažādās valstīs

Daily intake of fatty acids (g) / *Dienā uzņemtais taukskābju daudzums (g)*	**Latvia (this study) / *Latvija (šis pētījums)* (n=139)**	**Greece / *Grieķija* (Antonakou et al., 2013) (n=127)**	**France / *Francija* (Hébel et al., 2018) (n=250)**	**Poland / *Polija* (Bzikowska-Jura et al., 2018) (n=77)**	**Croatia / *Horvātija* (Krešić et al., 2013) (n=83)**	**Romania / *Rumānija* (Hegheș et al., 2018) (n=33)**	**United States / *Amerikas Savienotās valstis* (Pratt, Durham & Sherry, 2014) (n=88)**
SFA / *PT*	30.56	29.80	27.50	22.30	30.29	26.60	26.20
MUFA / *MNT*	32.85	35.55	21.00	23.40	29.98	23.08	24.80
LA / *LS*	11.89	NI / *NI*	4.80	NI / *NI*	12.42	NI / *NI*	11.94
ALA / *ALS*	2.27	NI / *NI*	0.06	NI / *NI*	1.10	NI / *NI*	1.21
LA/ALA ratio / *LS/ALS attiecība*	4.53	NI / *NI*	80.00	NI / *NI*	11.29	NI / *NI*	9.87

Table 3.13. continued / *3.13. tabulas turpinājums*

Daily intake of fatty acids (g) / ***Dienā uzņemtais taukskābju daudzums (g)***	**Latvia (this study) / *Latvija (šis pētījums)* (n=139)**	**Greece / *Grieķija* (Antonakou et al., 2013) (n=127)**	**France / *Francija* (Hébel et al., 2018) (n=250)**	**Poland / *Polija* (Bzikowska-Jura et al., 2018) (n=77)**	**Croatia / *Horvātija* (Krešić et al., 2013) (n=83)**	**Romania / *Rumānija* (Hegheș et al., 2018) (n=33)**	**United States / *Amerikas Savienotās valstis* (Pratt, Durham & Sherry, 2014) (n=88)**
PUFA / *PNT*	14.86	12.44	7.60	11.30	14.45	11.92	14.10
n-3 PUFA / *n-3 PNT*	2.40	NI / *NI*	NI / *NI*	NI / *NI*	1.15	1.32	1.33
n-6 PUFA / *n-6 PNT*	11.95	NI / *NI*	NI / *NI*	NI / *NI*	12.52	9.66	12.10
n-6/n-3 PUFA ratio / *n-6/n-3 PNT attiecība*	4.59	NI / *NI*	NI / *NI*	NI / *NI*	10.89	7.30	9.10

The intake of **monounsaturated fatty acids** is associated with a reduced risk for cardiovascular mortality, especially if saturated fatty acid intake is replaced by monounsaturated fatty acid intake (Schwingshackl & Hoffmann, 2014). Oleic acid is usually the most consumed monounsaturated fatty acid, with olive oil as the dominant source of oleic acid in the diet (Schwingshackl & Hoffmann, 2014). Only Nordic Nutrition Recommendations provide dietary guidelines about monounsaturated fatty acid intake and recommend that 10 % to 20 % of daily energy intake should be provided by monounsaturated fatty acids (Nordic Council of Ministers, 2014). Monounsaturated fatty acid intake among the participants of this study was within guidelines and compiled ~ 15 % of daily energy intake (Table 3.12.). If compared to data from other countries, monounsaturated fatty acids intake among lactating women in this study was similar to values reported from Croatia and Greece – Mediterranean countries, where also the habitual intake of olive oil is high (Table 3.13.).

A higher monounsaturated fatty acid intake was noted among the participants with a higher intake of plant-based fats (ρ=0.214, p=0.015). The obtained association could be explained by the fact that olive oil – a rich source of monounsaturated fatty acids – was the most commonly consumed oil among the participants according to the data from FFQ.

Monounsaturated fatty acid intake was also associated with habitual intake of salty snacks & fast food (ρ=0.204, p=0.021). This association should be further evaluated, because usually these food products mainly contain saturated fatty acids, but not monounsaturated fatty acids (Schwingshackl & Hoffmann, 2014).

The human body cannot synthesize **linoleic acid** and **α-linolenic acid**, therefore both essential fatty acids must be consumed via food (Nordic Council of Ministers, 2014). The intake of polyunsaturated fatty acids should be 5 % to 10 % of total energy intake, of which at least 1 % should be provided by n-3 polyunsaturated fatty acids (Nordic Council of Ministers, 2014), but linoleic acid intake should not exceed 4 % of daily energy intake (European Food Safety Authority, 2019a). The combined intake of linoleic acid and α-linolenic acid should reach at least 5 % of total energy intake (Nordic Council of Ministers, 2014).

Total **polyunsaturated fatty acid** and **n-3 polyunsaturated fatty acid** intake among the study participants was within guidelines (~ 7 % of daily energy intake consumed via polyunsaturated fatty acids and ~ 1 % of daily energy intake consumed by n-3 polyunsaturated fatty acids), but combined intake of linoleic acid and α-linolenic acid was above recommended 5 % of total daily energy intake (Table 3.12.). Compared to other countries, we report the highest daily n-3 polyunsaturated fatty acid intake among lactating women (Table 3.13.).

Plant oils, avocado, nuts, and seeds are naturally a good source of unsaturated fatty acids (Nordic Council of Ministers, 2014). Therefore, it is only self-evident, that a higher total polyunsaturated fatty acid and n-3 polyunsaturated fatty acid intake among study participants was associated with habitual intake of plant-based fats (ρ=0.287, p=0.001 and ρ=0.242, p=0.006, respectively).

Linoleic acid intake among the study participants was higher than recommended (~ 5 % of daily energy intake in contrary to recommended 4 % of daily energy intake, and in comparison, linoleic acid intake among study participants was twice times higher than among lactating women from France (Hébel et al., 2018) (Tables 3.12. and 3.13.).

α-linolenic acid intake among lactating women was significantly higher compared to data reported from France (Hébel et al., 2018) (Table 3.13.), and overall was above 0.5 % of total daily energy intake (Table 3.12.).

Both linoleic acid and α-linolenic acid intake was higher among the participants with a higher intake of plant-based fats (ρ=0.262, p=0.003 and ρ=0.303, p=0.001, respectively), which are naturally a dominant source of both n-6 and n-3 polyunsaturated fatty acids (Nordic Council of Ministers, 2014).

The dietary overabundance of **n-6 polyunsaturated fatty acids** over **n-3 polyunsaturated fatty acids** contributes to the higher risk of cardiovascular diseases, cancer, rheumatoid arthritis, etc. (Simopoulos, 2002). Although, no reference values are currently set for n-6 / n-3 polyunsaturated fatty acid ratio, proportion 5 / 1 to 10 / 1 is preferable for adults in reducing the risk of the above-mentioned diseases (Institute of Medicine of the National Academies, 2005; Simopoulos, 2002). Median **ratios of linoleic acid / α-linolenic acid and n-6 / n-3 polyunsaturated fatty acid** intake among the participants of this study were approximately five, and it was twice times lower than ratios reported from Croatia and United States (Table 3.13.).

Dietary guidelines of the European Food Safety Authority suggest that women during reproductive age should consume at least 250 mg of **eicosapentaenoic acid** plus **docosahexaenoic acid** per day (European Food Safety Authority, 2019a). During lactation, an additional 100 to 200 mg of docosahexaenoic acid per day should be consumed (European Food Safety Authority, 2019a).

Median **eicosapentaenoic acid** and **docosahexaenoic acid intake** (19 mg and 100 mg per day, respectively) among the participants was significantly lower than recommended (Table 3.14.). Low maternal intakes of eicosapentaenoic acid and docosahexaenoic acid have been also reported from United States (30 mg per day for eicosapentaenoic acid and 60 mg per day for docosahexaenoic acid) (Pratt, Durham & Sherry, 2014), France (70 mg per day for docosahexaenoic acid) and Croatia (20 mg per day for eicosapentaenoic acid and 120 mg per day for docosahexaenoic acid) (Hébel et al., 2018; Krešić et al., 2013; Pratt, Durham & Sherry, 2014).

Fish and seafood are a good source of eicosapentaenoic acid and docosahexaenoic acid (National Institute for Health and Welfare of Finland, 2019). Therefore, it is only self-evident that habitual fish & seafood intake was associated with a higher intake of eicosapentaenoic acid and docosahexaenoic acid intake among study participants (ρ=0.236, p=0.007 for eicosapentaenoic acid and ρ=0.224, p=0.011 for docosahexaenoic acid).

Table 3.14. / *3.14. tabula*

Median intake of eicosapentaenoic acid and docosahexaenoic acid among the participants / *Mediānais eikozapentaēnskābes un dokozaheksaēnskābes uzņemšanas daudzums pētījuma dalībniecēm* (n=139)

Fatty acids / ***Taukskābes***	**Median (IQR) /** ***Mediāna (SKI)***	**Range /** ***Diapazons***	**Guidelines for EPA and DHA intake during lactation /** ***Vadlīnijas EPS un DHS uzņemšanai zīdīšanas periodā***
EPA / ***EPS***	18.82 mg (96.17 mg)	0.00–1962.00 mg	No guidelines regarding daily intake of EPA / *Nav vadlīniju par ieteicamo EPS dienas devu*
DHA / ***DHS***	99.72 mg (217.97 mg)	0.00–4260.84 mg	200 mg per day / *200 mg dienā* (Nordic Council of Ministers, 2014)
EPA+DHA / ***EPS + DHS***	131.27 mg (308.02 mg)	0.00–6450.29 mg	250 mg of EPA + DHA plus additionally 100 to 200 mg of DHA per day / *250 mg EPS + DHS plus papildus 100 līdz 200 mg DHS dienā* (European Food Safety Authority, 2019a)

trans **fatty acids** are a specific type of unsaturated fatty acids with at least one non-conjugated carbon-carbon double bond in the *trans* configuration. The dominant dietary sources of *trans* fatty acids are fried, grilled foodstuff or industrially produced products containing partially hydrogenated plant oils (Nordic Council of Ministers, 2014).

Intake of industrially produced *trans* fatty acids has been associated with higher low-density cholesterol level and a higher risk for the development of cardiovascular diseases. Therefore, *trans* fatty acid intake from industrially produced products should be as low as possible (European Food Safety Authority, 2010b; Nordic Council of Ministers, 2014).

On the 20th of May 2016, the Cabinet Regulation of the Republic of Latvia No. 301 setting regulations regarding the maximum permitted amount of *trans* fatty acids in food products entered in force (Ministru kabineta noteikumi Nr. 301, 2016). This regulation sets maximum levels of *trans* fatty acid and applies to both domestic and imported food products containing industrially produced *trans* fatty acids. Therefore, manufacturers had to modify their products to comply with the permitted norms set in the Regulation. The maximum permitted amount of *trans* fatty acids according to Cabinet Regulation No. 301 (2016) may not exceed:

- 2 g per 100 g of the total amount of fats;
- 10 g per 100 g of the total amount of fats (if a product contains less than 3 % of total fat);
- 4 g per 100 g of the total amount of fats (if a product contains 3 % to 20 % of total fat) (Ministru kabineta noteikumi Nr. 301, 2016).

trans fatty acids can also be naturally found in foodstuff derived from ruminant animals (meat, milk & dairy products), and these *trans* fatty acids are not associated with the higher risk of cardiovascular diseases (European Food Safety Authority, 2010b).

Overall, *trans* fatty acid intake in industrialized countries varies from 2 to 8 g per day (Larqué, Zamora & Gil, 2001) with a higher *trans* fatty acid intake observed in the United States, but lower in Europe, especially Mediterranean countries (Craig-Schmidt, 2006). Calculated median *trans* fatty acids intake among the participants (0.55 g per day) was lower than data reported from Romania (0.95 g per day) and Croatia (1.72 g per day) (Hegheș et al., 2018; Krešić et al., 2013).

Median dietary intake of *trans* fatty acids among the participants positively correlated with habitual intake of milk & dairy products (ρ=0.421, p<0.0005) and sweets & baked goods (ρ=0.312, p<0.0005). This is similar to dietary patterns among the lactating women from Germany where milk and dairy products were also the major source of *trans* fatty acids (Precht & Molkentin, 1999) in the diet of lactating women, while major dietary sources of *trans* fatty acids for lactating women in Poland, Croatia, Germany, and Turkey were sweets, snacks, baked goods and fried food (Krešić et al., 2013; Mojska et al., 2003; Precht & Molkentin, 1999).

On the opposite, participants with a higher pulse and vegetable intake overall had a lower median *trans* fatty acid intake (Annex XV).

Unfortunately, due to a lack of information regarding the fatty acids composition of different foodstuff, we were not able to use the national food composition database of Latvia. Instead, we used the Finish Food Composition database Fineli (National Institute for Health and Welfare of Finland, 2019) to calculate median *trans* fatty acids intake. Therefore, actual *trans* fatty acid intake from industrially produced products among this study participants could differ.

Also, data from Finish Food Composition database Fineli (National Institute for Health and Welfare of Finland, 2019) do not distinguish industrially produced *trans* fatty acids from naturally produced *trans* fatty acids, and only total daily *trans* fatty acid intake among the study participants was calculated. Nevertheless, considering current legislative norms in Latvia (Ministru kabineta noteikumi Nr. 301, 2016), actual *trans* fatty acids intake among lactating women in Latvia are probably low and should not raise health concerns.

Lipid **cholesterol** is found in animal-based food products (meat, eggs, milk & dairy products), but can also be synthesized in the human body. Cholesterol is used to produce bile acids, and it is a compound of cell membranes (Nordic Council of Ministers, 2014). High intake of cholesterol can potentially increase the risk of cardiovascular diseases; therefore, it is recommended to consume less than 300 mg of cholesterol per day (Reiner et al., 2011).

The median intake of cholesterol among study participants was around 273 mg per day, and this is lower than reported cholesterol intake among lactating women in Italy – 362 mg per day (Giammarioli et al., 2002). Participants from this study who were consuming more animal-based products, were accordingly consuming more cholesterol, but lower cholesterol intake was noted among the participants with a higher plant-based food product intake (Annex XV).

Few participants noted the use of **alcohol** during the study period – mainly red wine (n=3), white wine (n=2), or beer (n=2). For four participants the small amount of alcohol was consumed via dessert – tiramisu. Nevertheless, the total median alcohol intake among above-mentioned participants did not exceed the upper limit of daily alcohol intake – 10 g per day.

It seems that maternal intake of **essential elements** does not directly affect essential element content in human milk (except for iodine and selenium) (Keikha et al., 2017). However, nutrients, including essential element intake, during lactation should be increased to compensate for nutrient losses via human milk. Median daily essential element intake among the participants, calculated from the 72-hour food diary in comparison to dietary guidelines (guidelines can be found in Annex III), is reported in Fig. 3.1.

Calcium intake during lactation should be increased and reach 900 mg per day (Veselības ministrija, 2017a). Milk and dairy products are a good source of calcium (Nordic Council of Ministers, 2014). Also, in this study, a significantly higher calcium intake was observed among the participants who consumed milk & dairy products more frequently (ρ=0.520, p<0.0005). Nevertheless, only for ~ 42 % of the participants median daily calcium intake reached the recommended 900 mg per day (Fig. 3.1.). Similar, researchers from France, Poland, Croatia, and United States (Table 3.15.) report low calcium intake among lactating women, and this raises concern.

Overall, 27 participants were using dietary supplements containing calcium, and for them, calcium intake was significantly higher and reached sufficient daily intake (1064.92 mg of calcium per day) compared to participants who consumed calcium only via food (median = 791.38 mg of calcium per day, p<0.0005).

For ten participants median calcium intake was below the defined lower intake level of calcium (400 mg per day). A prolonged low intake of calcium can affect bone health

(Nordic Council of Ministers, 2014). For two participants who were using dietary supplements, the median daily intake of calcium exceeded the tolerable upper intake level (2500 mg per day). Frequent high calcium intake can impair kidney function and lead to kidney stones (European Food Safety Authority, 2012).

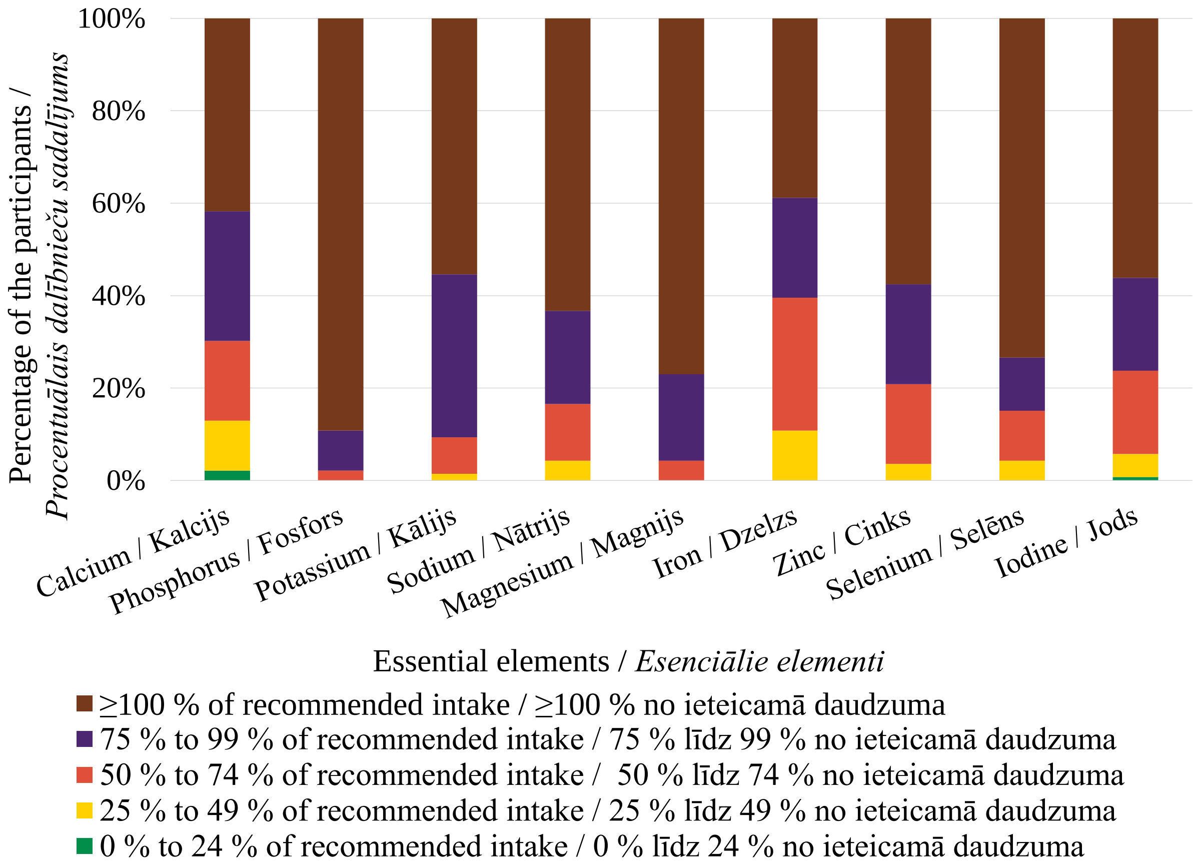

Fig. 3.1. **Median daily essential element intake among the participants in comparison to dietary guidelines /** *3.1. att.* ***Dienā uzņemtais esenciālo elementu daudzums pētījuma dalībniecēm, salīdzinot ar uztura vadlīnijām*** (n=139)

Table 3.15. / *3.15. tabula*

Comparison of essential elements intake among lactating women from different countries / ***Esenciālo elementu uzņemšanas daudzuma salīdzinājums sievietēm zīdīšanas periodā dažādās valstīs***

Daily intake of essential elements / ***Dienā uzņemtais esenciālo elementu daudzums***	**Latvia (this study) /** ***Latvija (šis pētījums)*** **(n=139)**	**France /** ***Francija*** **(Hébel et al., 2018) (n=250)**	**Poland /** ***Polija*** **(Bzikowska-Jura et al., 2018) (n=77)**	**Croatia /** ***Horvātija*** **(Krešić et al., 2012) (n=83)**	**The United States /** ***Amerikas Savienotās valstis*** **(Pratt, Durham & Sherry, 2014) (n=88)**
Calcium / ***Kalcijs*** **(mg)**	814.08	808.80	613.30–745.90	860.79–1093.79	888.00
Phosphorus / ***Fosfors*** **(mg)**	1400.31	1016.90	1146.50–1326.70	1293.68–1594.11	1234.30
Potassium / ***Kālijs*** **(mg)**	3297.94	NI / *NI*	2953.80–3132.60	NI / *NI*	2345.50

Table 3.15. continued / *3.15. tabulas turpinājums*

Daily intake of essential elements / *Dienā uzņemtais esenciālo elementu daudzums*	**Latvia (this study) / *Latvija (šis pētījums)* (n=139)**	**France / *Francija* (Hébel et al., 2018) (n=250)**	**Poland / *Polija* (Bzikowska-Jura et al., 2018) (n=77)**	**Croatia / *Horvātija* (Krešić et al., 2012) (n=83)**	**The United States / *Amerikas Savienotās valstis* (Pratt, Durham & Sherry, 2014) (n=88)**
Sodium / *Nātrijs* (mg)	2392.09	2407.90	2314.20–2612.40	NI / *NI*	3045.00
Magnesium / *Magnijs* (mg)	364.28	NI / *NI*	315.50–351.70	217.94–260.29	253.70
Iron / *Dzelzs* (mg)	12.75	10.20	12.20–12.80	10.92–13.24	14.70
Zinc / *Cinks* (mg)	11.36	8.00	8.60–10.50	4.73–5.80	10.20
Selenium / *Selēns* (µg)	80.95	NI / *NI*	NI / *NI*	79.11–87.78	97.50
Iodine / *Jods* (µg)	167.72	106.30	88.70–106.00	NI / *NI*	62.00

Although it seems that **phosphorus** level in human milk is not affected by the direct maternal intake of phosphorus, women during lactation are advised to increase the intake of phosphorus up to 900 mg per day (Veselības ministrija, 2017a). Phosphorus is found in both animal-based (milk and dairy products, meat & meat products) and plant-based foodstuff (cereals, pulses, etc.) (Nordic Council of Ministers, 2014). Also, in this study, a higher intake of phosphorus was noted among the participants with a higher intake of milk & dairy products (ρ=0.346, p<0.0005) and plant-based fats (ρ=0.241, p=0.006). Overall, for most participants (~ 89 %) daily intake of phosphorus reached the recommended 900 mg per day (Fig. 3.1.), and, compared to other countries, we report the highest phosphorus intake among lactating women (Table 3.15.). For one participant the median phosphorus intake exceeded the upper intake level of 3000 mg per day. Excessive phosphorus intake can lead to kidney damage and calcification of blood vessels (Nordic Council of Ministers, 2014).

Potassium can be easily taken up with vegetables, fruits, berries, nuts, and seeds (Nordic Council of Ministers, 2014). Also, potassium intake among the participants positively correlated with vegetable, fruit & berries, plant-based fat intake (ρ=0.325, p<0.0005, ρ=0.245, p=0.005 and ρ=0.388, p<0.0005, respectively). Although, compared to Poland and the United States (Table 3.15.), lactating women in Latvia consume more potassium, just over half of the participants in this study (~ 55 %) had a potassium intake of 3100 mg per day (Fig. 3.1.). For two participants the median daily intake of potassium did not even reach the lower intake level (1600 mg per day). Insufficient potassium intake could potentially lead to sodium retention in the body and increased blood pressure (Nordic Council of Ministers, 2014).

Sodium intake should be limited to 2000 mg per day (or maximum of 5000 mg as **salt**) (European Food Safety Authority, 2019a; Veselības ministrija, 2017a), because high sodium intake is associated with higher blood pressure and water retention in the body (Veselības ministrija, 2017b). Studies show that the dominant source of sodium in the diet among the adult Latvian population is processed foodstuff (Lazda, Goldmanis & Siksna, 2018).

Unfortunately, sodium intake among the majority of the participants (~ 63 %) was higher than recommended (Fig. 3.1.), and it was associated with the habitual intake of eggs, meat & meat products (ρ=0.306, $p<0.0005$) and milk & dairy product intake (ρ=0.196, $p=0.026$). It was probably since meat products like sausages, ham etc. and dairy products like cheese usually contain a high amount of salt (more than 1 g of salt per 100 g of the product) (National Institute for Health and Welfare of Finland, 2019). Similar sodium intake values among lactating women have been reported also from France and Poland, but lactating women in the United States consume 1.3 times more sodium compared to results from this study (Table 3.15.).

During lactation, **magnesium** is mobilised from maternal bones and transferred to the mammary glands. Therefore, the current maternal intake of magnesium does not directly influence magnesium content in human milk (Dror & Allen, 2018). Also, according to the guidelines, there is no need to increase magnesium intake during lactation and it should be kept at 280 mg per day (Veselības ministrija, 2017a). Nuts, dark chocolate, green leafy vegetables, pulses, and cereals provide magnesium in the diet (Nordic Council of Ministers, 2014).

Approximately for 77 % of the participants, the median daily intake of magnesium reached at least 280 mg (Fig. 3.1.), and we reported the highest daily magnesium intake among the countries (Table 3.15.). Participants with a higher habitual intake of plant-based products overall had a higher intake of magnesium, but a lower magnesium intake was noted among the participants with a higher animal-based product intake (Annex XV).

According to the national guidelines (Veselības ministrija, 2017a), **iron** intake during lactation should reach 15 mg per day. Unfortunately, according to the data from the 72-hour food diary, only for approximately 39 % of the participants the median daily iron intake reached at least 15 mg (Fig. 3.1.). Insufficient iron intake among lactating women has also been reported from Croatia, France, and Poland (Table 3.15.).

Iron from meat and meat products are better absorbed compared to plant-based food products (Nordic Council of Ministers, 2014). Interestingly, that a higher iron intake was among the participants who consumed more of plant-based products (Annex XV), but less of animal-based food products like meat (ρ=-0.285, $p=0.001$). Many participants during the study period were using dietary supplements containing iron (n=32) and for them, iron intake reached the recommended daily intake and was significantly higher (24.20 mg of iron per day) compared to participants who were consuming iron only via food (11.40 mg per day, $p<0.0005$).

For five participants median daily iron intake exceeded the upper intake level (60 mg per day). Excessive intake of iron can cause gastrointestinal discomfort to a woman – nausea, abdominal pain, and diarrhea (Nordic Council of Ministers, 2014).

Nutritional requirements for **zinc** during lactation are significantly increased (up to 11 mg per day) (Veselības ministrija, 2017a). According to the data from this study, for 58 % participants median daily zinc intake reached the recommended 11 mg per day (Fig. 3.1.). Although zinc is widely found in both animal and plant-based products (Nordic Council of Ministers, 2014), it seems that low zinc intake during breastfeeding is a common problem, because significantly lower intake of zinc among lactating women is also reported by other researchers (Table 3.15.). A higher zinc intake was noticed among the participants with a higher plant-based fat (like seeds, nuts etc.) intake (ρ=0.208, $p=0.019$).

For five participants the median daily intake of zinc exceeded the upper tolerable level – 25 mg per day. Prolonged elevated zinc intake can impair copper absorption (European Food Safety Authority, 2014b).

Selenium is also one of few nutrients whose content in human milk is directly affected by maternal diet (Zachara & Pilecki, 2000). To compensate for selenium loss via human milk, lactating women are encouraged to increase their daily selenium intake by an additional 10 µg (in total intake should reach 60 µg per day). Animal food sources like fish, meat, eggs, and milk are a better source of selenium than plant-based products (pulses, mushrooms etc.) (Nordic Council of Ministers, 2014). Adequate selenium intake was reached among 73 % of the participants (Fig. 3.1.), and higher selenium intake was among the participants with a higher habitual intake of eggs, meat & processed meat (ρ=0.174, $p=0.050$) and milk & dairy product intake (ρ=0.298, *p*=0.001), but lower intake was observed among the participants with higher consumption of starchy food products (ρ=-0.200, *p*=0.023). Overall, we report low selenium intake for lactating women, if compared to data from Croatia and United States (Table 3.15.).

For one participant median selenium intake did not reach the lower intake level (20 µg per day), but for three participants median selenium intake exceeded the upper tolerable level (300 µg per day). Prolonged low selenium intake can impair the function of the immune system, but prolonged excessive selenium intake can cause nail, hair deformities, nerve, and liver damage (Nordic Council of Ministers, 2014).

Iodine is vital for an infant's physical and mental development and exclusively breastfed infants solely depend on iodine supply via human milk. Iodine is one of the few nutrients in human milk that is directly affected by maternal diet (Keikha et al., 2017). Studies show that approximately 40 % to 45 % of iodine from the maternal diet is transferred to human milk (Laurberg & Andersen, 2014). As iodine content in human milk is affected by the maternal intake of iodine (Henjum et al., 2017; Petersen et al., 2020), women should pay special attention to sufficient iodine intake during lactation and consume 150 µg to 250 µg of iodine per day (Veselības ministrija, 2017a).

According to the evaluation of the 72-hour food diary, for most of the participants (56 %), median daily intake of iodine reached the minimum recommended daily intake of iodine – 150 µg per day (Fig. 3.1.). Fish & seafood, milk & dairy products, and iodised salt are the main iodine source in the diet (Nordic Council of Ministers, 2014), and overall, a higher intake of iodine in this study was noted among the participants with a higher intake of fish & seafood (ρ=0.190, *p*=0.032) and milk & dairy products (ρ=0.400, *p*<0.0005).

Unfortunately, we did not collect data on whether participants used iodised salt, but, overall, its consumption among the Latvian population is low – only in approximately 4 % of households in Latvia an iodised salt is used (Veselības ministrija, 2020). Nevertheless, compared to other countries, we report the highest iodine intake among lactating women (Table 3.15.). Also, it should be noted that for eight participants' median daily iodine intake did not even reach the lower intake level (70 µg per day). Low iodine intake can impair the production of thyroid hormones and therefore affect metabolism (Nordic Council of Ministers, 2014).

Vitamin content in human milk can be affected by maternal diet, therefore women during lactation should pay special attention to adequate vitamin intake (Bravi et al., 2016). Median **vitamin** intake among the study participants, calculated from the 72-hour food diary in comparison to dietary guidelines (guidelines can be found in Annex III), is reported in Fig. 3.2.

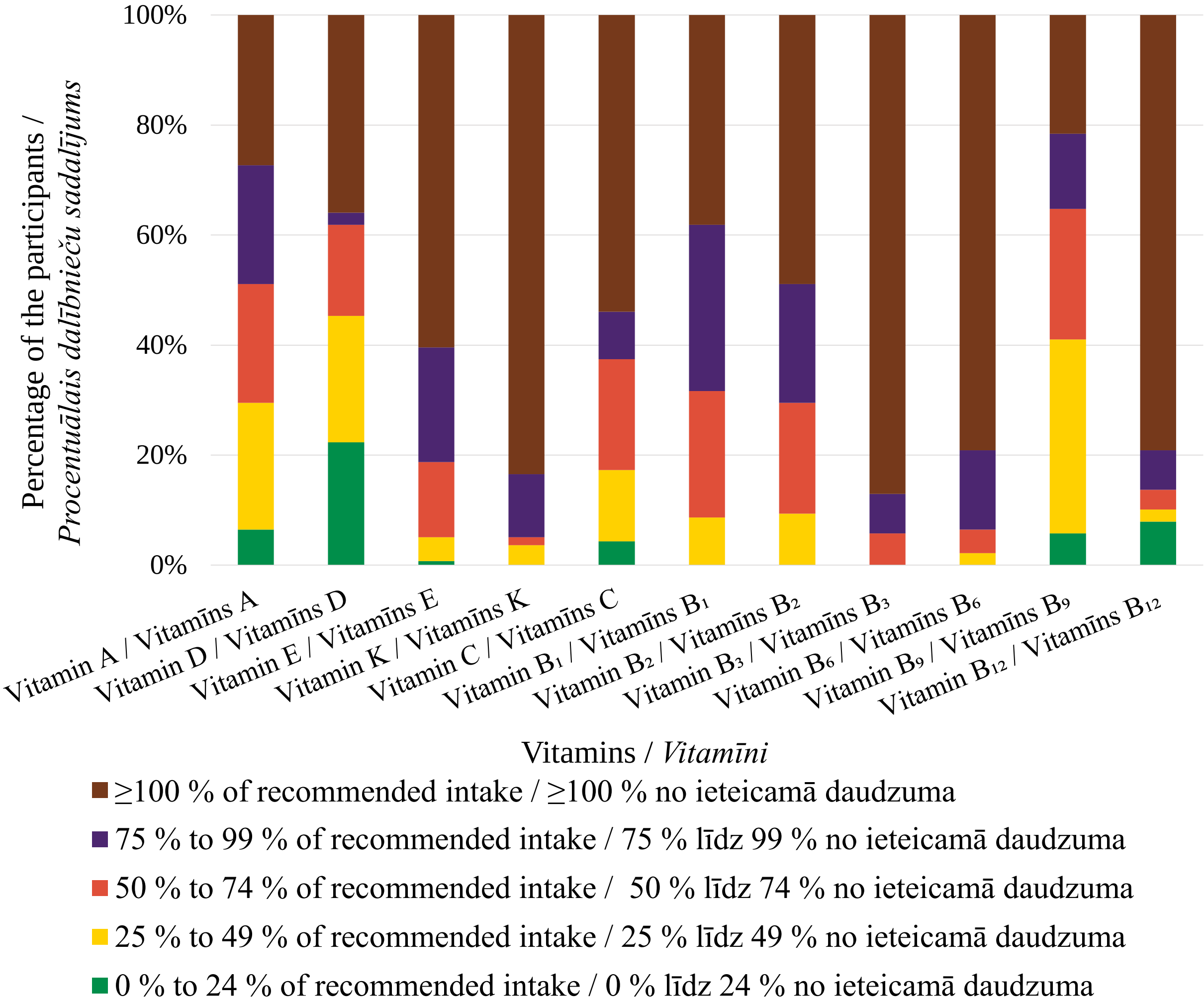

Fig. 3.2. **Median daily vitamin intake among the study participants in comparison to dietary guidelines /** *3.2. att.* ***Dienā uzņemtais vitamīnu daudzums pētījuma dalībniecēm, salīdzinot ar uztura vadlīnijām*** (n=139)

The content of **vitamin A** in human milk could be affected by the maternal intake of vitamin A (Dror & Allen, 2018). Also, vitamin A requirements during lactation are increased and should reach 1100 µg per day (Veselības ministrija, 2017a). Vitamin A can be found in animal-based foodstuff (eggs, butter, fish liver oil etc.) or A vitamin provitamins, mainly β-carotene, can be found in green leafy vegetables, red- and orange-coloured vegetables and fruits (Nordic Council of Ministers, 2014). A higher intake of vitamin A in this study was noted among the participants who were consuming more milk & dairy products (ρ=0.284, p=0.001) and plant-based fats (ρ=0.202, p=0.022). Median consumption of vitamin A among the participants was low – only approximately 27 % of the participants reached the daily adequate intake of 1100 µg per day. It also should be emphasized that for 24 participants, the median daily intake of vitamin A did not even reach the recommended lower intake level (400 µg per day). Insufficient intake of vitamin A for a prolonged period can affect vision (Nordic Council of Ministers, 2014). Other researchers also report low vitamin A intake among lactating women (Table 3.16.).

Carotenoids are vital for the vision and cognitive development of the infant, and carotenoid content in human milk is directly affected by the maternal intake of carotenoids (Zielinska, Hamulka & Wesolowska, 2019). Median carotenoid intake among participants was approximately 9724 µg per day, and the intake of carotenoids was associated with vegetable (ρ=0.305, p<0.0005) and plant-based fat (ρ=0.266, p=0.002) intake which are a natural source of carotenoids (Nordic Council of Ministers, 2014). Researchers from Poland report a higher carotenoid (~ 14880 µg per day) (Zielinska, Hamulka & Wesolowska, 2019) intake among lactating women compared to our data.

Table 3.16. / *3.16. tabula*

Comparison of vitamin intake among lactating women from different countries /
Vitamīnu uzņemšana daudzuma salīdzinājums sievietēm zīdīšanas periodā dažādās valstīs

Daily intake of vitamins / *Dienā uzņemtais vitamīnu daudzums*	**Latvia (this study) / *Latvija (šis pētījums)* (n=139)**	**France / *Francija* (Hébel et al., 2018) (n=250)**	**Poland / *Polija* (Bzikowska-Jura et al., 2018) (n=77)**	**Croatia / *Horvātija* (Krešić et al., 2012) (n=83)**	**The United States / *Amerikas Savienotās valstis* (Pratt, Durham & Sherry, 2014) (n=88)**
Vitamin A (RAE) / *Vitamīns A (RAE)* (µg)	797.28	692.30	1049.30–1390.00	807.55–1034.23	646.10
Vitamin D / *Vitamīns D* (µg)	5.49	1.90	2.70–3.23	1.50–1.69	3.60
Vitamin E (α-tocopherol) / *Vitamīns E (α-tokoferols)* (mg)	12.75	6.50	10.40–11.90	NI / *NI*	6.30
Vitamin K / *Vitamīns K* (µg)	117.37	NI / *NI*	NI / *NI*	NI / *NI*	102.40
Vitamin C / *Vitamīns C* (mg)	104.00	69.10	127.80–163.00	NI / *NI*	80.20
Vitamin B_1 / *Vitamīns B_1* (mg)	1.37	1.00	1.20–1.40	1.11–1.14	1.50
Vitamin B_2 / *Vitamīns B_2* (mg)	1.64	1.30	1.60–1.80	NI / *NI*	1.80
Vitamin B_3 (NE) / *Vitamīns B_3 (NE)* (mg)	32.39	13.10	16.20–16.80	NI / *NI*	35.00
Vitamin B_6 / *Vitamīns B_6* (mg)	2.03	1.30	1.90–4.80	1.33–1.74	1.80
Vitamin B_9 (dietary folate equivalents) / *Vitamīns B_9 (folātu ekvivalenti) (µg)**	306.42	211.90	310.00–436.50	104.45–106.59	492.20
Vitamin B_{12}/ *Vitamīns B_{12}* (µg)	4.36	4.20	3.20–4.04	NI / *NI*	4.20

* Total dietary folate equivalents = food folates (µg) + (1.7 × µg of folac acid) / *folātu ekvivalenti = pārtikas folāti (µg) + (1.7 × µg folskābes)* (European Food Safety Authority, 2019a).

It is recommended that the intake of **vitamin D** for women during breastfeeding should be 10 µg (400 IU) per day. During winter, the intake of vitamin D should be increased up to 15–20 µg (600 IU) per day (Veselības ministrija, 2017a; Veselības ministrija, 2017b). Oily fish, meat, and eggs may contribute to the vitamin D intake (Nordic Council of Ministers, 2014).

Only for 36 % of the participants, the median intake of vitamin D reached at least 10 µg per day (Fig. 3.2.). Nevertheless, compared to other studies, we report the highest median vitamin D intake among lactating women (Table 3.16.).

However, it should be noted that food is not the primary source of vitamin D. Vitamin D is predominantly synthesised in the skin from the cholesterol due to exposure to the sunlight, more specifically – sun's ultraviolet B rays (Nordic Council of Ministers, 2014; Veselības ministrija, 2017b). The presence of the sun's ultraviolet B rays depends on the angle of the fall of the sunlight. D vitamin synthesis in the skin is possible only when the angle of the sunlight exceeds 50 degrees relative to the horizon. Due to the geographical location of Latvia, from the end of November till the beginning of February sun's ultraviolet B rays irradiation is insufficient to initiate vitamin D synthesis in the skin, therefore, additional D vitamin intake may be required (Zariņš, Neimane & Bodnieks, 2018).

For 32 participants median daily intake of vitamin intake did not even reach the lower intake level (2.5 µg per day). In the long-term low vitamin D intake can affect bone health (Nordic Council of Ministers, 2014).

According to the data from the 72-hour diary – D vitamin was the most consumed dietary supplement among the study participants (n=59) and overall, the median D vitamin intake among the participants who used dietary supplement was significantly higher (~ 22 µg per day) compared to participants who consumed D vitamin only via food (~ 4 µg per day, p<0.005). However, D vitamin supplements should be used with caution because excessive intake of vitamin D can impact kidney function and lead to kidney stones. For 11 participants median daily intake of vitamin D exceeded the upper intake level (100 µg per day).

Vitamin E content in human milk is not associated with vitamin E content in human milk (Dror & Allen, 2018). However, to compensate for vitamin E loss via human milk, women should increase their vitamin E intake up to 11 mg per day (Veselības ministrija, 2017a). Plant-based fats (plant oils, nuts, seeds, and avocado), as well as egg yolk, is a good source of vitamin E (Nordic Council of Ministers, 2014). Therefore, it is only self-evident that a higher vitamin E intake was among the participants with a higher intake of plant-based fat sources (ρ=0.247, p=0.005), and overall, for 60 % of the participants median intake of vitamin E was within national dietary guidelines (Fig. 3.2.). Compared to France and the United States, vitamin E intake among our study participants was two times higher (Table 3.16.).

Vitamin K content in human milk is low and not influenced by maternal intake (Dror & Allen, 2018). Also, according to the guidelines, there is no need for women to increase vitamin K intake during lactation, and it should be kept 70 µg per day (European Food Safety Authority, 2019a). Green leafy vegetables, as well as plant oils, are a major source of vitamin K in the diet (Nordic Council of Ministers, 2014).

Also, among the study participants with a higher vegetable, fruit and plant-based fat intake, K vitamin intake was accordingly higher (Annex XV), and, for the majority of the participants (~ 84 %), vitamin K intake reached at least 70 µg per day (Fig. 3.2.). Researchers from the United States report similar values for vitamin K intake among lactating women to our elaborated results (Table 3.16.).

Vitamin C content in human milk can highly vary due to diverse maternal intake of vitamin C (Dror & Allen, 2018), and women during lactation should consume around 100 mg of vitamin C per day (Veselības ministrija, 2017a). Vegetables, fruits, and berries are a good source of vitamin C (Nordic Council of Ministers, 2014), and also according to the data from this study – participants, who consumed more vegetables (ρ=0.277, p=0.002), fruits & berries (ρ=0.244, p=0.006) and plant-based fat sources (ρ=0.252, p=0.004), also consumed more of vitamin C. However, only among 54 % of the participants, the median daily intake of vitamin C reached the recommended 100 mg per day (Fig. 3.2.). Low vitamin C intake has also been reported from France and the United States (Table 3.16.).

It is still unclear if maternal intake of **vitamin B_1** affects its content in human milk (Dror & Allen, 2018; European Food Safety Authority, 2016c), but it is advised to increase vitamin B_1 intake up to 1.6 mg per day (Veselības ministrija, 2017a). Although vitamin B_1 is widely found both in animal and plant-based foodstuff (European Food Safety Authority, 2016c), according to the data from this study, for only 38 % of the participants the intake of vitamin B_1 was sufficient (at least 1.6 mg per day), and overall, vitamin B_1 intake was higher among participants who consumed more of vegetables, fruits & berries and plant-based fat products (Annex XV). Similarly, low vitamin B_1 intake among lactating women have been also reported in Poland and the United States (Table 3.16.).

Vitamin B_2 content in human milk is sensitive to maternal nutrition (Dror & Allen, 2018; European Food Safety Authority, 2017). Therefore, to compensate for vitamin loss via human milk, the intake of vitamin B_2 during lactation should be increased up to 1.7 mg per day (Veselības ministrija, 2017a). Only for approximately half of the participants (~ 49 %), the median vitamin B_2 intake reached the recommended daily intake (Fig. 3.2.). Vitamin B_2 intake was positively associated with habitual milk & dairy product intake ($\rho=0.465$, $p<0.0005$), which are a good source of vitamin B_2 (European Food Safety Authority, 2017).

Unfortunately, for nine participants median daily intake if vitamin B_2 did not even reach the lowest intake level (0.8 mg per day). Insufficient intake of vitamin B_2 can cause weakness and fatigue (Nordic Council of Ministers, 2014).

If compared to other countries, vitamin B_2 intake among the participants of this study was similar to data reported from Poland and the United States (Table 3.16.).

It seems that **vitamin B_3** content in human milk is directly affected by the maternal intake of vitamin B_3 (European Food Safety Authority, 2014a). Therefore, women during lactation should increase their vitamin B_3 intake up to 20 mg per day (Nordic Council of Ministers, 2014). The main food sources of vitamin B_3 are meat & meat products, cereals & cereal products, and milk & dairy products (European Food Safety Authority, 2014a; Nordic Council of Ministers, 2014).

Other countries like Poland and France report low vitamin B_3 intake among lactating women (Table 3.16.), but in this study, vitamin B_3 intake for the majority (~ 87 %) of the participants was adequate. Overall, vitamin B_3 intake was associated with habitual intake of eggs, meat & processed meat, fish & seafood, milk & dairy product (Annex XV).

Vitamin B_6 intake during lactation should be increased up to 1.5 mg per day, and it seems that vitamin B_6 content in human milk is directly affected by maternal diet (Dror & Allen, 2018; European Food Safety Authority, 2016a; Veselības ministrija, 2017a). Dominant sources of vitamin B_6 in the diet are animal-based (milk, dairy products, meat, and fish) (Nordic Council of Ministers, 2014). On the contrary, in this study, participants who consumed more vitamin B_6 were consuming more plant-based foodstuff – vegetables, fruits & berries, and plant-based fats (Annex XV).

According to the data from 72-hour food diary, approximately 79 % of the participants the intake of vitamin B_6 was within guidelines (Fig. 3.2.). Similar values for vitamin B_6 intake among lactating women have also been reported from Poland, Croatia, and the United States (Table 3.16.). Nevertheless, it should be mentioned that for three participants median vitamin B_6 intake did not even reach the recommended lowest intake level (0.8 mg per day). In long term, vitamin B_6 deficiency is associated with microcytic anemia (Nordic Council of Ministers, 2014).

Sufficient **vitamin B_9** intake during gestation (400 µg per day) reduces the risk of foetus developing neural tube defects (Veselības ministrija, 2017b). Also, during lactation, the intake of vitamin B_9 maintains elevated (500 µg per day) (Veselības ministrija, 2017a). Green leafy vegetables, broccoli, pulses are a good source of vitamin B_9 (Nordic Council of Ministers, 2014). Nevertheless, it should be noted that heat treatment reduces the content of vitamin B_9 by at least one quarter. Therefore, vitamin B_9 rich vegetables should be consumed fresh as often as possible (United States Department of Agriculture, 2007).

A higher vitamin B_9 intake was noted among the participants with a higher intake of vegetables, fruits & berries, pulses, and plant-based fat products (Annex XV). However, results from the 72-hour food diaries revealed that the median vitamin B_9 intake among study participants was the lowest, compared to other nutrient intakes – only for 22 % of the participants, the median daily intake of vitamin B_9 reached the recommended 500 µg per day (Fig. 3.2.). In most cases, the recommended daily intake of vitamin B_9 was reached because additionally to food, dietary supplements containing vitamin B_9 were consumed. Only three participants reached the recommended daily intake of vitamin B_9 only via food. This indicates that it is unlikely that food alone can provide enough vitamin B_9 for women during lactation, and similarly to guidelines during pregnancy (Veselības ministrija, 2017b), women during lactation should consider the use of a dietary supplement containing vitamin B_9 to achieve an adequate intake of this vitamin. Low vitamin B_9 intake during lactation has also been reported from France and Poland. Especially low vitamin B_9 intake have been reported among lactating women from Croatia (Table 3.16.).

Unlike other B group vitamins, there is no need to increase the intake of **vitamin B_{12}** during lactation, and it should be kept 2 µg per day (Veselības ministrija, 2017a). However, considering that vitamin B_{12} can be mainly found only in animal-based products, vegetarians and vegans during lactation should consider the use of B_{12} dietary supplements (Nordic Council of Ministers, 2014).

In total, for 79 % of the participants, the intake of vitamin B_{12} was within guidelines. Also, the intake of vitamin B_{12} was higher among the participants who consumed more animal-based foodstuff (Annex XV). Similar values for vitamin B_{12} intake have been reported from France and the United States (Table 3.16.).

The lowest daily intake of vitamin B_{12} is set at 1 µg per day (Nordic Council of Ministers, 2014). For 14 participants (mostly among participants who were vegetarians or vegans), the median vitamin B_{12} intake did not reach the recommended lowest daily intake. In the long-term insufficient intake of vitamin B_{12} can impair the production of red blood cells and therefore lead to anemia (Nordic Council of Ministers, 2014).

Summary of Chapter 3.3. / *3.3. nodaļas kopsavilkums*

Overall, evaluation of the food frequency questionnaire and 72-hour food diaries revealed that participants who consumed more plant-based products had a higher intake of fibre, potassium, magnesium, iron, carotenoids, vitamins (C, B_1, B_6, B_9, and K), but lesser intake of fat, saturated fatty acids, and cholesterol. Participants with a higher animal-based product intake consumed more protein, fat, saturated fatty acids and cholesterol, sodium and salt, selenium, iodine, vitamins B_3 and B_{12}. Milk & dairy product, as well as sweets & bakery product consumption, were associated with a higher saturated fatty acid and *trans* fatty acid intake. Participants with a higher milk & dairy product intake consumed more calcium, phosphorus, and iodine, but participants who were eating fish and seafood more frequently were consuming more of iodine, eicosapentaenoic acid, and docosahexaenoic acid.

According to the evaluation of the 72-hour food diary, participating women received adequate energy intake from protein. Energy intake from fat was higher than recommended, but energy intake from carbohydrates inadequate. Participants consumed more fat, saturated fatty acids, and salt than recommended, but dietary intake of fibre, eicosapentaenoic acid, and docosahexaenoic acid, essential elements – calcium, iron, and vitamins – A, D, B_1, B_2, B_9 was lower than recommended. Low intake for the majority of vital nutrients was due to insufficient intake of nutritious foods like vegetables, fruits, berries, pulses, cereals, milk & dairy products, and fish.

Kopumā, pārtikas produktu lietošanas biežuma anketu un 72-stundu uztura dienasgrāmatu izvērtējums atklāja, ka tām pētījuma dalībniecēm, kuras uzņēma vairāk augu valsts izcelsmes produktus, uzturā bija vairāk šķiedrvielu, kālija, magnija, dzelzs, karotenoīdu, vitamīnu (C, B_1, B_6, B_9 un K), bet mazāk – tauku, tai skaitā piesātināto taukskābju un holesterīna. Tās pētījuma dalībnieces, kuras uzņēma vairāk dzīvnieku valsts izcelsmes *produktu, uzņēma vairāk olbaltumvielu, tauku, tai skaitā piesātināto taukskābju un holesterīna, nātrija un sāls, selēna, joda, vitamīnu B_3 un B_{12}. Piena & piena produktu, kā arī saldumu & konditorejas izstrādājumu patērēšana bija saistīta ar augstāku piesātināto taukskābju un trans taukskābju uzņemšanu. Pētījuma dalībniecēm, kuras patērēja vairāk pienu & piena produktus, uzturā bija vairāk kalcija, fosfora un joda, bet pētījuma dalībnieces, kuras vairāk patērēja zivis & jūras veltes, uzņēma vairāk joda, eikozapentaēnskābes un dokozaheksaēnskābes.*

72-stundu uztura dienasgrāmatu izvērtējums norādīja, ka pētījuma dalībnieces ir uzņēmušas pietiekamu enerģijas daudzumu ar olbaltumvielām. Enerģijas uzņemšana ar taukiem bija augstāka nekā ieteicams, bet enerģijas uzņemšana ar ogļhidrātiem – nepietiekama. Pētījuma dalībnieces uzņēma vairāk tauku, piesātināto taukskābju un sāls nekā rekomendēts, bet šķiedrvielu, eikozapentaēnskābes, dokozaheksaēnskābes, esenciālo elementu – kalcija, dzelzs un A, D, B_1, B_2, B_9 vitamīnu uzņemšana bija nepietiekama. Nepietiekamā uzturvielu uzņemšana skaidrojama ar tādu uzturvielām bagātu produktu kā dārzeņi, augļi, ogas, pākšaugi, graudaugi, piens & piena produkti, zivis zemo patēriņu.

3.4. Human milk composition in relation to maternal nutrition / *Uztura ietekme uz mātes piena sastāvu*

Human milk in the first six months of life is the sole nutrient source for the infant (Andreas, Kampmann & Le-Doare, 2015; Hale & Hartmann, 2017). Since maternal diet can affect human milk composition, it is important to evaluate what nutrients in human milk are directly affected by the maternal diet (Andreas, Kampmann & Le-Doare, 2015; Innis, 2014).

3.4.1. Impact of maternal nutrition on macronutrient (fat, protein, lactose) content in human milk / *Uztura ietekme uz makrouzturvielu (tauku, olbaltumvielu, laktozes) saturu mātes pienā*

Data statistical analysis did reveal few significant, but weak correlations between habitual dietary intake of specific food groups and macronutrient content in human milk. For example, a lower fat content in human milk was noted among the participants with a higher intake of fish & seafood (ρ=-0.196, p=0.030), but a higher protein content in human milk was observed among the participants with a higher habitual intake of pulses (ρ=0.184, p=0.041), plant-based fats (ρ=0.201, p=0.025) and salty snacks & fast food (ρ=0.180, p=0.047).

According to the data from 72-hour food diaries, protein content in human milk positively correlated with median maternal intake of monounsaturated fatty acids (ρ=0.178, p=0.049), n-3 polyunsaturated fatty acids (ρ=0.264, p=0.003), α-linolenic acid (ρ=0.335, p<0.0005), iron (ρ=0.220, p=0.015) and vitamin B_6 (ρ=-0.390, p<0.0005). Lactose content in human milk positively correlated with monounsaturated fatty acid (ρ=0.199, p=0.027) and selenium (ρ=0.185, p=0.041) intake, but negatively with sugar (ρ=-0.198, p=0.029) and vitamin B_6 (ρ=-0.650, p<0.0005) intake. However, no direct correlation was found between maternal intake of **fat**, **protein** or **lactose** and the content of these macronutrients in the human milk (p>0.05).

3.4.2. Impact of maternal nutrition on qualitative and quantitative fatty acid composition in human milk / *Uztura ietekme uz kvalitatīvo un kvantitatīvo taukskābju sastāvu mātes pienā*

Fatty acids <C16 are synthesized in the lactocytes from the glucose. Fatty acids (≥C16) cannot be synthesized in the lactocytes, therefore are derived from the maternal bloodstream

(recent meal, endogenous stores, or release from the liver), and therefore reflect maternal diet (Hale & Hartmann, 2017).

Saturated fatty acids level in human milk in this study positively correlated with habitual eggs, meat & meat product (ρ=0.211, *p*=0.017), fish & seafood (ρ=0.217, *p*=0.014) and milk & dairy product (ρ=0.368, *p*<0.005), as well as sweet & bakery good intake (ρ=0.187, p=0.034). Meat & meat products, milk & dairy products, and sweets & bakery goods are the main sources of saturated fatty acids in the diet (National Institute for Health and Welfare of Finland, 2019), thus explaining the correlations elaborated.

Fish and seafood are not the saturated fatty acid source in the diet. Even fatty fish contain only around 2 % to 5 % of saturated fat (National Institute for Health and Welfare of Finland, 2019), therefore other factors should be considered to explain why participants with a higher fish & seafood intake had a higher level of saturated fatty acid in human milk.

A maternal diet low in fat, but high in carbohydrates increases the endogenous synthesis of **medium-chain fatty acids** in mammary glands (Bahrami & Rahimi, 2005; Lawrence & Lawrence, 2015; Mohammad, Sunehag & Haymond, 2014). Also, in this study, medium-chain fatty acid level in human milk negatively correlated with the fat intake (ρ=-0.242, *p*=0.006).

We were not able to calculate **palmitic acid** intake among the study participants, but we speculate that maternal intake of palmitic acid affects the level of this fatty acid in human milk. This is evidenced by two positive associations that were found between palmitic acid level in human milk and habitual milk & dairy product consumption (ρ=0.509, *p*<0.0005), as well as lactose intake (ρ=0.478, *p*<0.0005) among the participants. Palmitic acid is also the dominant saturated fatty acid found in bovine milk and dairy products (Lindmark Månsson, 2008). Also, researchers from Slovenia have reported that palmitic acid level in human milk is higher for women who consume more of milk and dairy products (Jagodic et al., 2020).

The palmitic acid content in human milk was also higher for women with a higher sweets & baked goods intake (ρ=0.267, *p*=0.002). This association could be explained by the fact that industrially produced sweets & baked goods contain an ingredient palm oil, which is a rich source of palmitic acid (National Institute for Health and Welfare of Finland, 2019).

The palmitic acid level in human milk was also higher for women with a higher median intake of saturated fatty acids (ρ=0.410, *p*<0.0005) and *trans* fatty acids (ρ=0.449, *p*<0.0005). This could be related to a higher intake of milk & dairy products and sweets & baked goods, which both are a source of saturated fatty acids and *trans* fatty acids in the diet (National Institute for Health and Welfare of Finland, 2019).

Stepwise multiple regression analysis also confirmed the significance of maternal intake of saturated fatty acids on the palmitic acid level in human milk (F(3, 135)=7.075, *p*<0.0005). However, maternal intake of saturated fatty acids explained only 12 % of the variability of the palmitic acid level in human milk (adjusted R^2=0.117). Regression analysis revealed that only dietary intake of saturated fatty acids on the day before sampling had a significant impact on the palmitic acid level in human milk (Table 3.17.).

Table 3.17. / *3.17. tabula*

Summary of multiple regression analysis regarding maternal saturated fatty acids intake and palmitic acid level in human milk / *Daudzfaktoru regresijas analīzes rezultāti par piesātināto taukskābju uzņemšanu ar uzturu un palmitīnskābes saturu mātes pienā* (n=139)*

Variables / *Rādītāji*	**Unstandardized regression coefficient / *Nestandartizēts regresijas koeficients***	**The standard error of the coefficient / *Koeficienta standartkļūda***	**Standardised coefficient / *Standartizēts koeficients***	**p-value / *p-vērtība***
Intercept / *Regresijas konstante*	13.456	1.747	-	<**0.0005**
Maternal SFA intake three days before sampling / *Mātes uzņemtais PT daudzums trīs dienas pirms mātes piena parauga ievākšanas*	0.605	0.322	0.185	0.062
Maternal SFA intake two days before sampling / *Mātes uzņemtais PT daudzums divas dienas pirms mātes piena parauga ievākšanas*	-0.057	0.342	-0.018	0.867
Maternal SFA intake one day before sampling / *Mātes uzņemtais PT daudzums dienu pirms mātes piena parauga ievākšanas*	0.852	0.322	0.260	**0.009**

* participants who were able to both donate human milk for fatty acid composition analysis and submitted the 72-hour diary / *dalībnieces, kuras ziedoja mātes pienu taukskābju sastāva analīzēm un iesniedza 72-stundu uztura dienasgrāmatu*.

Also, total maternal saturated fatty acid intake affected saturated fatty acid level in human milk, but only maternal intake three days before sampling had a significant impact on the saturated fatty acid level in human milk, F(3, 135)=4.223, *p*=0.007 (Table 3.18.). However, maternal intake of saturated fatty acids explained only 6 % (adjusted R^2=0.065) of the variability of the saturated fatty acid level in human milk.

Table 3.18. / *3.18. tabula*

Summary of multiple regression analysis regarding maternal saturated fatty acid intake and saturated fatty acid level in human milk / *Daudzfaktoru regresijas analīzes rezultāti par piesātināto taukskābju uzņemšanu ar uzturu un piesātināto taukskābju saturu mātes pienā* (n=139)*

Variables / *Rādītāji*	Unstandardized regression coefficient / *Nestandartizēts regresijas koeficients*	The standard error of the coefficient / *Koeficienta standartkļūda*	Standardised coefficient / *Standartizēts koeficients*	*p*-value / *p-vērtība*
Intercept / *Regresijas konstante*	33.322	2.670	-	**<0.0005**
Maternal SFA intake three days before sampling / *Mātes uzņemtais PT daudzums trīs dienas pirms mātes piena parauga ievākšanas*	1.059	0.491	0.218	**0.033**
Maternal SFA intake two days before sampling / *Mātes uzņemtais PT daudzums divas dienas pirms mātes piena parauga ievākšanas*	-0.305	0.523	-0.064	0.561
Maternal SFA intake one day before sampling / *Mātes uzņemtais PT daudzums dienu pirms mātes piena parauga ievākšanas*	0.830	0.491	0.171	0.094

* participants who were able to both donate human milk for fatty acid composition analysis and submitted the 72-hour diary / *dalībnieces, kuras ziedoja mātes pienu taukskābju sastāva analīzēm un iesniedza 72-stundu uztura dienasgrāmatu*.

Participants with a higher carbohydrate, fibre, and sugar (except for lactose, galactose, and maltose) intake had a lower level of palmitic acid in their milk (Annex XVII). This observation could be explained by the fact that a maternal diet rich in carbohydrates induces the synthesis of medium-chain fatty acids in mammary glands, but fatty acids ≥C16 (also palmitic acid) are derived from maternal plasma (Bahrami & Rahimi, 2005; Lawrence & Lawrence, 2015; Mohammad, Sunehag & Haymond, 2014).

The palmitic acid level in human milk was lower for participants with a higher iron, potassium, magnesium, and vitamin B_6 intake (Annex XVII). We did not find the explanation for these obtained results in the literature, but associations could be related to the overall dietary habits of the participants and consumption of specific food products. For example, participants with a higher intake of potassium, iron, magnesium, B_6 also reported higher consumption of vegetables (Annex XV), and there was a negative correlation found between vegetable intake and level of palmitic acid in the human milk (ρ=-0.267, *p*=0.002).

Plant oil consumption affects the **unsaturated fatty acid** composition of human milk (Brenna & Lapillonne, 2009; Nishimura et al., 2013). Lactating women with a higher olive oil intake (contains dominantly oleic acid) shows a higher level of oleic acid in their milk, but women with a higher sunflower or soybean oil intake (contains dominantly n-6 polyunsaturated fatty acids) shows a higher level of n-6 polyunsaturated fatty acids in human milk (de la Presa-Owens, López-Sabater & Rivero-Urgell, 1996; Jagodic et al., 2020; Krešić et al., 2013; Nishimura et al., 2013).

Among the participants of this study, the most preferred plant oil was olive oil (n=98), and among the participants from the second study period, it was preferred more (*p*=0.019, see Table 3.19.). Sunflower oil (n=34), canola oil (n=31), and grape seed oil (n=20) were also frequently consumed among the participants (Table 3.19.).

Table 3.19. / *3.19. Tabula*

Type of plant oils used among the participants / *Augu eļļas, kuras lietojušas pētījuma dalībnieces* (n=138)*

Plant oils / *Augu eļļas*	**First study period / *Pirmais pētījuma posms* (n=68)**	**Second study period / *Otrais pētījuma posms* (n=70)**	***p*-value / *p-vērtība***
Olive oil / *Olīveļļa*	n=42	n=56	**0.019**
Sunflower oil / *Saulespuķu eļļa*	n=19	n=15	0.376
Canola oil / *Rapšu eļļa*	n=15	n=16	0.911
Grapeseed oil / *Vīnogu kauliņu eļļa*	n=7	n=13	0.169
Flaxseed oil / *Linsēklu eļļa*	n=6	n=5	0.717
Hemp seed oil / *Kaņepju sēklu eļļa*	n=1	n=4	0.184
Sesame seed oil / *Sezama sēklu eļļa*	n=3	n=2	0.626
Pumpkin seed oil / *Ķirbja sēklu eļļa*	n=5	n=2	0.231
Walnut oil / *Valriekstu eļļa*	n=1	n=1	0.984
Coconut oil / *Kokosriekstu eļļa*	n=5	n=5	0.962
Corn oil / *Kukurūzas eļļa*	n=0	n=1	0.324
Avocado oil / *Avokado eļļa*	n=0	n=1	0.324
Rice oil / *Rīsu eļļa*	n=0	n=2	0.162

* three out of 141 participants did not submit the FFQ. Participants in the FFQ could mark more than one most preferred plant oil / *trīs no 141 pētījuma dalībniecēm neiesniedza pārtikas produktu lietošanas biežuma anketu. Dalībnieces pārtikas produktu lietošanas biežuma anketā drīkstēja atzīmēt vairāk nekā vienu biežāk lietoto augu eļļu.*

There was no significant association found between the preference of olive oil or canola oil consumption and changes in the fatty acid composition of human milk ($p>0.05$ for both oils).

Sunflower oil as the main plant oil source in the diet was related to a higher level of linoleic acid, n-6 polyunsaturated and total polyunsaturated fatty acid levels in human milk. On the opposite, a lower level of monounsaturated fatty acids, docosahexaenoic acid, n-3 polyunsaturated fatty acids level in human milk samples was found among the participants with the preference for the consumption of sunflower oil (Table 3.20.).

Table 3.20. / *3.20. tabula*

The fatty acid level in human milk depending on the preferential plant oil source in the maternal diet / *Taukskābju saturs mātes pienā atkarībā no lietotā augu eļļas avota uzturā* (n=138)*

Fatty acids in human milk / *Taukskābes mātes pienā*	**Sunflower oil as the preferential plant oil? / *Saulespuķu eļļa kā preferenciālā augu eļļa?***		***p*-value / *p-vērtība***
	No / *Nē*	**Yes / *Jā***	
MUFA level / *MNT saturs*	40.10 %	38.15 %	p=0.050
LA level / *LS saturs*	11.90 %	15.00 %	p=0.001
n-6 PUFA level / *n-6 PNT saturs*	13.20 %	16.45 %	p=0.001
n-3 PUFA level / *n-3 PNT saturs*	2.10 %	1.80 %	p=0.023
PUFA level / *Kopējās PNT saturs*	14.05 %	15.90 %	p=0.006
The ratio between LA and ALA / *attiecība starp LS un ALS*	8.74	11.09	p=0.001

Table 3.20. continued / *3.20. tabulas turpinājums*

Fatty acids in human milk / ***Taukskābes mātes pienā***	**Sunflower oil as the preferential plant oil? /** ***Saulespuķu eļļa kā preferenciālā augu eļļa?***		***p*-value /** ***p-vērtība***
	No / ***Nē***	**Yes /** ***Jā***	
The ratio between n-6 PUFA and n-3 PUFA / ***attiecība starp n-6 PNT un n-3 PNT***	6.49	9.03	*p*<0.0005
DHA level / ***DHS saturs***	0.40 %	0.30 %	*p*=0.001
Fatty acids in human milk / ***Taukskābes mātes pienā***	**Grapeseed oil as the preferential plant oil? /** ***Vīnogu kauliņu eļļa kā preferenciālā augu eļļa?***		***p*-value /** ***p-vērtība***
OA level / ***OS saturs***	36.55 %	33.45 %	0.002
MUFA level / ***MNT saturs***	40.40 %	37.45 %	0.002

* three out of 141 participants did not submit the FFQ/ *trīs no 141 pētījuma dalībniecēm neiesniedza pārtikas produktu lietošanas biežuma anketu.*

Although grapeseed oil mostly contains polyunsaturated fatty acids, preferentially – linoleic acid (Garavaglia et al., 2016), we did not observe significant differences regarding linoleic acid or total polyunsaturated fatty acid level in human milk ($p>0.05$). However, among study participants who noted the use of this plant oil, lower oleic acid and total monounsaturated fatty acid level in human milk was observed (Table 3.20.).

Elaborated results indicate that n-6 polyunsaturated fatty acids which are abundantly found in sunflower and grape seed oil, are actively incorporated in the triglycerides of human milk. Unfortunately, consumption of plant oils rich in n-6 polyunsaturated fatty acids also leads to a lower level of the docosahexaenoic acid level in human milk which is a vital n-3 polyunsaturated fatty acid during infancy.

Also, other plant-based fat sources like avocado, nuts, seeds contain oleic acid and essential unsaturated fatty acids – linoleic acid and α-linoleic acid. Intake of plant-based fat sources could affect the fatty acids composition of human milk (Comerford et al., 2016; Nordic Council of Ministers, 2014). Also, in this study a higher α-linolenic acid level in human milk was observed among the participants with a higher intake plant-based fat sources ($\rho=0.180$, $p=0.042$).

Both **oleic acid** and **monounsaturated fatty acid** level in human milk positively correlated with maternal intake of monounsaturated fatty acids ($\rho=0.346$, $p<0.0005$ and $\rho=0.294$, $p=0.001$, respectively), but negatively with maternal intake of *trans* fatty acids ($\rho=-0.190$, $p=0.032$ and $\rho=-0.193$, $p=0.029$, respectively).

Stepwise multiple regression analysis also confirmed the significance of maternal intake of monounsaturated fatty acids on total monounsaturated fatty acid, as well as individually on the oleic acid level in human milk, $F(3, 135)=5.698$, $p=0.001$ and $F(3, 135)=7.647$, $p<0.0005$, respectively. However, maternal intake of monounsaturated fatty acids explained only 9 % of the variability of the monounsaturated fatty acid level in human milk (adjusted $R^2=0.093$) and only 13 % of the variability of the oleic acid level in human milk (adjusted $R^2=0.126$). Both regression analyses revealed that only dietary intake of monounsaturated fatty acids on the day before sampling had a significant impact on the oleic acid level and total monounsaturated fatty acid level in human milk (Table 3.21. and Table 3.22.).

Table 3.21. / *3.21. tabula*

Summary of multiple regression analysis regarding maternal monounsaturated fatty acid intake and monounsaturated fatty acids level in human milk / *Daudzfaktoru regresijas analīzes rezultāti par mononepiesātināto taukskābju uzņemšanu ar uzturu un mononepiesātināto taukskābju saturu mātes pienā* (n=138)*

Variables / *Rādītāji*	**Unstandardized regression coefficient / *Nestandartizēts regresijas koeficients***	**The standard error of the coefficient / *Koeficienta standartkļūda***	**Standardised coefficient / *Standartizēts koeficients***	***p*-value / *p-vērtība***
Intercept / *Regresijas konstante*	32.317	1.852	-	**<0.0005**
Maternal MUFA intake three days before sampling / *Mātes uzņemtais MNTS daudzums trīs dienas pirms mātes piena parauga ievākšanas*	0.163	0.287	0.053	0.570
Maternal MUFA intake two days before sampling / *Mātes uzņemtais MNTS daudzums divas dienas pirms mātes piena parauga ievākšanas*	0.548	0.307	0.172	0.076
Maternal MUFA intake one day before sampling / *Mātes uzņemtais MNTS daudzums dienu pirms mātes piena parauga ievākšanas*	0.585	0.286	0.189	**0.043**

* two participants did not submit the 72-hour diary. Result from one participant was excluded as a significant outlier in this analysis / divas no 141 *dalībnieces, neiesniedza 72-stundu uztura dienasgrāmatu. Vienas dalībnieces rezultāti tika izslēgti no šīs analīzes kā izlecošā vērtība.*

Table 3.22. / *3.22. tabula*

Summary of multiple regression analysis regarding maternal monounsaturated fatty acids intake and oleic acid level in human milk / *Daudzfaktoru regresijas analīzes rezultāti par mononepiesātināto taukskābju uzņemšanu ar uzturu un oleīnskābes saturu mātes pienā* (n=139)*

Variables / *Rādītāji*	**Unstandardized regression coefficient / *Nestandartizēts regresijas koeficients***	**The standard error of the coefficient / *Koeficienta standartkļūda***	**Standardised coefficient / *Standartizēts koeficients***	***p*-value / *p-vērtība***
Intercept / *Regresijas konstante*	27.495	1.926	-	**<0.0005**
Maternal MUFA intake three days before sampling / *Mātes uzņemtais MNTS daudzums trīs dienas pirms mātes piena parauga ievākšanas*	0.169	0.299	0.052	0.572

Table 3.22. continued / *3.22. tabulas turpinājums*

Variables / *Rādītāji*	**Unstandardized regression coefficient / *Nestandartizēts regresijas koeficients***	**The standard error of the coefficient / *Koeficienta standartkļūda***	**Standardised coefficient / *Standartizēts koeficients***	**p-value / *p-vērtība***
Maternal MUFA intake two days before sampling / *Mātes uzņemtais MNTS daudzums divas dienas pirms mātes piena parauga ievākšanas*	0.626	0.319	0.186	0.052
Maternal MUFA intake one day before sampling / *Mātes uzņemtais MNTS daudzums dienu pirms mātes piena parauga ievākšanas*	0.757	0.298	0.230	**0.012**

* participants who were able to both donate human milk for fatty acid composition analysis and submitted the 72-hour diary / *dalībnieces, kuras ziedoja mātes pienu taukskābju sastāva analīzēm un iesniedza 72-stundu uztura dienasgrāmatu*.

A direct association was found between maternal intake of **linoleic acid**, **α-linolenic acid**, **n-6 and n-3 polyunsaturated fatty acid**, **total polyunsaturated fatty acid** intake and the level of these fatty acids in human milk (Annex XVII).

A lower linoleic acid, n-6 polyunsaturated and total polyunsaturated fatty acid level in human milk was observed among the participants with a higher intake of milk & dairy products (source of saturated fatty acids and *trans* fatty acids) and habitual fish intake (source of n-3 polyunsaturated fatty acids), but a ratio of linoleic acid / α-linolenic acid in human milk was associated with the ratio of linoleic acid / α-linolenic acid and ratio of n-6 / n-3 polyunsaturated fatty acids in the maternal diet ($\rho=0.438$, $p<0.0005$ and $\rho=0.477$, $p<0.0005$).

Stepwise multiple regression analysis confirmed that **polyunsaturated fatty acid** level in human milk was related to maternal intake of polyunsaturated fatty acids – a significant association was found between polyunsaturated fatty acid level in human milk and maternal intake of polyunsaturated fatty acids three days and on the day before sampling, $F(3, 135)=9.502$, $p<0.0005$. However, overall, maternal intake of polyunsaturated fatty acids explained only around 16 % of the variability of the polyunsaturated fatty acid level in human milk (adjusted $R^2=0.156$) (Table 3.23.).

Table 3.23. / *3.23. tabula*

Summary of multiple regression analysis regarding maternal polyunsaturated fatty acid intake and polyunsaturated fatty acids intake level in human milk / *Daudzfaktoru regresijas analīzes rezultāti par polinepiesātināto taukskābju uzņemšanu ar uzturu un polinepiesātināto taukskābju saturu mātes pienā* (n=138)*

Variables / *Rādītāji*	Unstandardized regression coefficient / *Nestandartizēts regresijas koeficients*	The standard error of the coefficient / *Koeficienta standartkļūda*	Standardised coefficient / *Standartizēts koeficients*	*p*-value / *p-vērtība*
Intercept / *Regresijas konstante*	0.922	0.061	-	**<0.0005**
Maternal PUFA intake three days before sampling / *Mātes uzņemtais PNTS daudzums trīs dienas pirms mātes piena parauga ievākšanas*	0.095	0.046	0.188	**0.040**
Maternal PUFA intake two days before sampling / *Mātes uzņemtais PNTS daudzums divas dienas pirms mātes piena parauga ievākšanas*	-0.016	0.048	-0.030	0.737
Maternal PUFA intake one day before sampling / *Mātes uzņemtais PNPT daudzums dienu pirms mātes piena parauga ievākšanas*	0.160	0.045	0.318	**<0.0005**

* two participants did not submit the 72-hour diary. Result of one participant was excluded as a significant outlier in this analysis / *divas no 141 dalībnieces, neiesniedza 72-stundu uztura dienasgrāmatu. Vienas dalībnieces rezultāti tika izslēgti no analīzes kā izlecošā vērtība.*

Also, **n-6 polyunsaturated fatty acids** intake ($F(3, 135)=7.730$, $p<0.0005$) three days before sampling and on the day before sampling showed the greatest impact on the level of these fatty acids in the milk (Table 3.24.), but the intake of **n-3 polyunsaturated fatty acids** in all three days before sampling had a significant impact on n-3 polyunsaturated fatty acids level in human milk, $F(3, 135)=14.852$, $p<0.0005$ (Table 3.25.). Intake of n-6 polyunsaturated fatty acids explained around 15 % of n-6 polyunsaturated fatty acids level in human milk (adjusted $R^2=0.147$) but n-3 polyunsaturated fatty acids intake – approximately 28 % of the n-3 polyunsaturated fatty acid level in human milk (adjusted $R^2=0.283$).

Table 3.24. / *3.24. tabula*

Summary of multiple regression analysis regarding maternal n-6 polyunsaturated fatty acids intake and n-6 polyunsaturated fatty acids level in human milk / *Daudzfaktoru regresijas analīzes rezultāti par n-6 polinepiesātināto taukskābju uzņemšanu ar uzturu un n-6 polinepiesātināto taukskābju saturu mātes pienā* (n=139)*

Variables / *Rādītāji*	Unstandardized regression coefficient / *Nestandartizēts regresijas koeficients*	The standard error of the coefficient / *Koeficienta standartkļūda*	Standardised coefficient / *Standartizēts koeficients*	p-value / *p-vērtība*
Intercept / *Regresijas konstante*	0.900	0.058	-	**<0.0005**
Maternal n-6 PUFA intake three days before sampling / *Mātes uzņemtais n-6 PNTS daudzums trīs dienas pirms mātes piena parauga ievākšanas*	0.095	0.046	0.184	**0.040**
Maternal n-6 PUFA intake two days before sampling / *Mātes uzņemtais n-6 PNTS daudzums divas dienas pirms mātes piena parauga ievākšanas*	-0.009	0.049	-0.016	0.859
Maternal n-6 PUFA intake one day before sampling / *Mātes uzņemtais n-6 PNTS daudzums dienu pirms mātes piena parauga ievākšanas*	0.155	0.044	0.307	**0.001**

* participants who were able to both donate human milk for fatty acid composition analysis and submitted the 72-hour diary / *dalībnieces, kuras ziedoja mātes pienu taukskābju sastāva analīzēm un iesniedza 72-stundu uztura dienasgrāmatu*.

Table 3.25. / *3.25. tabula*

Summary of multiple regression analysis regarding maternal n-3 polyunsaturated fatty acids intake and n-3 polyunsaturated fatty acids level in human milk / *Daudzfaktoru regresijas analīzes rezultāti par n-3 polinepiesātināto taukskābju uzņemšanu ar uzturu un n-3 polinepiesātināto taukskābju saturu mātes pienā* (n=139)*

Variables / *Rādītāji*	Unstandardized regression coefficient / *Nestandartizēts regresijas koeficients*	The standard error of the coefficient / *Koeficienta standartkļūda*	Standardised coefficient / *Standartizēts koeficients*	p-value / *p-vērtība*
Intercept / *Regresijas konstante*	0.187	0.022	-	**<0.0005**
Maternal n-3 PUFA intake three days before sampling / *Mātes uzņemtais n-3 PNTS daudzums trīs dienas pirms mātes piena parauga ievākšanas*	0.107	0.041	0.218	**0.010**

Table 3.25. continued / *3.25. tabulas turpinājums*

Variables / *Rādītāji*	**Unstandardized regression coefficient / *Nestandartizēts regresijas koeficients***	**The standard error of the coefficient / *Koeficienta standartkļūda***	**Standardised coefficient / *Standartizēts koeficients***	***p*-value / *p-vērtība***
Maternal n-3 PUFA intake two days before sampling / *Mātes uzņemtais n-3 PNTS daudzums divas dienas pirms mātes piena parauga ievākšanas*	0.113	0.042	0.228	**0.008**
Maternal n-3 PUFA intake one day before sampling / *Mātes uzņemtais n-3 PNTS daudzums dienu pirms mātes piena parauga ievākšanas*	0.137	0.038	0.283	**<0.005**

* participants who were able to both donate human milk for fatty acid composition analysis and submitted the 72-hour diary / *dalībnieces, kuras ziedoja mātes pienu taukskābju sastāva analīzēm un iesniedza 72-stundu uztura dienasgrāmatu.*

Also, multiple regression analysis confirmed that maternal intake of **linoleic acid** three days before sampling and on the day before sampling, influenced the linoleic acid level in human milk, $F(3, 135)=8.273$, $p<0.0005$, and maternal intake of linoleic acid explained around 14 % of the variability of the linoleic acid level in human milk (adjusted $R^2=0.137$) (Table 3.26.). Higher results have reported Demmelmair et al. (1998), indicating that about 30 % of human milk linoleic acid is directly transferred to human milk from the maternal diet.

Table 3.26. / *3.26. tabula*

Summary of multiple regression analysis regarding maternal linoleic acid intake and linoleic acid level in human milk / *Daudzfaktoru regresijas analīzes rezultāti par linolskābes uzņemšanu ar uzturu un linolskābes saturu mātes pienā* (n=139)*

Variables / *Rādītāji*	**Unstandardized regression coefficient / *Nestandartizēts regresijas koeficients***	**The standard error of the coefficient / *Koeficienta standartkļūda***	**Standardised coefficient / *Standartizēts koeficients***	***p*-value / *p-vērtība***
Intercept / *Regresijas konstante*	0.110	0.232	-	0.635
Maternal LA intake three days before sampling / *Mātes uzņemtais LS daudzums trīs dienas pirms mātes piena parauga ievākšanas*	0.109	0.049	0.200	**0.029**
Maternal LA intake two days before sampling / *Mātes uzņemtais LS daudzums divas dienas pirms mātes piena parauga ievākšanas*	-0.006	0.052	-0.011	0.901

Table 3.26. continued / *3.26. tabulas turpinājums*

Variables / ***Rādītāji***	**Unstandardized regression coefficient /** ***Nestandartizēts regresijas koeficients***	**The standard error of the coefficient /** ***Koeficienta standartkļūda***	**Standardised coefficient /** ***Standartizēts koeficients***	***p*-value /** ***p-vērtība***
Maternal LA intake one day before sampling / ***Mātes uzņemtais LS daudzums dienu pirms mātes piena parauga ievākšanas***	0.147	0.047	0.276	**0.002**

* participants who were able to both donate human milk for fatty acid composition analysis and submitted the 72-hour diary / *dalībnieces, kuras ziedoja mātes pienu taukskābju sastāva analīzēm un iesniedza 72-stundu uztura dienasgrāmatu.*

Multiple regression analysis also confirmed that both maternal intake of α-linolenic acid three days before sampling and on the day before sampling significantly influenced α-linolenic acid level in human milk, F(3, 135)=20.230, p<0.0005 (Table 3.27.). Overall, maternal intake of α-linolenic acid explained 30 % of the variability of the α-linolenic acid level in human milk (adjusted R^2=0.295). Other studies indicate that approximately 65 % of the α-linolenic acid in human milk is directly transferred from the maternal diet (Demmelmair et al., 2016).

Table 3.27. / *3.27. tabula*

Summary of multiple regression analysis regarding maternal α-linolenic acid intake and α-linolenic acid level in human milk / ***Daudzfaktoru regresijas analīzes rezultāti par α-linolēnskābes uzņemšanu ar uzturu un α-linolēnskābes saturu mātes pienā*** **(n=139)***

Variables / ***Rādītāji***	**Unstandardized regression coefficient /** ***Nestandartizēts regresijas koeficients***	**The standard error of the coefficient /** ***Koeficienta standartkļūda***	**Standardised coefficient /** ***Standartizēts koeficients***	***p*-value /** ***p-vērtība***
Intercept / ***Regresijas konstante***	-1.304	0.192	-	**<0.0005**
Maternal ALA intake three days before sampling / ***Mātes uzņemtais ALS daudzums trīs dienas pirms mātes piena parauga ievākšanas***	0.146	0.057	0.232	**0.011**
Maternal ALA intake two days before sampling / ***Mātes uzņemtais ALS daudzums divas dienas pirms mātes piena parauga ievākšanas***	0.045	0.059	0.068	0.450

Table 3.27. continued / *3.27. tabulas turpinājums*

Variables / *Rādītāji*	**Unstandardized regression coefficient / *Nestandartizēts regresijas koeficients***	**The standard error of the coefficient / *Koeficienta standartkļūda***	**Standardised coefficient / *Standartizēts koeficients***	***p*-value / *p-vērtība***
Maternal ALA intake one day before sampling / *Mātes uzņemtais ALS daudzums dienu pirms mātes piena parauga ievākšanas*	0.246	0.054	0.371	**<0.0005**

* participants who were able to both donate human milk for fatty acid composition analysis and submitted the 72-hour diary / *dalībnieces, kuras ziedoja mātes pienu taukskābju sastāva analīzēm un iesniedza 72-stundu uztura dienasgrāmatu.*

Dietary sources for **arachidonic acid** are meat, milk & dairy products, but arachidonic acid in the body can be also synthesized from the precursor – linoleic acid (Brenna & Lapillonne, 2009). It seems that arachidonic acid level in human milk is mostly affected by the maternal diet, but up to 3.2 % of arachidonic in human milk originates from the endogenous synthesis from linoleic acid (Demmelmair et al., 1998).

Unfortunately, we were not able to calculate the median intake of arachidonic acid among the participants, therefore we were unavailable to evaluate if maternal intake of arachidonic acid affects the level of arachidonic acid in the human milk, respectively. But we did observe that arachidonic acid level in human milk negatively correlated with habitual intake of cereals, cereal products & potatoes (ρ=-0.254, p=0.004) and habitual intake of pulses (ρ=-0.248, p=0.005).

Lactating women who often consume fish have been shown to have a higher **docosahexaenoic acid** level in their milk (de la Presa-Owens, López-Sabater & Rivero-Urgell, 1996; Quinn & Kuzawa, 2012; Wu et al., 2010). Also, in this study, a habitual fish & seafood intake positively correlated with docosahexaenoic acid level in human milk (ρ=0.287, p=0.001). Participants who consumed fish at least twice a week had a significantly higher docosahexaenoic acid level in human milk compared to non-fish eaters (p=0.001) (Table 3.28.).

Table 3.28. / *3.28. tabula*

The docosahexaenoic acid level in human milk depending on the fish intake frequency / *Dokozaheksaēnskābes saturs mātes pienā atkarībā no zivju lietošanas biežuma uzturā* (n=138)*

DHA level in human milk / *DHS saturs mātes pienā* (%)	**Non-fish eaters / *Neēd zivis vai ēd tās reti* (n=87)**	**Consuming fish once a week / *Lieto zivis uzturā 1x nedēļā* (n=31)**	**Consuming fish ≥2 times a week / *Lieto zivis uzturā vismaz 2x nedēļā* (n=20)**
Median (IQR) / *Mediāna (SKI)*	0.30 % (0.30 %)	0.30 % (0.10 %)	0.50 % (0.47 %)
Range / *Diapazons*	0.10 %–3.20 %	0.20 %–1.30 %	0.20 %–4.30 %

* the number of the participants who donate human milk for fatty acid composition analysis and submitted the completed FFQ / *dalībnieču skaits, kuras ziedoja mātes piena taukskābju sastāva analīzēm un iesniedza pārtikas produktu lietošanas biežuma anketu.*

There was also a significant strong positive association between dietary eicosapentaenoic acid and docosahexaenoic acid intake and docosahexaenoic acid level in human milk ($\rho=0.534$, $p<0.0005$ and $\rho=0.570$, $p<0.0005$, respectively).

Multiple regression analysis also confirmed that maternal intake of docosahexaenoic acid all three days before sampling significantly influenced docosahexaenoic acid level in human milk, $F(3, 134)=13.347$, $p<0.0005$ (Table 3.29.). Overall, maternal intake of docosahexaenoic acid explained 26 % of the variability of the docosahexaenoic acid level in human milk (adjusted $R^2=0.259$).

***trans* fatty acids** synthesis in humans is limited, therefore their presence in human milk derives from the maternal diet (Larqué, Zamora & Gil, 2001). Nevertheless, no direct association was found between maternal intake of *trans* fatty acids and *trans* fatty acid level in human milk ($\rho=0.167$, $p=0.056$), but overall, a higher *trans* fatty acid level in human milk was observed among the participants with a higher intake of animal-based food products (Annex XVI).

Researchers Precht & Molkentin (1999) observed that a high **vaccenic acid** level in human milk among lactating women in Germany was linked to high consumption of milk and dairy products. However, no significant correlation between vaccenic acid level in human milk and milk & dairy products intake was found in this study ($\rho=0.078$, $p=0.379$).

However, **elaidic acid** as well as **linolelaidic acid** level in human milk correlated with maternal intake of milk & dairy products ($\rho=0.607$, $p<0.0005$ and $\rho=0.436$, $p<0.0005$).

Overall, elaborated results indicate that milk & dairy products are the dominant source of *trans* fatty acids found in human milk among lactating women in Latvia.

Table 3.29. / *3.29. tabula*

Summary of multiple regression analysis regarding maternal docosahexaenoic acid intake and docosahexaenoic acid level in human milk / *Daudzfaktoru regresijas analīzes rezultāti par dokozaheksaēnskābes uzņemšanu ar uzturu un dokozaheksaēnskābes saturu mātes pienā* (n=138)*

Variables / *Rādītāji*	**Unstandardized regression coefficient / *Nestandartizēts regresijas koeficients***	**The standard error of the coefficient / *Koeficienta standartkļūda***	**Standardised coefficient / *Standartizēts koeficients***	***p*-value / *p-vērtība***
Intercept / *Regresijas konstante*	-0.955	0.093	-	**<0.0005**
Maternal DHA intake three days before sampling / *Mātes uzņemtais DHS daudzums trīs dienas pirms mātes piena parauga ievākšanas*	0.104	0.030	0.302	**0.001**
Maternal DHA intake two days before sampling / *Mātes uzņemtais DHS daudzums divas dienas pirms mātes piena parauga ievākšanas*	0.073	0.036	0.183	**0.048**
Maternal DHA intake one day before sampling / *Mātes uzņemtais DHS daudzums dienu pirms mātes piena parauga ievākšanas*	0.087	0.033	0.241	**0.009**

* two participants out of did not submit the 72-hour diary. Results of one participant was excluded as significant outlier in this analysis / *divas no 141 dalībnieces, neiesniedz 72-stundu uztura dienasgrāmatas. Viena dalībnieces rezultāti tika izslēgti no šīs analīzes kā izlecošā vērtība.*

3.4.3. Essential and potentially toxic element content in human milk in relation to maternal nutrition / *Uztura ietekme uz esenciālo un potenciāli toksisko elementu saturu mātes pienā*

The majority of researchers state that there is no direct association between maternal dietary intake of essential elements and the content of these elements in human milk (Bravi et al., 2016) indicating that a woman's body adapts to the additional nutrient loss via human milk (Hale & Hartmann, 2017; Lawrence & Lawrence, 2015).

Correlations between maternal habitual food intake or immediate nutrient intake and essential element content in human milk are summarized in Annex XVIII and Annex XIX.

Calcium content in human milk was higher for the participants who reported a higher habitual intake of eggs, meat & meat products (ρ=0.404, *p*=0.002). On the contrary, participants who, according to the data from the 72-hour food diary, reported a higher intake of iron had a lower content of calcium in human milk (ρ=-0.324, *p*=0.014). Calcium content in human milk was lower among participants with higher plant-based fat (ρ=-0.279, *p*=0.036), fibre (ρ=-0.294, *p*=0.026), fructose (ρ=-0.288, *p*=0.030), vitamin E (ρ=-0.283, *p*=0.033) and carotenoid (ρ=-0.268, *p*=0.044) intake, but no direct association was found between maternal intake of calcium and calcium content in human milk (ρ=-0.063, *p*=0.642).

There was no direct association between maternal intake of magnesium and **magnesium** content in human milk (ρ=-0.160, *p*=0.235). Only a weak significant association was found between magnesium content in human milk and habitual intake of fish & seafood (ρ=0.298, *p*=0.024).

Sodium was the only element which content in human milk was directly influenced by the maternal intake of sodium and salt. However, only a weak association was found between maternal intake of sodium & salt, and sodium content in human milk (ρ=0.263, *p*=0.048 and ρ=0.265, *p*=0.046, respectively). Researchers from Sweden (Björklund et al., 2012) also have reported that sodium content in human milk may be affected by maternal sodium intake. Researchers Tan et al. (2020) also report a significant correlation between maternal intake of sodium and sodium content in human milk, but only in transitional human milk samples (2 to 3 weeks postpartum).

However, a stepwise multiple regression disclosed that sodium content in human milk is not directly influenced by the maternal intake of sodium, F(3,61)=1.332, *p*=0.272 (Table 3.30.). Other factors, like infant age, lactose, protein, calcium, magnesium, and potassium content in human milk potentially interacts with sodium content in human milk (Table 3.31. and Table 3.32.).

Table 3.30. / *3.30. tabula*

Summary of multiple regression analysis regarding maternal sodium intake and sodium level in human milk / *Daudzfaktoru regresijas analīzes rezultāti par nātrija uzņemšanu ar uzturu un nātrija saturu mātes pienā* (n=65)*

Variables / *Rādītāji*	**Unstandardized regression coefficient / *Nestandartizēts regresijas koeficients***	**The standard error of the coefficient / *Koeficienta standartkļūda***	**Standardised coefficient / *Standartizēts koeficients***	***p*-value / *p-vērtība***
Intercept / *Regresijas konstante*	11.248	1.675	-	**<0.0005**
Maternal sodium intake three days before sampling / *Mātes uzņemtais nātrija daudzums trīs dienas pirms mātes piena parauga ievākšanas*	0.000	0.001	-0.106	0.461
Maternal sodium intake two days before sampling / *Mātes uzņemtais nātrija daudzums divas dienas pirms mātes piena parauga ievākšanas*	0.001	0.001	0.209	0.146
Maternal sodium intake one day before sampling / *Mātes uzņemtais nātrija daudzums dienu pirms mātes piena parauga ievākšanas*	0.000	0.000	0.137	0.302

* participants who both donated human milk for element analysis and submitted 72-hour food diary / *dalībnieces, kuras ziedoja mātes pienu elementu noteikšanai un iesniedza 72-stundu uztura dienasgrāmatu.*

Potassium content in human milk was negatively associated with habitual intake of pulses (ρ=-0.299, *p*=0.024). Similar observations have not been reported from other researchers, therefore further research should be conducted to explain obtained correlation.

Potassium is a dominant osmotic element found in the cells but sodium – the dominant osmotic element found outside the cells. This could potentially explain why a lower content of potassium in human milk was found among the participants who reported a higher salty snack & fast food (ρ=-0.316, *p*=0.017) consumption, because these products contain a high amount of sodium. Nevertheless, no significant correlation was found regarding sodium or salt intake and potassium level in human milk (ρ=-0.033, *p*=0.809 and ρ=-0.031, *p*=0.817).

Also, lower potassium content in human milk was among women with a higher intake of zinc (ρ=-0.305, *p*=0.023) and sucrose (ρ=-0.286, *p*=0.031). Nevertheless, no direct association was found between maternal intake of potassium and potassium content in human milk (ρ=-0.067, *p*=0.622).

Zinc content in human milk was positively affected by the maternal intake of polyunsaturated fatty acids (ρ=0.277, *p*=0.037), n-6 polyunsaturated fatty acids (ρ=0.305, *p*=0.021) and linoleic acid (ρ=0.311, *p*=0.018), but a negative association was found for fish & seafood intake (ρ=-0.265, *p*=0.046). No direct association was found between maternal intake of zinc and zinc content in human milk (ρ=0.001, *p*=0.996).

Other essential element (**iron, selenium, manganese, copper, cobalt, chromium**), content in human milk was below the detection limit, therefore further evaluation regarding maternal diet impact on the content of elements in human milk was not possible.

Although few significant associations were found between essential element content in human milk and maternal diet, overall, we conclude that essential element content in human milk is unlikely to be influenced by the direct maternal intake of essential elements.

Researchers from other countries report that maternal diet affects **potentially toxic element** content in human milk. For example, researchers from Norway (Vollset et al., 2019) reported that lead content in human milk was associated with the intake of by-products from wild animals (liver & kidneys), but no association with maternal dietary habits was found for cadmium. On the opposite, researchers from Slovenia reported an association between cadmium content in human milk and vegetable intake (Tratnik et al., 2019).

In the majority of obtained human milk samples from this study, potentially toxic element content (aluminium, nickel, arsenic, strontium, cadmium, tin, antimony, lead) was below the detection limit, therefore further evaluation regarding maternal diet impact on the potentially toxic element content in human milk was not possible.

Summary of Chapter 3.4. / *3.4. nodaļas kopsavilkums*

Overall, the fatty acids (≥C16) level in human milk was directly affected by the immediate maternal intake of these fatty acids, respectively. Fatty acid (≥C16) level in human milk was mostly affected by the maternal intake of these fatty acids in the previous day before sampling.

Participants with a higher animal product intake had a higher level of palmitic acid, saturated fatty acid, *trans* fatty acid, but a lower level of linoleic acid, total polyunsaturated fatty acid as well as n-6 polyunsaturated fatty acid level in human milk.

The docosahexaenoic acid level in human milk was associated with habitual fish intake, and participants who consumed fish at least twice a week had approximately 1.5 times higher level of docosahexaenoic acid in human milk (0.50 %) compared to participants who avoided eating fish or ate them rarely (0.30%).

Also, elaborated results showed that the choice of plant oil can impact the fatty acid composition of human milk.

Although some statistically significant associations were found between the macronutrient (fat, protein, lactose) or essential element content in human milk and the maternal consumption of certain products or nutrients, overall, the content of the above-mentioned nutrients in human milk was not directly influenced by the maternal intake of these nutrients.

Taukskābju (≥C16) saturs mātes pienā bija tieši atkarīgs no taukskābju uzņemšanas ar uzturu. Taukskābju (≥C16) saturu mātes pienā visbūtiskāk ietekmēja attiecīgo taukskābju uzņemšana ar uzturu dienu pirms piena parauga ievākšanas pētījumam.

Pētījuma dalībniecēm ar augstāku dzīvnieku valsts izcelsmes produktu patēriņu bija augstāks palmitīnskābes, kopējais piesātināto taukskābju, trans taukskābju saturs mātes pienā, *bet zemāks linolskābes, kopējais polinepiesātināto taukskābju, kā arī n-6 polinepiesātināto taukskābju saturs mātes pienā.*

Dokozaheksaēnskābes saturs mātes pienā bija atkarīgs no zivju lietošanas biežuma uzturā. Pētījuma dalībniecēm, kuras uzturā lietoja zivis vismaz 2x nedēļā, bija 1.5 reizes augstāks dokozaheksaēnskābes saturs mātes pienā (0.50 %), salīdzinot ar tām pētījuma dalībniecēm, kuras zivis lietoja reti vai vispār nelieto uzturā (0.30 %).

Iegūtie pētījuma rezultāti norāda, ka arī augu eļļas izvēle var ietekmēt taukskābju sastāvu mātes pienā.

Lai gan dažas statistiski ticamas saistības tika konstatētas starp makrouzturvielu (tauku, olbaltumvielu, laktozes) vai esenciālo elementu saturu mātes pienā un konkrētu produktu lietošanu vai uzturvielu uzņemšanu, kopumā augstāk minēto uzturvielu saturs mātes pienā nebija tieši atkarīgs no šo pašu uzturvielu uzņemšanas daudzuma ar uzturu.

3.5. Supply of energy and nutrients for exclusively breastfed infants via human milk / *Enerģijas un uzturvielu nodrošinājums ar mātes pienu ekskluzīvi zīdītiem zīdaiņiem*

To evaluate if exclusively breastfed infants (1 to 6 months old) from this study received a sufficient amount of energy and nutrients via human milk, we used the following formula (3.1.):

$$a = b \times c, \tag{3.1.}$$

where a – daily amount of energy or nutrient consumed via human milk;
b – obtained median energy or nutrient value in 100 ml of human milk;
c – mean daily intake of human milk consumed by the infant depending on age in the developed countries, ml (Fig. 3.3.).

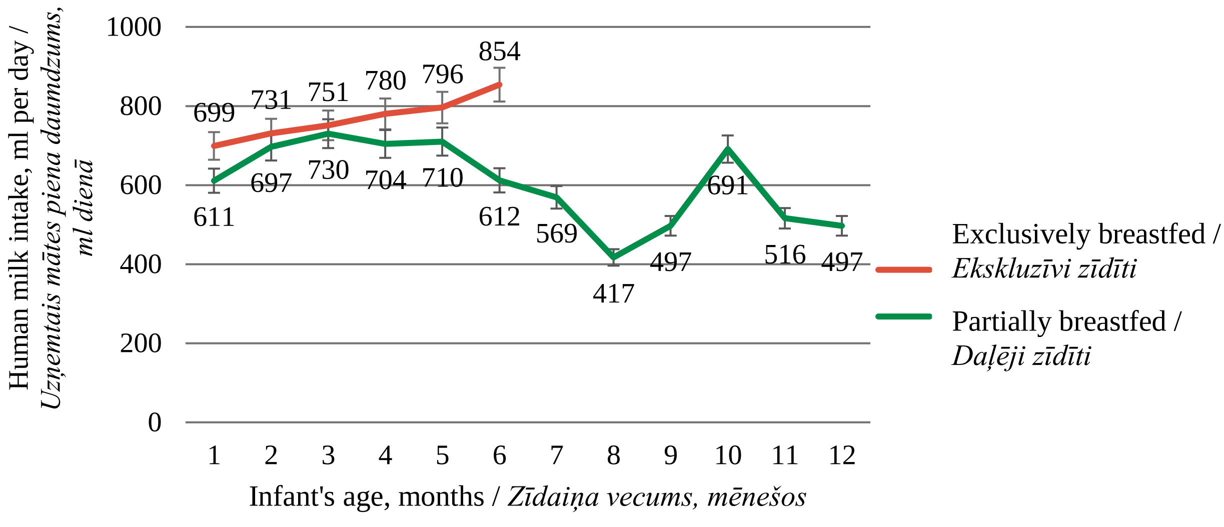

Fig. 3.3. **Mean daily human milk intake by infants in the developed countries /**
3.3. att. ***Vidējais uzņemtais mātes piena daudzums dienā zīdaiņiem attīstītajās valstīs***
(Butte, Lopez-Alarcon & Garza, 2002)

Then elaborated values were compared with the level of nutrients that are considered to be adequate for the majority of infants (Table 3.31.).

Table 3.31. / *3.31. tabula*

Daily intake of energy and macronutrients via human milk for exclusively breastfed infants (1 to <6 months) / *Dienā ar mātes pienu uzņemtais enerģijas un makrouzturvielu daudzums ekskluzīvi zīdītiem 1 līdz 6 mēnešus veciem zīdaiņiem* (n=83)*

Nutrient (unit) / *Uzturviela (mērvienība)*	**Nutrient supply via human milk according to elaborated data / *Uzturvielu nodrošinājum ar mātes pienu, balstoties uz pētījuma datiem***		**Level of intake that is considered adequate for the majority of infants / *Daudzums, ko uzskata par adekvātu lielākajai daļai zīdaiņu*** (European Food Safety Authority, 2013)	**Recommen-ded intake / *Ieteicamais daudzums*** (Veselības ministrija, 2017a)
	Median (IQR) / *Mediāna (SKI)*	**Range / *Diapazons***		
Energy / *Enerģija* (kcal)	519.25 (102.14)	366.67–708.30	335–358 (1 to <2 months / *1 līdz <2 mēneši*)	520 (girls / *meitenes*) 590 (boys / *zēni*)
	510.74 (103.78)	384.39–672.17	454–502 (2 to <3 months / *2 līdz <3 mēneši*)	
	506.55 (120.31)	328.61–717.81	478–523 (3 to <4 months / *3 līdz <4 mēneši*)	
	538.62 (98.91)	312.44–697.63	502–550 (4 to <5 months / *4 līdz <5 mēneši*)	
	524.56 (98.20)	411.13–644.95	550–573 (5 to <6 months / *5 līdz < 6 mēneši*)	
Carbohydrates / *Ogļhidrāti* (E %)	39.96 (9.66)	22.88–69.04	40–45	ND / *ND*
Protein / *Olbaltumvielas* (g per day / *g dienā*)	8.79 (1.23)	6.53–13.37	7–9	ND / *ND*
Fat / *Tauki* (E %)	53.34 (11.04)	22.47–68.84	50–55	ND / *ND*
LA / *LS* (E %)	13.30 (6.20)	6.30–35.30	4	ND / *ND*
ALA / *ALS* (E %)	0.75 (0.47)	0.20–4.19	0.50	ND / *ND*
ARA / *ARS* (mg)	91.43 (79.03)	17.54–941.41	140	ND / *ND*
DHA / *DHS* (mg)	109.43 (87.88)	36.27–960.96	100	ND / *ND*

* count of the participants who were exclusively breastfeeding their 1 to 6 months old infants and were able to donate milk both for fat, protein, lactose, and fatty acid composition analysis / *pētījuma dalībnieču skaits, kuras ekskluzīvi zīdīja 1 līdz 6 mēnešus vecu zīdaini un ziedoja mātes pienu tauku, olbaltumvielu, laktozes un taukskābju sastāva analīzēm.*

Based on theoretical calculations, the energy intake among 1–2 months old exclusively breastfed infants was higher than the level considered to be adequate. The energy intake among 3–4 months old exclusively breastfed infants was adequate, but energy intake among 5 to <6 months old exclusively breastfed infants was lower than the level considered to be adequate (Table 3.31.).

Median daily intake of **protein**, **fat**, and **carbohydrates** (in this case, **lactose**) via human milk for exclusively breastfed infants till six months of age was adequate according to the European Food Safety Authority guidelines (European Food Safety Authority, 2013) (Table 3.31.).

Median energy intake of **linoleic acid** via human milk for exclusively breastfed infants (1 to <6 months) in this study was significantly higher than the level considered adequate for the majority of infants according to the European Food Safety Authority guidelines (European Food Safety Authority, 2013). The median daily intake of **α-linolenic acid** and **docosahexaenoic acid** via human milk for exclusively breastfed infants in this study was slightly higher than the adequate daily intake, but median daily intake of **arachidonic acid** via human milk was lower than adequate daily intake according to the European Food Safety Authority guidelines (Table 3.31.). However, a large variance in daily fatty acids intake for infants via human milk was observed since fatty acid levels in human milk were affected by maternal dietary intake which was also quite variable among the participating women.

Although currently European Food Safety Authority (2010b) states that there is a lack of evidence to set a specific **n-6 / n-3 polyunsaturated fatty acid ratio** in the diet, studies show that a high n-6 / n-3 polyunsaturated fatty acid ratio (~ 9/1) in human milk is linked to an increased amount of pro-inflammatory cytokines (tumour necrosis factor-alpha, interleukin 6 and interferon-gamma) that can alter the metabolism of an infant, and is associated with the risk of obesity in later life (Muhlhausler & Ailhaud, 2013; Vaidya & Cheema, 2018). It is suggested that the **linoleic acid / α-linolenic acid ratio** in the diet of infants should not exceed 5 / 1 to improve plasma docosahexaenoic acid levels (Makrides et al., 2000). The calculated linoleic acid / α-linolenic acid ratio in human milk samples in this study was ~ 9 / 1, therefore almost twice as high as recommended by Makrides et al. (2000). n-6 / n-3 polyunsaturated fatty acid ratio was somewhat lower (~ 7 / 1, respectively).

There were 38 participants from the first study period who were exclusively breastfeeding 1 to <6 months old infants and were able to donate human milk for essential element analysis. According to theoretically calculated data, those exclusively breastfed infants received a sufficient amount of **calcium, magnesium, and potassium** (Fig. 3.4., 3.5. and 3.6.).

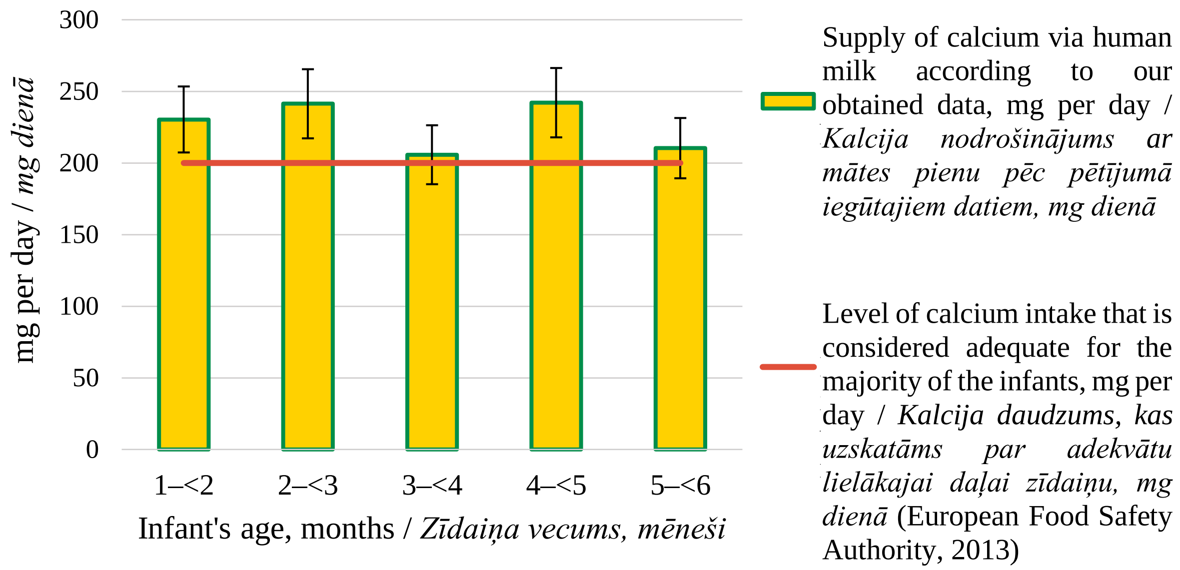

Fig. 3.4. **Supply of calcium via human milk for exclusively breastfed infants /**
3.4. att. ***Kalcija nodrošinājums ar mātes pienu ekskluzīvi zīdītiem zīdaiņiem*** (n=38)

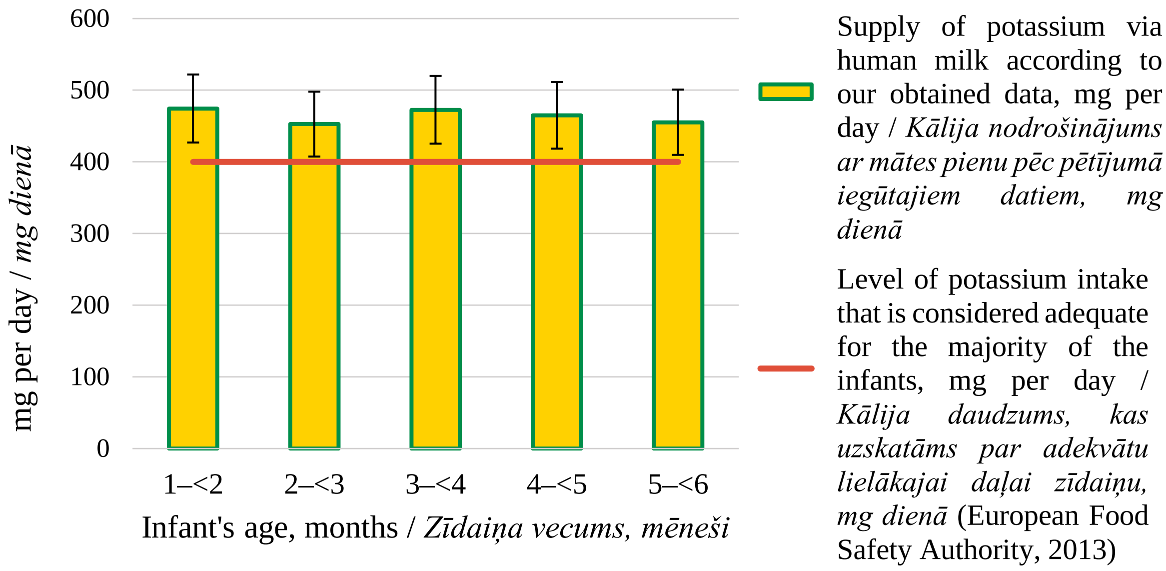

Fig. 3.5. **Supply of potassium via human milk for exclusively breastfed infants /** *3.5. att.* ***Kālija nodrošinājums ar mātes pienu ekskluzīvi zīdītiem zīdaiņiem*** (n=38)

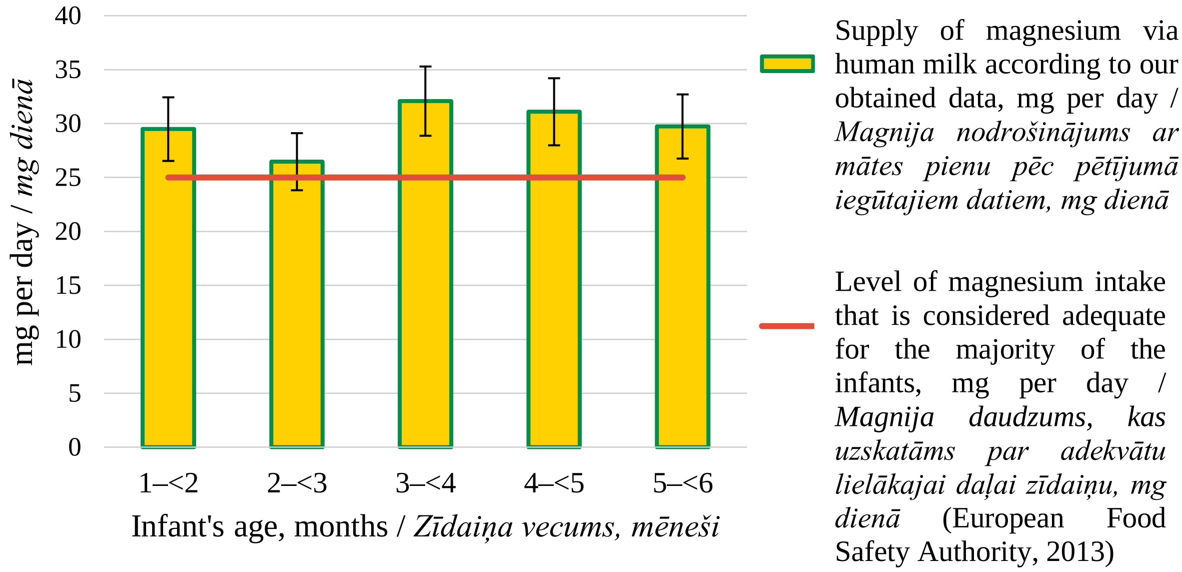

Fig. 3.6. **Supply of magnesium via human milk for exclusively breastfed infants /** *3.6. att.* ***Magnija nodrošinājums ar mātes pienu ekskluzīvi zīdītiem zīdaiņiem*** (n=38)

Although median sodium and salt intake among the participants was higher than recommended, but zinc intake within guidelines, the daily intake of **sodium** and **zinc** for exclusively breastfed infants via human milk according to calculated data was lower than adequate values based on European Food Safety Authority scientific opinion (Fig. 3.7. and 3.8).

A lower **sodium** level in human milk and therefore an insufficient intake of sodium for infants via human milk have been also reported by other researchers (Daniels et al., 2019), but they explain elaborated results by diurnal variations (human milk samples in their study was collected only in the morning) and breastfeeding frequency.

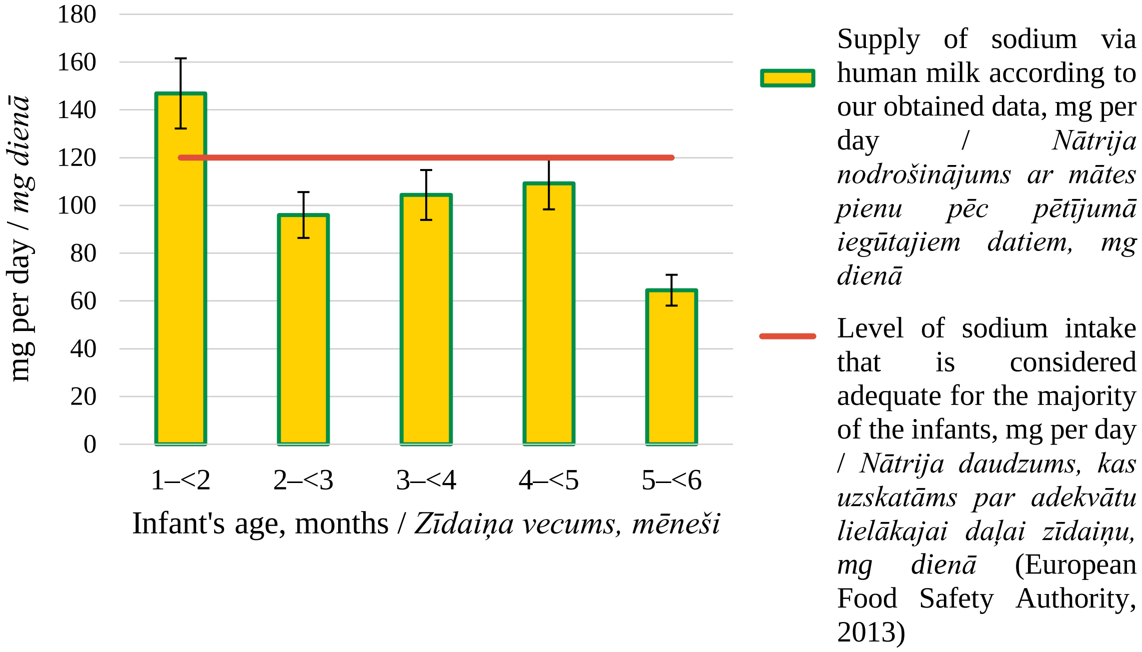

Fig. 3.7. **Supply of sodium via human milk for exclusively breastfed infants /**
3.7. att. ***Nātrija nodrošinājums ar mātes pienu ekskluzīvi zīdītiem zīdaiņiem*** (n=38)

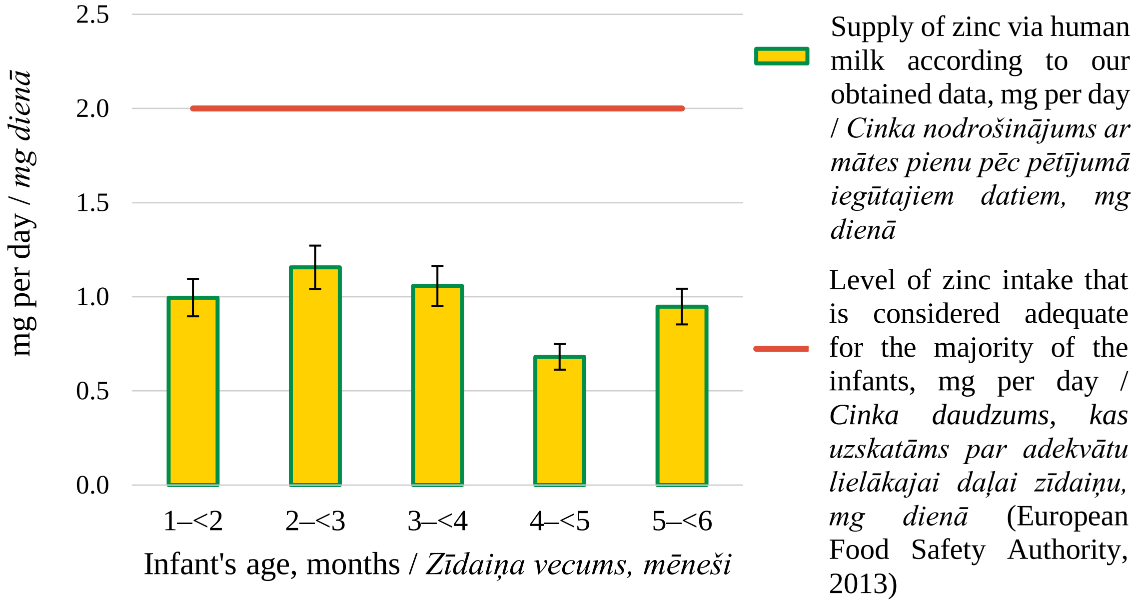

Fig. 3.8. **Supply of zinc via human milk for exclusively breastfed infants /**
3.8. att. ***Cinka nodrošinājums uzņemts ar mātes pienu ekskluzīvi zīdītiem zīdaiņiem*** (n=38)

Zinc could be the first limiting nutrient in human milk because its content significantly lowers as lactation progresses (from ~ 0.54 mg 100 ml^{-1} in colostrum to 0.12 mg 100 ml^{-1} in mature human milk) (Awua et al., 2019). It was also noted in this study that a child's age was a significant negative predictor for zinc content in human milk (ρ=-0.250, p=0.039).

However, it should be taken into account that an adequate level of some essential elements for the infant could be met both by human milk and endogenous stores (for example, iron) (Butte, Lopez-Alarcon & Garza, 2002; European Food Safety Authority, 2013). Therefore, future research should aim for the assessment of limiting essential element status by evaluating essential element content not only in human milk, but also in plasma or serum for both mothers and infants.

Due to insufficient data, the upper limit for nutrient intake in infancy has not been declared (except for vitamin D) (European Food Safety Authority, 2013), therefore it was not possible in this study to evaluate if exclusively breastfed infants could potentially receive higher nutrient intakes than needed.

I also should be declared that these were only theoretical calculations based on a small sample size. To evaluate if the infant receives enough energy and nutrients via human milk, regular anthropometrical measurements should be performed by the child's family doctor (Nacionālais Veselības dienests, 2020), and obtained results should be evaluated using growth charts developed by World Health Organization (Nacionālais Veselības dienests, 2020; World Health Organization, 2021).

Summary of Chapter 3.5. / *3.5. nodaļas kopsavilkums*

Based on theoretical calculations, 1 to 6 months old exclusively breastfed infants whose mothers participated in the study received a sufficient energy and macronutrient (fat, protein, and carbohydrate) as well as fatty acid – α-linolenic and docosahexaenoic acid intake via human milk. On the contrary, linoleic acid intake among exclusively breastfed infants from this study was higher, but arachidonic intake lower than adeqaute.

Based on theoretical calculations, 1 to 6 months old exclusively breastfed infants whose mothers participated in the study, received an adequate intake of calcium, magnesium, and potassium via human milk, but a low supply of sodium and zinc via human milk raises concern. To more objectively assess if exclusively breastfeed infants have an optimal essential element status, future research should aim to evaluate not only essential element content in human milk, but also to analyse essential element levels in plasma or serum of both mothers and infants.

Pamatojoties uz aprēķiniem, 1 līdz 6 mēnešus veci ekskluzīvi zīdīti zīdaiņi, kuru mātes piedalījās pētījumā, ar mātes pienu saņēma atbilstošu enerģijas, tauku, olbaltumvielu, ogļhidrātu, α-linolēnskābes un dokozaheksaenskābes daudzumu. Linolskābes uzņemšana bija augstāka, bet arahidonskābes uzņemšana – zemāka par adekvāto daudzumu.

Pamatojoties uz aprēķiniem, 1 līdz 6 mēnešus veci ekskluzīvi zīdīti zīdaiņi, kuru mātes piedalījās pētījumā, ar mātes pienu saņēma pietiekamu kalcija, magnija un kālija daudzumu, bet zemais nātrija un cinka saturs mātes pienā rada bažas. Lai objektīvāk varētu novērtēt vai ekskluzīvi zīdītiem zīdaiņiem ir optimāls esenciālo elementu nodrošinājums, turpmākās izpētes ietvaros būtu jāveic ne tikai esenciālo elementu satura noteikšana mātes pienā, bet jāvērtē arī to saturs mātes un zīdaiņa asins serumā vai plazmā.

CONCLUSIONS

1) For the first time in Latvia fatty acid composition of human milk has been comprehensively studied providing an insight of differences related to the geographical location and dietary patterns of the lactating women.
2) Three dominating fatty acids in human milk were palmitic acid, oleic acid, and linoleic acid, in total compiling ~ 71 % of the total fatty acid level in human milk.
3) Although median docosahexaenoic acid level in human milk corresponded to the recommended target value – 0.30 %, a large variance in values was observed (from 0.10 % to 4.30 % of a total fatty acid level).
4) Compared to other countries, a low total *trans* fatty acid level (<2.0 %) in human milk was observed.
5) Elaborated values for fat, protein, lactose and calcium, potassium, magnesium content in human milk were similar to data found in literature, but zinc and sodium content in human milk was lower comparing to data from other countries.
6) Human milk contained only trace amounts of arsenic, cadmium, tin, and lead which did not exceed the maximum levels of potentially toxic elements defined in legislation for in the infant formulas and foodstuff destined for infants and toddlers.
7) Participants consumed more fat, saturated fatty acids, and salt than recommended, but dietary intake of carbohydrates, fibre, eicosapentaenoic acid, and docosahexaenoic acid, calcium, iron, and vitamins A, D, B_1, B_2, B_9 was insufficient.
8) Low intake for the majority of essential nutrients (carbohydrates, fibre, eicosapentaenoic acid, and docosahexaenoic acid, calcium, iron, and vitamins A, D, B_1, B_2, B_9) among the participants was due to insufficient intake of nutritious foods like vegetables, fruits, berries, pulses, cereals, milk & dairy products, and fish.
9) Immediate maternal intake affects the fatty acid (C≥16) composition of human milk. Also, the habitual intake of specific food products (like fish, plant oils, etc.) affects the fatty acid composition of human milk and therefore impacts the fatty acid intake for the infant.
10) On the opposite, macronutrient (fat, protein, lactose), as well as essential element content in human milk is insensitive to immediate maternal diet.
11) Based on calculations, 1 to 6 months old exclusively breastfed infants received adequate energy, fat, protein, carbohydrate, α-linolenic, docosahexaenoic acid, calcium, magnesium, and potassium intake via human milk, but the intake of arachidonic acid, sodium and zinc was lower than recommended.
12) The hypothesis of the research was approved – maternal nutrition predicts human milk composition and serves as the basis for providing essential nutrients for the infant.

SECINĀJUMI

1) Pirmo reizi Latvijā ir vispusīgi analizēts taukskābju sastāvs mātes pienā, sniedzot ieskatu atšķirībās, kas saistītas ar ģeogrāfisko ietekmi un mātes uztura paradumiem.
2) Dominējošās taukskābes mātes pienā ir palmitīnskābe, oleīnskābe un linolskābe, nodrošinot ~ 71 % no kopējā taukskābju satura mātes pienā.
3) Lai gan dokozaheksaēnskābes saturs mātes pienā sasniedza rekomendēto robežvērtību – 0.30 %, tas krasi atšķīrās analizētajos mātes piena paraugos (no 0.10 % līdz 4.30 % no kopējā taukskābju satura).
4) Salīdzinot ar citu valstu pētījumiem, tika konstatēts mazs kopējais *trans* taukskābju saturs mātes pienā (<2 %).
5) Noteiktais tauku, olbaltumvielu, laktozes, kalcija, kālija un magnija saturs mātes pienā bija salīdzināms ar literatūras datiem, bet cinka un nātrija saturs bija zemāks nekā citu valstu pētījumos.
6) Mātes piens saturēja nenozīmīgu arsēna, kadmija, alvas un svina daudzumu, nepārsniedzot maksimāli pieļaujamo saturu, kas noteikts normatīvajos aktos mātes piena aizstājējiem un pārtikai, kas paredzēta zīdaiņu un mazu bērnu ēdināšanai.
7) Pētījuma dalībnieces ar uzturu uzņēma vairāk tauku, piesātināto taukskābju un sāls nekā ieteicams, bet nepietiekamā daudzumā tika uzņemti ogļhidrāti, šķiedrvielas, eikozapentaēnskābe un dokozaheksaēnskābe, kalcijs, dzelzs, A, D, B_1, B_2, B_9 vitamīni.
8) Uzņemtais uzturvielu (ogļhidrāti, šķiedrvielas, eikozapentaēnskābe un dokozaheksaēnskābe, kalcijs, dzelzs, A, D, B_1, B_2, B_9 vitamīni) daudzums pētījuma dalībniecēm skaidrojums ar nepietiekamu dārzeņu, augļu, ogu, pākšaugu, graudaugu, piena, piena produktu un zivju patēriņu.
9) Taukskābju uzņemšana ar uzturu ietekmē taukskābju ($C \geq 16$) sastāvu mātes pienā. Arī noteiktu produktu lietošana (piemēram, zivju, augu eļļas izvēle u.c.) ietekmē taukskābju sastāvu un saturu mātes pienā.
10) Makrouzturvielu (tauku, olbaltumvielu, laktozes) un esenciālo elementu saturs mātes pienā nav atkarīgs no sievietes uztura zīdīšanas periodā.
11) Pamatojoties aprēķiniem, 1 līdz 6 mēnešus veci ekskluzīvi zīdīti zīdaiņi ar mātes pienu uzņēma atbilstošu enerģijas, tauku, olbaltumvielu, ogļhidrātu, α-linolēnskābes, dokozaheksaēnskābes, kalcija, magnija un kālija daudzumu, bet arahidonskābes, nātrija un cinka uzņemšana bija mazāka par vadlīnijās noteikto.
12) Izvirzītā pētījuma hipotēze ir apstiprinājusies – mātes uzturs zīdīšanas periodā var ietekmēt piena sastāvu un nepieciešamo uzturvielu nodrošinājumu zīdainim.

PROPOSITIONS FOR FURTHER RESEARCH

In the future, author hopes to continue human milk composition analysis in relation to maternal nutrition on a much larger nationally representative sample (at least 500 samples) and to additionally analyse iodine and water-soluble vitamin content in human milk, because studies from other countries indicate that the content of these nutrients in human milk is also affected by maternal diet (Bravi et al., 2016; Keikha et al., 2017).

Also, oligosaccharide composition in human milk among lactating women in Latvia has not been previously evaluated and would be novel research to do. Other studies indicate that maternal diet can also affect the oligosaccharide composition in human milk (Seferovic et al., 2020).

At the beginning of 2022, the project Conducting Fundamental Research in the Latvia University of Life Sciences and Technologies (Project No. G1. Contract No. 3.2-10/2019/LLU) will conclude. During this project, a human milk fatty acid composition in relation to maternal nutrition has continued to be analysed. The number of analysed fatty acids has expanded, and the detection of conjugated linoleic acid in human milk samples has been included. A manuscript regarding *trans* fatty acid level in human milk in Latvia will be prepared for the publication in the scientific journal, indexed in the SCOPUS and/or Web of Science databases.

On May 2021, the European Social Fund Project No. 8.2.2.0/20/I/001 "Latvia University of Life Sciences and Technologies Transition to the New Doctoral Funding Model" has begun. During this project it is planned to participate in the international conference to present data about vitamin intake among lactating women in Latvia. It is also planned to prepare two manuscripts (about potentially toxic element content in human milk and dietary habits among lactating women in Latvia) for the publication in the scientific journals, indexed in the SCOPUS and/or Web of Science databases.

PRIEKŠLIKUMI TURPMĀKIEM PĒTĪJUMIEM

Ir plānots turpināt pētīt, kā uzturs ietekmē mātes piena sastāvu, izmantojot daudz lielāku nacionāli reprezentatīvu paraugu kopu (vismaz 500 paraugi) un papildus analizēt joda un ūdenī šķīstošo vitamīnu saturu mātes pienā, jo citu valstu pētījumi liecina ka šo uzturvielu saturu mātes pienā arī ietekmē uzturs (Bravi et al., 2016; Keikha et al., 2017).

Arī oligosaharīdu sastāvs mātes pienā sievietēm zīdīšanas periodā Latvijā iepriekš nav pētīts. Citu valstu pētījumi liecina, ka uzturs var ietekmēt arī oligosaharīdu sastāvu mātes pienā (Seferovic et al., 2020).

2022. gada sākumā noslēgsies projekts "Fundamentālo pētījuma veikšana Latvijas Lauksaimniecības universitātē" (Projekta Nr. G1, Līguma Nr. 3.2-10/2019/LLU). Minētā projekta ietvaros tiek turpināts analizēt uztura ietekmi uz mātes piena taukskābju sastāvu, un ir paplašināts nosakāmo taukskābju daudzums mātes pienā, iekļaujot konjugētās linolskābes noteikšanu. Šī projekta ietvaros plānots izstrādāt publikāciju par *trans* taukskābju sastāvu mātes pienā Latvijā, publicēšanā zinātniskajā žurnālā, kas tiek indeksēts SCOPUS un/vai Web of Science datu bāzēs.

2021. gada maijā tika uzsākts ESF projekts Nr. 8.2.2.0/20/I/001 "LLU pāreja uz jauno doktorantūras finansēšanas modeli". Šī projekta ietvaros plānots piedalīties starptautiskā konferencē, lai prezentētu datus par vitamīnu uzņemšanu sievietēm zīdīšanas periodā Latvijā. Plānots izstrādāt arī divas publikācijas (par potenciāli toksisko elementu saturu mātes pienā un sieviešu uztura paradumiem zīdīšanas periodā Latvijā) publicēšanai zinātniskajos žurnālos, kas tiek indeksēts SCOPUS un/vai Web of Science datu bāzēs.

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ANNEXES / ***PIELIKUMI***

Daily nutrient intakes that are considered to be adequate for the majority of infants and toddlers in Europe / *Dienā uzņemamais uzturvielu daudzums, ko uzskata par adekvātu lielākajai daļai zīdaiņu un mazu bērnu Eiropā* (European Food Safety Authority, 2013)

Nutrient (unit) / *Uzturviela (mērvienība)*	**0 to <6 months / *0 līdz < 6 mēneši***			**6 to <12 months / *6 līdz < 12 mēneši***			**12 to <36 months / *12 līdz < 36 mēneši***		
Water / *Ūdens* (ml)	700–1000			800–1000			1100–1300		
Energy / *Enerģija* (kcal / kJ)	Months / *Mēneši*	Boys / *Zēni*	Girls / *Meitenes*	Months / *Mēneši*	Boys / *Zēni*	Girls / *Meitenes*	Months / *Mēneši*	Boys / *Zēni*	Girls / *Meitenes*
	0 to / *līdz* <1	358 / 1498	334 / 1398	6 to / *līdz* <7	597 / 2498	550 / 2301	12 to / *līdz* <24	788 / 3297	717 / 3000
	1 to / *līdz* <2	502 / 2100	454 / 1900	7 to / *līdz* <8	645 / 2699	573 / 2397			
	2 to / *līdz* <3	526 / 2201	478 / 2000	8 to / *līdz* <9	669 / 2799	597 / 2498	24 to / *līdz* <36	1027 / 4297	956 / 4000
	3 to / *līdz* <4	502 / 2100	454 / 1900	9 to / *līdz* <10	693 / 2900	621 / 2598			
	4 to / *līdz* <5	550 / 2301	502 / 2100	10 to / *līdz* <11	717 / 3000	645 / 2699	≥36	1171 / 4900	1099 / 4598
	5 to / *līdz* <6	573 / 2397	550 / 2301	11 to / *līdz* <12	741 / 3100	669 / 2799			
Carbohydrates / *Ogļhidrāti* (E %)	40–45			45–55			45–60		
Fibre / *Šķiedrvielas* (g)	ND / *ND*			ND / *ND*			10		
Protein / *Olbaltumvielas* (g)	0 to / *līdz* <1	ND / *ND*	ND / *ND*	6 to / *līdz* <7	9	8	12 to / *līdz* <18	11	10
	1 to / *līdz* <2	8	7	7 to / *līdz* <8	11	10	18 to / *līdz* <24	11	11
	2 to / *līdz* <3	8	8	8 to / *līdz* <9	11	10	24 to / *līdz* <36	12	11
	3 to / *līdz* <4	9	8	9 to / *līdz* <10	11	10			
	4 to / *līdz* <5	9	8	10 to / *līdz* <11	11	10	≥36	13	13
	5 to / *līdz* <6	9	8	11 to / *līdz* <12	11	10			
Fats / *Tauki* (E %)	50–55			40			35–40		
LA / *LS* (E %)	4			4			4		
ALA / *ALS* (E %)	0.5			0.5			0.5		
ARA / *ARS* (mg)	140			ND / *ND*			ND / *ND*		
DHA / *DHS* (mg)	100			100			100 (<24 months / *mēneši*)		
EPA + DHA / *EPS + DHS* (mg)	ND / *ND*			ND / *ND*			250 (>24 months / *mēneši*)		

Nutrient (unit) / *Uzturviela (mērvienība)*	**0 to <6 months / *0 līdz < 6 mēneši***	**6 to <12 months / *6 līdz < 12 mēneši***	**12 to <36 months / *12 līdz < 36 mēneši***
Calcium / *Kalcijs* (mg)	200	400	600
Phosphorus / *Fosfors* (mg)	100	300	460
Potassium / *Kālijs* (mg)	400	800	800
Sodium / *Nātrijs* (mg)	120	170–370	170–370
Magnesium / *Magnijs* (mg)	25	80	85
Iron / *Dzelzs* (mg)	0.3 (breastfed infants / *zīdaiņi, kas saņem mātes pienu*)	8	8
Zinc / *Cinks* (mg)	2 (breastfed infants / *zīdaiņi, kas saņem mātes pienu*)	4	4
Copper / *Varš* (mg)	0.3	0.3	0.4
Manganese / *Mangāns* (mg)	0.003	0.02–0.5	0.5
Selenium / *Selēns* (µg)	12.5	15	20
Iodine / *Jods* (µg)	90	90	90
Chromium / *Hroms* (µg)	ND / *ND*	ND / *ND*	ND / *ND*
Vitamin A / *Vitamīns A* (µg RAE / *µg RAE*)	350	350	400
Vitamin D / *Vitamīns D* (µg)	10	10	10
Vitamin K / *Vitamīns K* (µg)	5	8.5	12
Vitamin E / *Vitamīns E* (mg TE / *mg TE*)	3	5	6
Vitamin C / *Vitamīns C* (mg)	20	20	20
Vitamin B_1 / *Vitamīns B_1* (mg)	0.2	0.3	0.5
Vitamin B_2 / *Vitamīns B_2* (mg)	0.3	0.4	0.8
Vitamin B_3 / *Vitamīns B_3* (mg NE / *mg NE*)	2	5	9
Vitamin B_5 / *Vitamīns B_5* (mg)	2	3	4
Vitamin B_6 / *Vitamīns B_6* (mg)	0.1	0.4	0.7
Vitamin B_7 / *Vitamīns B_7* (µg)	4	6	20
Vitamin B_9 / *Vitamīns B_9* (µg DFE / *µg UFE*)	65	80	100
Vitamin B_{12} / *Vitamīns B_{12}* (µg)	0.4	0.5	0.9

Changes through the years in recommended daily energy and nutrient intakes in the national guidelines for lactating women in Latvia / *Izmaiņas gadu laikā nacionālajās vadlīnijās ieteicamo enerģijas un uzturvielu devām sievietēm zīdīšanas laikā Latvijā*

Nutrient (unit) / ***Uzturviela (mērvienība)***	**Veselības ministrija (2008)**	**Veselības ministrija (2017a)**
Energy / *Enerģija* (kcal / kJ)	2000+500 kcal / 8368+2092 kJ	1700–2510 +500–600 kcal / 7113–10502 +2092–2510 kJ (depending on age / *atkarībā no vecuma*)
Protein / *Olbaltumvielas* (E %)	10–15 E % +20 g	10–20 E %
Fat / *Tauki* (E %)	25–30	25–30
SFA / *PT* (E %)	ND / *ND*	≤10
SFA/MUFA/PUFA / *PT/MNT/PNT*	1/1.2/0.8	ND / *ND*
Carbohydrates / *Ogļhidrāti* (E %)	55–60	45–60
Sugars / *Cukuri* (E %)	≤10	≤10 (free sugars / *"brīvie" cukuri*)
Sodium / *Nātrijs* (mg)	3300	2000
Salt / *Sāls* (g)	no more than 5 / *ne vairāk par 5*	no more than 5 / *ne vairāk par 5*
Potassium / *Kālijs* (mg)	4000	3100
Calcium / *Kalcijs* (mg)	1200	900
Phosphorus / *Fosfors* (mg)	1200	900
Magnesium / *Magnijs* (mg)	340	280
Iron / *Dzelzs* (mg)	18	15
Zinc / *Cinks* (mg)	19	11
Iodine / *Jods* (µg)	200	150–250
Selenium / *Selēns* (µg)	75	60
Copper / *Varš* (µg)	3.0	1.3
Manganese / *Mangāns* (mg)	3.5	ND / *ND*
Chromium / *Hroms* (mg)	0.2	ND / *ND*
Vitamin A / *Vitamīns A* (µg)	1300	1100
Vitamin D / *Vitamīns D* (µg)	10	10
Vitamin E / *Vitamīns E* (mg)	12	11
Vitamin K / *Vitamīns K* (µg)	65	ND / *ND*
Vitamin C / *Vitamīns C* (mg)	150	100
Vitamin B_1 / *Vitamīns B_1* (mg)	1.6	1.6
Vitamin B_2 / *Vitamīns B_2* (mg)	2.0	1.7
Vitamin B_3 / *Vitamīns B_3* (mg)	20	ND / *ND*
Vitamin B_6 / *Vitamīns B_6* (mg)	2.2	1.5
Vitamin B_9 / *Vitamīns B_9* (µg)	300	500
Vitamin B_{12} / *Vitamīns B_{12}* (µg)	3.0	2.0

Daily energy and nutrient reference values for women / *Dienā rekomendējamās enerģijas un uzturvielu devas sievietēm*

(European Food Safety Authority, 2019a; Nordic Council of Ministers, 2014; Veselības ministrija, 2017a)

Nutrient (unit) / *Uzturviela (mērvienība)*	**Veselības ministrija (2017a)**	**Nordic Council of Ministers (2014)**	**European Food Safety Authority (2019a)**	**Veselības ministrija (2017a)**	**Nordic Council of Ministers (2014)**	**European Food Safety Authority (2019a)**	**Veselības ministrija (2017a)**	**Nordic Council of Ministers (2014)**	**European Food Safety Authority (2019a)**
	Non-pregnant, non-lactating women / *Sievietes, kuras nav grūtniecības vai zīdīšanas periodā*			**Pregnant women / *Sievietes grūtniecības periodā***			**Lactating women / *Sievietes zīdīšanas periodā***		
Energy/ *Enerģija*	RI / *ID*	ND / *ND*	AI / *AD*	RI / *ID*	ND / *ND*	AR / *VD*	RIR / *IUD*	ND / *ND*	AR / *VD*
	1960–2510 kcal / 8201–10502 kJ (18 to 30 years old / *18 līdz 30 gadi*) 1840–2360 kcal / 7699–9874 kJ (31 to 60 years old / *31 līdz 60 gadi*)		1878–2683 kcal / 7858–11226 kJ (18 to 29 years old / *18 līdz 29 gadi*) 1813–2590 kcal / 7586–10837 kJ (30 to 39 years old / *30 līdz 39 gadi*) 1798–2569 kcal / 7523–10749 kJ (40 to 59 years old / *40 līdz 59 gadi*)	+100 kcal / +418 kJ (first trimester / *pirmajā trimestrī*) +300 kcal / 1255 kJ (second trimester / *otrajā trimestrī*) +300 kcal / 1255 kJ (third trimester / *trešajā trimestrī*)		+70 kcal / +293 kJ (first trimester / *pirmajā trimestrī*) +260 kcal / +1088 kJ (second trimester / *otrajā trimestrī*) +500 kcal / +2092 kJ (third trimester / *trešajā trimestrī*)	+500–600 kcal / +2092–2510 kJ		+500 kcal / +2092 kJ
Carbohydrates / *Ogļhidrāti*	RIR / *IUD*	RIR / *IUD*	RIR / *IUD*	RIR / *IUD*	RIR / *IUD*	ND / *ND*	RIR / *IUD*	RIR / *IUD*	ND / *ND*
	45–60 E %	45–60 E %	45–60 E %	45–60 E %	45–60 E %		45–60 E %	45–60 E %	

Nutrient (unit) / *Uzturviela (mērvienība)*	**Veselības ministrija (2017a)**	**Nordic Council of Ministers (2014)**	**European Food Safety Authority (2019a)**	**Veselības ministrija (2017a)**	**Nordic Council of Ministers (2014)**	**European Food Safety Authority (2019a)**	**Veselības ministrija (2017a)**	**Nordic Council of Ministers (2014)**	**European Food Safety Authority (2019a)**
	Non-pregnant, non-lactating women / *Sievietes, kuras nav grūtniecības vai zīdīšanas periodā*			**Pregnant women / *Sievietes grūtniecības periodā***			**Lactating women / *Sievietes zīdīšanas periodā***		
Fibre / *Šķiedrvielas*	ND / *ND*	RIR / *IUD* at least / *vismaz* 25–35 g	AI / *AD* 25 g	ND / *ND*	RIR / *IUD* 25–35 g	ND / *ND*	ND / *ND*	RIR / *IUD* 25–35 g	ND / *ND*
Free sugars / "*Brīvie*" *cukuri*[1]	UIL / *MUL* no more than 10 E % / *ne vairāk kā 10 E %*	UIL / *MUL* below 10 E % / *mazāk par 10 E %*	ND / *ND*	UIL / *MUL* no more than 10 E % / *ne vairāk kā 10 E %*	UIL / *MUL* below 10 E % / *mazāk par 10 E %*	ND / *ND*	UIL / *MUL* no more than 10 E % / *ne vairāk kā 10 E %*	UIL / *MUL* below 10 E % / *mazāk par 10 E %*	ND / *ND*
Alcohol / *Alkohols*	ND / *ND*	UIL / *MUL* below 10 g / *mazāk par 10 g*	ND / *ND*	ND / *ND*	UIL / *MUL* below 10 g / *mazāk par 10 g*	ND / *ND*	ND / *ND*	UIL / *MUL* below 10 g / *mazāk par 10 g*	ND / *ND*

[1] monosaccharides and disaccharides added to foods and beverages by the manufacturer, cook or consumer, and sugars naturally present in honey, syrups, fruit juices and fruit juice concentrates / *monosaharīdi un disaharīdi, ko ražotājs, pavārs vai patērētājs ir pievienojis ēdienam un dzērienam, kā arī cukuri, kuri dabīgi atrodami medū, sīrupos, augļu sulās un augļu sulu koncentrātos* (World Health Organization, 2015a).

Nutrient (unit) / *Uzturviela (mērvienība)*	**Veselības ministrija (2017a)**	**Nordic Council of Ministers (2014)**	**European Food Safety Authority (2019a)**	**Veselības ministrija (2017a)**	**Nordic Council of Ministers (2014)**	**European Food Safety Authority (2019a)**	**Veselības ministrija (2017a)**	**Nordic Council of Ministers (2014)**	**European Food Safety Authority (2019a)**
	Non-pregnant, non-lactating women / *Sievietes, kuras nav grūtniecības vai zīdīšanas periodā*			**Pregnant women / *Sievietes grūtniecības periodā***			**Lactating women / *Sievietes zīdīšanas periodā***		
Protein / *Olbaltumvielas*	RIR / *IUD*	RIR / *IUD*	PRI / *PRD*	*RIR / IUD*	*RIR / IUD*	PRI / *PRD*	*RIR / IUD*	*RIR / IUD*	AR / *VD*
	10–20 E %[2]	10–20 E %	0.83 g per kg of body weight / *0.83 g uz kg ķermeņa masas*	10–20 E % or 1.1 g per kg of body weight / 10–20 E % vai 1.1 g *uz kg ķermeņa masas*	10–20 E %	+1 g (first trimester / *pirmajā trimestrī*) +9 g (second trimester / *otrajā trimestrī*) +28 g (third trimester / *trešajā trimestrī*)	10–20 E %	10–20 E %	+ 15 g (≤6 months postpartum / *≤6 mēnešus pēc dzemdībām*) + 10 g (>6 months postpartum / *>6 mēnešus pēc dzemdībām*)
Fat / *Tauki*	RIR / *IUD*	RIR / *IUD*	RIR / *IUD*	RI / *ID*	RIR / *IUD*	RIR / *IUD*	RIR / *IUD*	RIR / *IUD*	RIR / *IUD*
	25–30 E %	25–40 E %	20–35 E %	30 E %	25–40 E %	20–35 E %	25–30 E %	25–40 E %	20–35 E %
SFA / *PT*	UIL / *MUL*	UIL / *MUL*	AI / *AD*	UIL / *MUL*	UIL / *MUL*	AI / *AD*	UIL / *MUL*	UIL / *MUL*	AI / *AD*
	no more than 10 E % / *ne vairāk kā 10 E %*	below 10 E % / *mazāk par 10 E %*	ALAP / *CMVI*	no more than 10 E %/ *ne vairāk kā 10 E %*	below 10 E % / *mazāk par 10 E %*	ALAP / *CMVI*	no more than 10 E % / *ne vairāk kā 10 E %*	below 10 E % / *mazāk par 10 E %*	ALAP / *CMVI*
cis* MUFA / *cis MNT	ND / *ND*	RIR / *IUD*	ND / *ND*	ND / *ND*	RIR / *IUD*	ND / *ND*	ND / *ND*	RIR / *IUD*	ND / *ND*
		10–20 E %			10–20 E %			10–20 E %	

[2] the required amount of protein may be determined individually by multiplying the 1.0–1.5 g protein per kilogram body weight. The recommended amount of protein per kilogram may be determined individually, depending on the physical activity and age of the person / *Individuāli var noteikt nepieciešamo olbaltumvielu daudzumu,reizinot 1.0–1.5 g olbaltumvielu uz vienu kilogramu ķermeņa svara. Ieteicamo olbaltumvielu daudzumu uz vienu kilogramu svara nosaka individuāli, atkarībā no cilvēka fiziskās aktivitātes un vecuma* (Veselības ministrija, 2017a).

Annex III continued / *III pielikuma turpinājums*

Nutrient (unit) / *Uzturviela (mērvienība)*	**Veselības ministrija (2017a)**	**Nordic Council of Ministers (2014)**	**European Food Safety Authority (2019a)**	**Veselības ministrija (2017a)**	**Nordic Council of Ministers (2014)**	**European Food Safety Authority (2019a)**	**Veselības ministrija (2017a)**	**Nordic Council of Ministers (2014)**	**European Food Safety Authority (2019a)**
	Non-pregnant, non-lactating women / *Sievietes, kuras nav grūtniecības vai zīdīšanas periodā*			**Pregnant women / *Sievietes grūtniecības periodā***			**Lactating women / *Sievietes zīdīšanas periodā***		
cis* PUFA / *cis PNT	ND / *ND*	RIR / *IUD* 5–10 E %	ND / *ND*	ND / *ND*	RIR / *IUD* 5–10 E %	ND / *ND*	ND / *ND*	RIR / *IUD* 5–10 E %	ND / *ND*
cis* n-3 PUFA / *cis n-3 PNT	ND / *ND*	LIL / *ZUL* at least / *vismaz* 1 E %	ND / *ND*	ND / *ND*	LIL / *ZUL* at least / *vismaz* 1 E %	ND / *ND*	ND / *ND*	LIL / *ZUL* at least / *vismaz* 1 E %	ND / *ND*
LA / *LS*	ND / *ND*	ND / *ND*	AI / *AD* 4 E %	ND / *ND*	ND / *ND*	AI / *AD* 4 E %	ND / *ND*	ND / *ND*	AI / *AD* 4 E %
ALA / *ALS*	ND / *ND*	LIL / *ZUL* at least / *vismaz* 0.5 E %	AI / *AD* 0.5 E %	ND / *ND*	LIL / *ZUL* at least / *vismaz* 0.5 E %	AI / *AD* 0.5 E %	ND / *ND*	LIL / *ZUL* at least / *vismaz* 0.5 E %	AI / *AD* 0.5 E %
LA + ALA / *LS + ALS*	ND / *ND*	LIL / *ZUL* at least / *vismaz* 3 E %	ND / *ND*	ND / *ND*	LIL / *ZUL* at least / *vismaz* 5 E %	ND / *ND*	ND / *ND*	LIL / *ZUL* at least / *vismaz* 5 E %	ND / *ND*
EPA, DHA / *EPS, DHS*	ND / *ND*	ND / *ND*	AI / *AD* 250 mg (EPA + DHA / *EPS* + *DHS*)	ND / *ND*	RI / *ID* 200 mg (DHA / *DHS*)	AI / *AD* 250 mg (EPA + DHA / *EPS* + *DHS*) + 100–200 mg (DHA / *DHS*)	ND / *ND*	RI / *ID* 200 mg (DHA / *DHS*)	AI / *AD* 250 mg (EPA + DHA / *EPS* + *DHS*) + 100–200 mg (DHA / *DHS*)
TFA / *TT*	ND / *ND*	AI / *AD* ALAP / *CMVI*	AI / *AD* ALAP / *CMVI*	ND / *ND*	AI / *AD* ALAP / *CMVI*	AI / *AD* ALAP / *CMVI*	ND / *ND*	AI / *AD* ALAP / *CMVI*	AI / *AD* ALAP / *CMVI*

Nutrient (unit) / *Uzturviela (mērvienība)*	**Veselības ministrija (2017a)**	**Nordic Council of Ministers (2014)**	**European Food Safety Authority (2019a)**	**Veselības ministrija (2017a)**	**Nordic Council of Ministers (2014)**	**European Food Safety Authority (2019a)**	**Veselības ministrija (2017a)**	**Nordic Council of Ministers (2014)**	**European Food Safety Authority (2019a)**
	Non-pregnant, non-lactating women / *Sievietes, kuras nav grūtniecības vai zīdīšanas periodā*			**Pregnant women / *Sievietes grūtniecības periodā***			**Lactating women / *Sievietes zīdīšanas periodā***		
Calcium / *Kalcijs*	RI / *ID*	RI / *ID*	PRI / *PRD*	RI / *ID*	RI / *ID*	PRI / *PRD*	RI / *ID*	RI / *ID*	PRI / *PRD*
	800 mg	800 mg	1000 mg (18 to 24 years / *18 līdz 24 gadi*) 950 mg (≥25 years / *≥25 gadi*)	1000 mg (first trimester / *pirmajā trimestrī*) 1300 mg (from the second trimester / *sākot no otrā trimestra*)	900 mg	1000 mg (18–24 years / *gadi*) 950 mg (≥25 years / *gadi*)	900 mg	900 mg	1000 mg (18–24 years / *gadi*) 950 mg (≥25 years / *gadi*)
		LIL / *ZUL*			LIL / *ZUL*			LIL / *ZUL*	
		400 mg			400 mg			400 mg	
		UIL / *MUL*	UIL / *MUL*		UIL / *MUL*	UIL / *MUL*		UIL / *MUL*	UIL / *MUL*
		2500 mg	2500 mg		2500 mg	2500 mg		2500 mg	2500 mg
Phosphorus / *Fosfors*	RI / *ID*	RI / *ID*	AI / *AD*	RI / *ID*	RI / *ID*	AI / *AD*	RI / *ID*	RI / *ID*	AI / *AD*
	600 mg	600 mg	550 mg	700 mg	700 mg	550 mg	900 mg	900 mg	550 mg
		LIL / *ZUL*			LIL / *ZUL*			LIL / *ZUL*	
		300 mg			300 mg			300 mg	
		UIL / *MUL*			UIL / *MUL*			UIL / *MUL*	
		3000 mg			3000 mg			3000 mg	
Potassium / *Kālijs*	RI / *ID*	RI / *ID*	AI / *AD*	RI / *ID*	RI / *ID*	AI / *AD*	RI / *ID*	RI / *ID*	AI / *AD*
	3100 mg	3100 mg	3500 mg	3100 mg	3100 mg	3500 mg	3100 mg	3100 mg	4000 mg
		LIL / *ZUL*			LIL / *ZUL*			LIL / *ZUL*	
		1600 mg			1600 mg			1600 mg	
Sodium / *Nātrijs*	RI / *ID*	2400 mg[3]	2000 mg[3]	RI / *ID*	2400 mg[3]	2000 mg[3]	RI / *ID*	2400 mg[3]	2000 mg[3]
	2000 mg			2000 mg			2000 mg		

[3] safe and adequate intake – provides guidance on a level of sodium intake compatible with good health / *drošs un atbilstošs daudzums – sniedz norādījumus par tādu nātrija devu, kas atbilst labas veselības prasībām* (European Food Safety Authority, 2019a).

Nutrient (unit) / *Uzturviela (mērvienība)*	**Veselības ministrija (2017a)**	**Nordic Council of Ministers (2014)**	**European Food Safety Authority (2019a)**	**Veselības ministrija (2017a)**	**Nordic Council of Ministers (2014)**	**European Food Safety Authority (2019a)**	**Veselības ministrija (2017a)**	**Nordic Council of Ministers (2014)**	**European Food Safety Authority (2019a)**
	Non-pregnant, non-lactating women / *Sievietes, kuras nav grūtniecības vai zīdīšanas periodā*			**Pregnant women / *Sievietes grūtniecības periodā***			**Lactating women / *Sievietes zīdīšanas periodā***		
Salt / *Sāls*	UIL / *MUL*	6 g[3]	ND / *ND*	UIL / *MUL*	6 [3]	ND / *ND*	UIL / *MUL*	6 g[3]	ND / *ND*
	no more than 5 g / *ne vairāk kā 5 g*			no more than 5 g / *ne vairāk kā 5 g*			no more than 5 g/ *ne vairāk kā 5 g*		
Magnesium / *Magnijs*	RI / *ID*	RI / *ID*	AI / *AD*	RI / *ID*	RI / *ID*	AI / *AD*	RI / *ID*	RI / *ID*	AI / *AD*
	280 mg	280 mg	300 mg	280 mg	280 mg	300 mg	280 mg	280 mg	300 mg
Manganese / *Mangāns*	ND / *ND*	ND / *ND*	AI / *AD*	ND / *ND*	ND / *ND*	AI / *AD*	ND / *ND*	ND / *ND*	AI / *AD*
			3 mg			3 mg			3 mg
Iron / *Dzelzs*	RI / *ID*	RI / *ID*	PRI / *PRD*	RI / *ID*	RI / *ID*	PRI / *PRD*	RI / *ID*	RI / *ID*	PRI / *PRD*
	15 mg	15 mg	16 mg[4]	15 mg[5]	15 mg[4]	16 mg[4]	15 mg	15 mg[4]	16 mg[4]
		UIL / *MUL*			UIL / *MUL*			UIL / *MUL*	
		60 mg			60 mg			60 mg	
Zinc / *Cinks*	RI / *ID*	RI / *ID*	PRI / *PRD*	RI / *ID*	RI / *ID*	PRI / *PRD*	RI / *ID*	RI / *ID*	PRI / *PRD*
	7 mg	7 mg	7.5–12.7 mg (depending of phytate intake / *atkarībā no uzņemtā fitātu daudzuma*)	10 mg	9 mg	7.5–12.7 mg + 1.6 mg	11 mg	11 mg	7.5–12.7 mg + 2.9 mg
		LIL / *ZUL*	UIL / *MUL*		LIL / *ZUL*	UIL / *MUL*		LIL / *ZUL*	UIL / *MUL*
		4 mg	25 mg		4 mg	25 mg		4 mg	25 mg

[4] for premenopausal women (including pregnant and lactating women), the PRI covers the requirement of approximately 95 % of women / *PRD nodrošina nepieciešamo dzelzs daudzumu aptuveni 95 % sieviešu pirms-menopauzes periodā (tai skaitā sievietēm grūtniecības un zīdīšanas periodā)* (European Food Safety Authority, 2019a).

[5] additional intake of iron is appointed by the medical doctor / *Papildu nepieciešamību pēc dzelzs individuāli grūtniecēm nosaka ārsts* (Nordic Council of Ministers, 2014; Veselības ministrija, 2017a).

Annex III continued / *III pielikuma turpinājums*

<table>
<tr><th rowspan="2">Nutrient (unit) / Uzturviela (mērvienība)</th><th>Veselības ministrija (2017a)</th><th>Nordic Council of Ministers (2014)</th><th>European Food Safety Authority (2019a)</th><th>Veselības ministrija (2017a)</th><th>Nordic Council of Ministers (2014)</th><th>European Food Safety Authority (2019a)</th><th>Veselības ministrija (2017a)</th><th>Nordic Council of Ministers (2014)</th><th>European Food Safety Authority (2019a)</th></tr>
<tr><th colspan="3">Non-pregnant, non-lactating women / Sievietes, kuras nav grūtniecības vai zīdīšanas periodā</th><th colspan="3">Pregnant women / Sievietes grūtniecības periodā</th><th colspan="3">Lactating women / Sievietes zīdīšanas periodā</th></tr>
<tr><td rowspan="6">Copper / Varš</td><td>RI / ID</td><td>RI / ID</td><td>AI / AD</td><td>RI / ID</td><td>RI / ID</td><td>AI / AD</td><td>RI / ID</td><td>RI / ID</td><td>AI / AD</td></tr>
<tr><td rowspan="5">0.9 mg</td><td>0.9 mg</td><td rowspan="3">1.3 mg</td><td rowspan="5">1.1 mg</td><td>1.0 mg</td><td rowspan="5">1.5 mg</td><td rowspan="5">1.3 mg</td><td>1.3 mg</td><td rowspan="5">1.5 mg</td></tr>
<tr><td>LIL / ZUL</td><td>LIL / ZUL</td><td>LIL / ZUL</td></tr>
<tr><td>0.4 mg</td><td>0.4 mg</td><td>0.4 mg</td></tr>
<tr><td>UIL / MUL</td><td>UIL / MUL</td><td>UIL / MUL</td><td>UIL / MUL</td></tr>
<tr><td>5 mg</td><td>5 mg</td><td>5 mg</td><td>5 mg</td></tr>
<tr><td rowspan="6">Selenium / Selēns</td><td>RI / ID</td><td>RI / ID</td><td>AI / AD</td><td>RI / ID</td><td>RI / ID</td><td>AI / AD</td><td>RI / ID</td><td>RI / ID</td><td>AI / AD</td></tr>
<tr><td rowspan="5">50 µg</td><td>50 µg</td><td rowspan="3">70 µg</td><td rowspan="5">60 µg</td><td>60 µg</td><td rowspan="3">70 µg</td><td rowspan="5">60 µg</td><td>60 µg</td><td rowspan="3">85 µg</td></tr>
<tr><td>LIL / ZUL</td><td>LIL / ZUL</td><td>LIL / ZUL</td></tr>
<tr><td>20 µg</td><td>20 µg</td><td>20 µg</td></tr>
<tr><td>UIL / MUL</td><td>UIL / MUL</td><td>UIL / MUL</td><td>UIL / MUL</td><td>UIL / MUL</td><td>UIL / MUL</td></tr>
<tr><td>300 µg</td><td>300 µg</td><td>300 µg</td><td>300 µg</td><td>300 µg</td><td>300 µg</td></tr>
<tr><td rowspan="6">Iodine / Jods</td><td>RI / ID</td><td>RI / ID</td><td>AI / AD</td><td>RI / ID</td><td>RI / ID</td><td>AI / AD</td><td>RI / ID</td><td>RI / ID</td><td>AI / AD</td></tr>
<tr><td rowspan="5">200 µg</td><td>150 µg</td><td rowspan="3">150 µg</td><td rowspan="5">150–250 µg</td><td>175 µg</td><td rowspan="3">200 µg</td><td rowspan="5">150–250 µg</td><td>200 µg</td><td rowspan="3">200 µg</td></tr>
<tr><td>LIL / ZUL</td><td>LIL / ZUL</td><td>LIL / ZUL</td></tr>
<tr><td>70 µg</td><td>70 µg</td><td>70 µg</td></tr>
<tr><td>UIL / MUL</td><td>UIL / MUL</td><td>UIL / MUL</td><td>UIL / MUL</td><td>UIL / MUL</td><td>UIL / MUL</td></tr>
<tr><td>600 µg</td><td>600 µg</td><td>600 µg</td><td>600 µg</td><td>600 µg</td><td>600 µg</td></tr>
<tr><td rowspan="2">Vitamin C / Vitamīns C</td><td>RI / ID</td><td>RI / ID</td><td>PRI / PRD</td><td>RI / ID</td><td>RI / ID</td><td>PIR / PRD</td><td>RI / ID</td><td>RI / ID</td><td>PRI / PRD</td></tr>
<tr><td>75 mg</td><td>75 mg</td><td>95 mg</td><td>85 mg</td><td>85 mg</td><td>105 mg</td><td>100 mg</td><td>100 mg</td><td>155 mg</td></tr>
<tr><td rowspan="4">Vitamin B_1 / Vitamīns B_1</td><td>RI / ID</td><td>RI / ID</td><td>PRI / PRD</td><td>RI / ID</td><td>RI / ID</td><td>PRI / PRD</td><td>RI / ID</td><td>RI / ID</td><td>PRI / PRD</td></tr>
<tr><td rowspan="3">1.1 mg</td><td>1.1 mg</td><td rowspan="3">0.42 mg per 1000 kcal / 0.42 mg uz 1000 kcal</td><td rowspan="3">1.4 mg</td><td>1.5 mg</td><td rowspan="3">0.42 mg per 1000 kcal / 0.42 mg uz 1000 kcal</td><td rowspan="3">1.6 mg</td><td>1.6 mg</td><td rowspan="3">0.42 mg per 1000 kcal / 0.42 mg uz 1000 kcal</td></tr>
<tr><td>LIL / ZUL</td><td>LIL / ZUL</td><td>LIL / ZUL</td></tr>
<tr><td>0.5 mg</td><td>0.5 mg</td><td>0.5 mg</td></tr>
</table>

Annex III continued / *III pielikuma turpinājums*

Nutrient (unit) / *Uzturviela (mērvienība)*	**Veselības ministrija (2017a)**	**Nordic Council of Ministers (2014)**	**European Food Safety Authority (2019a)**	**Veselības ministrija (2017a)**	**Nordic Council of Ministers (2014)**	**European Food Safety Authority (2019a)**	**Veselības ministrija (2017a)**	**Nordic Council of Ministers (2014)**	**European Food Safety Authority (2019a)**
	Non-pregnant, non-lactating women / ***Sievietes, kuras nav grūtniecības vai zīdīšanas periodā***			**Pregnant women /** ***Sievietes grūtniecības periodā***			**Lactating women /** ***Sievietes zīdīšanas periodā***		
Vitamin B_2 / ***Vitamīns B_2***	RI / *ID* 1.5 mg	RI / *ID* 1.3 mg LIL / *ZUL* 0.8 mg	PRI / *PRD* 1.6 mg	RI / *ID* 1.6 mg	RI / *ID* 1.6 mg LIL / *ZUL* 0.8 mg	PRI / *PRD* 1.9 mg	RI / *ID* 1.7 mg	RI / *ID* 1.7 mg LIL / *ZUL* 0.8 mg	PRI / *PRD* 2.0 mg
Vitamin B_3 / ***Vitamīns B_3***	ND / *ND*	RI / *ID* 15 mg LIL / *ZUL* 9 mg	PRI / *PRD* 6.8 NE per 1000 kcal / *6.8 NE uz 1000 kcal*	ND / *ND*	RI / *ID* 17 mg LIL / *ZUL* 9 mg	PRI / *PRD* 6.8 NE per 1000 kcal / *6.8 NE uz 1000 kcal*	ND / *ND*	RI / *ID* 20 mg LIL / *ZUL* 9 mg	PRI / *PRD* 6.8 NE per 1000 kcal / *6.8 NE uz 1000 kcal*
Vitamin B_5 / ***Vitamīns B_5***	ND / *ND*	ND / *ND*	AI / *AD* 5 mg	ND / *ND*	ND / *ND*	AI / *AD* 5 mg	ND / *ND*	ND / *ND*	AI / *AD* 7 mg
Vitamin B_6 / ***Vitamīns B_6***	RI / *ID* 1.3 mg	RI / *ID* 1.2 mg LIL / *ZUL* 0.8 mg UIL / *MUL* 25 mg	PRI / *PRD* 1.6 mg UIL / *MUL* 25 mg	RI / *ID* 1.9 mg	RI / *ID* 1.4 mg LIL / *ZUL* 0.8 mg UIL / *MUL* 25 mg	PRI / *PRD* 1.8 mg UIL / *MUL* 25 mg	RI / *ID* 1.5 mg	RI / *ID* 1.5 mg LIL / *ZUL* 0.8 mg UIL / *MUL* 25 mg	PRI / *PRD* 1.7 mg UIL / *MUL* 25 mg
Vitamin B_7 / ***Vitamīns B_7***	ND / *ND*	ND / *ND*	AI / *AD* 40 µg	ND / *ND*	ND / *ND*	AI / *AD* 40 µg	ND / *ND*	ND / *ND*	AI / *AD* 45 µg

Annex III continued / *III pielikuma turpinājums*

Nutrient (unit) / ***Uzturviela (mērvienība)***	**Veselības ministrija (2017a)**	**Nordic Council of Ministers (2014)**	**European Food Safety Authority (2019a)**	**Veselības ministrija (2017a)**	**Nordic Council of Ministers (2014)**	**European Food Safety Authority (2019a)**	**Veselības ministrija (2017a)**	**Nordic Council of Ministers (2014)**	**European Food Safety Authority (2019a)**
	Non-pregnant, non-lactating women / ***Sievietes, kuras nav grūtniecības vai zīdīšanas periodā***			**Pregnant women /** ***Sievietes grūtniecības periodā***			**Lactating women /** ***Sievietes zīdīšanas periodā***		
Vitamin B9 / ***Vitamīns B9***	RI / *ID*	RI / *ID*	AR / *VD*	RI / *ID*	RI / *ID*	AI / *AD*	RI / *ID*	RI / *ID*	PRI / *PRD*
	300 µg	400 µg	250 µg DFE / *UFE*	400 µg	500 µg	600 µg DFE / *UFE*	500 µg	500 µg	500 µg DFE / *UFE*
		LIL / *ZUL*			LIL / *ZUL*			LIL / *ZUL*	
		100 µg	UIL / *MUL*		100 µg	UIL / *MUL*		100 µg	UIL / *MUL*
			1000 µg of folic acid / *folskābes*			1000 µg of folic acid / *folskābes*			1000 µg of folic acid / *folskābes*
Vitamin B12 / ***Vitamīns B12***	RI / *ID*	RI / *ID*	AI / *AD*	RI / *ID*	RI / *ID*	AI / *AD*	RI / *ID*	RI / *ID*	AI / *AD*
	2.0 µg	2.0 µg	4 µg	2.0 µg	2.0 µg	4.5 µg	2.0 µg	2.6 µg	5 µg
		LIL / *ZUL*			LIL / *ZUL*			LIL / *ZUL*	
		1 µg			1 µg			1 µg	
Vitamin A / ***Vitamīns A***	RI / *ID*	RI / *ID*	PRI / *PRD*	RI / *ID*	RI / *ID*	PRI / *PRD*	RI / *ID*	RI / *ID*	PRI / *PRD*
	700 µg	700 µg RAE / *RAE*	650 µg RAE / *RAE*	800 µg	800 µg RAE / *RAE*	700 µg RAE / *RAE*	1100 µg	1100 µg RAE / *RAE*	1300 µg RAE / *RAE*
		LIL / *ZUL*			LIL / *ZUL*			LIL / *ZUL*	
		400 µg RAE / *RAE*			400 µg RAE / *RAE*			400 µg RAE / *RAE*	
		UIL / *MUL*	UIL / *MUL*		UIL / *MUL*	UIL / *MUL*		UIL / *MUL*	UIL / *MUL*
		3000 µg as preformed retinol / *kā retinols*	3000 µg as retinol or retinyl esters / *kā retinols vai retinilesteri*		3000 µg as preformed retinol / *kā retinols*	3000 µg as retinol or retinyl esters / *kā retinols vai retinilesteri*		3000 µg as preformed retinol / *kā retinols*	3000 µg as retinol or retinyl esters / *kā retinols vai retinilesteri*

Annex III continued / *III pielikuma turpinājums*

Nutrient (unit) / *Uzturviela (mērvienība)*	**Veselības ministrija (2017a)**	**Nordic Council of Ministers (2014)**	**European Food Safety Authority (2019a)**	**Veselības ministrija (2017a)**	**Nordic Council of Ministers (2014)**	**European Food Safety Authority (2019a)**	**Veselības ministrija (2017a)**	**Nordic Council of Ministers (2014)**	**European Food Safety Authority (2019a)**
	Non-pregnant, non-lactating women / *Sievietes, kuras nav grūtniecības vai zīdīšanas periodā*			**Pregnant women / *Sievietes grūtniecības periodā***			**Lactating women / *Sievietes zīdīšanas periodā***		
Vitamin D / *Vitamīns D*	RI / *ID*	RI / *ID*	AI / *AD*	RI / *ID*	RI / *ID*	AI / *AD*	RI / *ID*	RI / *ID*	AI / *AD*
	10 µg	10 µg	15 µg	10 µg 15 µg (during winter / *ziemas periodā*)	10 µg	15 µg	10 µg	10 µg	15 µg
		LIL / *ZUL*			LIL / *ZUL*			LIL / *ZUL*	
		2.5 µg			2.5 µg			2.5 µg	
		UIL / *MUL*	UIL / *MUL*		UIL / *MUL*	UIL / *MUL*		UIL / *MUL*	UIL / *MUL*
		100 µg	100 µg		100 µg	100 µg		100 µg	100 µg
Vitamin E as / *Vitamīns E*	RI / *ID*	RI / *ID*	AI / *AD*	RI / *ID*	RI / *ID*	AI / *AD*	RI / *ID*	RI / *ID*	AI / *AD*
	8 mg	8 mg	11 mg as α-tocopherol / kā *α-tokoferols*	15 mg	10 mg	11 mg as α-tocopherol / kā *α-tokoferols*	11 mg	11 mg	2.5 µg
		UIL / *MUL*			UIL / *MUL*			UIL / *MUL*	2.5 µg
		3 mg			3 mg			3 mg	2.5 µg
		UIL / *MUL*	UIL / *MUL*		UIL / *MUL*	UIL / *MUL*		UIL / *MUL*	UIL / *MUL*
		300 mg	300 mg		300 mg	300 mg		300 mg	300 mg
Vitamin K / *Vitamīns K*	ND / *ND*	ND / *ND*	AI / *AD*	ND / *ND*	ND / *ND*	AI / *AD*	ND / *ND*	ND / *ND*	AI / *AD*
			70 µg as phylloquinone / *kā filokvinons*			70 µg as phylloquinone / *kā filokvinons*			70 µg as phylloquinone / *kā filokvinons*

The ethical approval from Riga Stradiņš University Ethics Committee and the renewal of ethical approval / *Rīgas Stradiņa universitātes Ētikas komitejas atļauja pētījuma veikšanai un atļaujas atjauninājums*

Veidlapa Nr. E-9 (2)

RSU ĒTIKAS KOMITEJAS LĒMUMS NR. 4 / 28.07.2016.

Rīga, Dzirciema iela 16, LV-1007
Tel. 67061596

	Komitejas sastāvs	Kvalifikācija	Nodarbošanās
1.	Profesors Olafs Brūvers	Dr.theo.	teologs
2.	Profesore Vija Sīle	Dr.phil.	filozofs
3.	Asoc.prof. Santa Purviņa	Dr.med.	farmakologs
4.	Asoc.prof. Voldemārs Arnis	Dr.biol.	rehabilitologs
5.	Profesore Regīna Kleina	Dr.med.	patalogs
6.	Profesors Guntars Pupelis	Dr.med.	ķirurgs
7.	Asoc.prof. Viesturs Liguts	Dr.med.	toksikologs
8.	Docente Iveta Jankovska	Dr.med.	
9.	Docents Kristaps Circenis	Dr.med.	

Pieteikuma iesniedzējs: **Līva Aumeistere**
Medicīnas fakultāte, doktorantūras nodaļa

Pētījuma nosaukums: „ Uztura ietekme uz mātes piena ķīmisko sastāvu"

Iesniegšanas datums: 28.07.2016

Pētījuma protokols: Izskatot iesniegtos pētījuma dokumentus (protokolu) ir redzams, ka pētījuma mērķis tiek sasniegts veicot, bez kāda apdraudējuma dalībnieču veselībai, drošībai un dzīvībai, mātes piena atbilstošas analīzes un dalībnieču aptauju-anketēšanu, iegūto datu apstrādi un analīzi, kā arī izsakot priekšlikumus. Personu (dalībnieču) datu aizsardzība, brīvprātīga informēta piekrišana piedalīties pētījumā un konfidencialitāte tiek nodrošināta. Līdz ar to pieteikums atbilst medicīnas pētījuma ētikas prasībām.

Izskaidrošanas formulārs: ir

Piekrišana piedalīties pētījumā: ir

Komitejas lēmums: **piekrist** pētījumam

Komitejas priekšsēdētājs Olafs Brūvers　　Tituls: Dr. miss., prof.

Parakststs

Ētikas komitejas sēdes datums: 28.07.2016.

Veidlapa Nr. E-9(3)
APSTIPRINĀTA
ar Rīgas Stradiņa universitātes rektora
2018. gada 26. septembra rīkojumu Nr. 5-1/238/2018

Rīgas Stradiņa universitātes
Pētījumu ētikas komitejas
LĒMUMS
Rīgā

30.01.2020. Nr.6-1/01/ 6

	Komitejas sastāvs	Kvalifikācija	Nodarbošanās
1	Profesors Olafs Brūvers	Dr.theo.	teologs
2	Asoc.prof. Santa Purviņa	Dr.med.	farmakologs
3	Asoc.prof. Voldemārs Arnis	Dr.biol.	rehabilitologs
4	Profesore Regīna Kleina	Dr.med.	patalogs
6	Asoc.prof. Viesturs Liguts	Dr.med.	toksikologs
7	Docente Iveta Jankovska	Dr.med.	ortodonts
8	Docents Kristaps Circenis	Dr.med.	docētājs

Pieteikuma iesniedzējs/i: **Līva Aumeistere**
Latvijas Lauksaimniecības universitāte

Pētījuma / pētnieciskā darba nosaukums: "Taukskābju variācija mātes pienā"

Iesniegšanas datums: 09.01.2020.

Pētījuma protokols:
Izskatot augstāk minētā pētījuma pieteikuma materiālus (protokolu) ir redzams, ka pētījuma mērķis tiek sasniegts veicot no dalībniecēm nepieciešamo amateriālu paraugu (mātes piena)ņemšanu, izdarot atbilstošas analīzes, pārbaudes, mērījumus, iegūto datu apstrādi un analīzi, kā arī izsakot priekšlikumus. Personu (dalībnieču) datu izmantošana, glabāšana, aizsardzība, informēta brīvprātīga piedalīšanās, anonimitāte un konfidencialitāte ir ievērota un nodrošināta. Līdz ar to pieteikums atbilst pētījuma ētikas prasībām.

Komitejas lēmums: **piekrist** pētījumam

Komitejas priekšsēdētājs Olafs Brūvers Tituls: Dr. miss., prof.

Paraksts

RĪGAS STRADIŅA UNIVERSITĀTE
ĒTIKAS KOMITEJA

I.Bēniņa
67061596

Annex V / *V pielikums*

A consent form for the first study period / *Pētījuma piekrišanas forma 1. pētījuma posma ietvaros*

PIEKRIŠANAS FORMA PĒTĪJUMAM
"MĀTES PIENA SASTĀVA IZPĒTE"

Latvijas Lauksaimniecības universitāte | BIOR PĀRTIKAS DROŠĪBAS, DZĪVNIEKU VESELĪBAS UN VIDES ZINĀTNISKAIS INSTITŪTS | RĪGAS STRADIŅA UNIVERSITĀTE

"Zīdīšana ir viens no dzīves brīnumiem. Tā ir īsta mīlestība. Tās ir rūpes un prieks par jauno dzīvību, ko turi savās rokās. Tā ir bauda būt sievietei." Anwar Fazal (World Alliance for Breastfeeding Action)

Aicinām jaunās un topošās māmiņas piedalīties pētījumā par mātes piena sastāva izpēti.

PĒTĪJUMA SKAIDROJUMS

Mātes piens ir vispiemērotākais uzturvielu avots bērnam pirmajos sešos dzīves mēnešos, un vienlaicīgi ar citu uzturu līdz 2 gadu vecumam (PVO, 2016). Piens krūts dziedzeros tiek sintezēts no izejvielām mātes asinīs, kas tiek uzņemtas arī ar uzturu zīdīšanas periodā. Tādēļ sievietes uzturā lietotie pārtikas produkti zīdīšanas laikā var ietekmēt mazuļa augšanu un attīstību.

PĒTĪJUMA MĒRĶIS

Mātes piena sastāva izpēte.

Ieguvumi:

1. Pētījumā iekļautajām dalībniecēm bez maksas tiks noteikts dažādu uzturvielu saturs mātes pienā.
2. Pētījumā iekļautajām dalībniecēm būs iespēja iegūt datus par uzturvielu nodrošinājumu viņu uztura racionā.

PĒTĪJUMA IEKĻAUŠANAS UN IZSLĒGŠANAS KRITĒRIJI:

Jūs varat tikt iekļauta pētījumā, ja:

☐ Esiet parakstījusi piekrišanas formu dalībai pētījumā;
☐ Šobrīd dzīvojat Latvijā;
☐ Dzemdībās Jums ir piedzims viens bērns;
☐ Jūs esiet jaunā māmiņa, kas ekskluzīvi[1] zīda mazuli vai paralēli zīdīšanai mazulis saņem arī mātes piena aizstājēju vai paralēli zīdīšanai esiet ieviesusi mazulim papildpuzturu;
☐ Jūsu mazulis ir vismaz 28 dienas vecs;

[1] mazulis saņem tikai mātes pienu un nesaņem nekādus citus šķidrumus vai cietu barību, izņemot medicīniski indicētus medikamentus, minerālvielas vai vitamīnus.

01

PIEKRIŠANAS FORMA PĒTĪJUMAM "MĀTES PIENA SASTĀVA IZPĒTE"

☐ Jūs šobrīd zīdāt tikai vienu mazuli;
☐ pašlaik Jūs un Jūsu mazulis esiet veseli.

Jūs neatbilstat pētījuma iekļaušanas kritērijiem, ja:
☐ Jūs neparakstāt piekrišanas formu;
☐ Jūsu mazulis tiek ēdināts tikai ar mātes piena aizstājēju vai esiet beigusi zīdīt mazuli;
☐ Jums vai Jūsu mazulim pašlaik ir kādas veselības problēmas.

ĒTIKAS KOMITEJAS ATZINUMS

Šo pētījumu ir apstiprinājusi Rīgas Stradiņa universitātes Ētikas komiteja (Nr. 4/28.07.2016.).

DALĪBNIECES RĪCĪBA:

Pētījuma ietvaros nepieciešamajām analīzēm Jums būs jānoslauc ar roku vai piena pumpīti ~100 ml piena. Paraugs jāiegūst 24 h periodā, katrā barošanas reizē noslaucot nedaudz piena, ko salej kopā vienā atsevišķā traukā analīzēm. Starp barošanas reizēm trauku ar piena paraugu uzglabā ledusskapī.

Svarīgi atcerēties, ka piena noslaukšana pētījumam neatņems pienu Jūsu mazulim! Pēc 24 h parauga iegūšanas (~100 ml), piens būs jāsalej četros plastmasas stobriņos:

- **~40 ml** 1. stobriņā (tauku, olbaltumvielu satura noteikšanai);
- **~40 ml** 2. stobriņā (esenciālo un potenciāli toksisko elementu satura noteikšanai);
- **~10 ml** 3. stobriņā (laktozes satura noteikšanai);
- **~10 ml** 4. stobriņā (taukskābju kvalitatīvās un kvantitatīvās analīzes).

Stobriņi līdz nodošanai pētniekam būs jāuzglabā saldētavā.

ANKETAS

Jums būs jāatbild uz dažiem jautājumiem par sevi, mazuli un pašreizējo mazuļa ēdināšanas veidu. Vēl būs jāaizpilda arī 72 stundu uztura dienasgrāmatu par patērētajiem pārtikas produktiem trīs dienas pirms parauga ņemšanas. Precizitātes dēļ ieteicams dienasgrāmatu aizpildīt konkrētajās dienās. Pētnieks Jūs nodrošinās ar materiāliem un informēs kā pareizi aizpildīt dienasgrāmatu. Tāpat būs jāaizpilda arī anketa par biežāk lietotajiem pārtikas produktiem pēdējā mēneša ietvaros. Anketas un uztura dienasgrāmatas varēs aizpildīt elektroniski vai papīrveidā (vienojoties ar pētnieku par ērtāko veidu).

PIEKRIŠANAS FORMA PĒTĪJUMAM “MĀTES PIENA SASTĀVA IZPĒTE”

PĒTĪJUMA ILGUMS

Kopumā dalība pētījumā Jums aizņems aptuveni divas (2) stundas anketu un uztura dienasgrāmatu aizpildīšanai un apmēram divas (2) stundas 100 ml piena noslaukšanai (24 h perioda ietvaros).

PROCEDŪRAS

Pētījuma laikā Jums paredzētas divas tikšanās ar pētnieku.

Pirmās tikšanās laikā ar pētnieku Jums tiks izskaidrota pētījuma norise, Jūs kopīgi ar pētnieku aizpildīsiet dalības piekrišanas formu, pētnieks atstās nepieciešamos materiālus, rakstiskas instrukcijas, kontaktinformāciju saziņai.

Otrās tikšanās laikā pētnieks paņems no Jums saldētos mātes piena paraugus un anketas, ja tās būs aizpildītas papīrveidā.

Jūsu pienam laboratorijā bez maksas tiks noteikts ķīmiskais sastāvs (tauku, taukskābju, olbaltumvielu, laktozes un esenciālo un potenciāli toksisko elementu saturs).

RISKI UN NEĒRTĪBAS

Jūs variet izjust nelielu diskomfortu piena noslaukšanas laikā. Pētnieks Jums izsniegs informatīvo materiālu par to, kā pareizi veikt piena noslaukšanu un uzglabāt paraugu. Trīs dienu uztura dienasgrāmatas un pārtikas produktu biežumu anketas aizpildīšana prasīs atvēlēt laiku, taču tas nebūs ilgāks par divām (2) stundām. Pētnieks ar Jums sazināsies, ja būs kādi jautājumi par anketās ietvertajiem datiem.

KONFIDENCIALITĀTE

Apliecinājums, ka ņemtais materiāls netiks izmantots citiem nolūkiem kā norādīts pētījumā. Iegūtā informācija būs konfidenciāla. Pētījuma rezultāti tiks publicēti tikai apkopotā veidā. Pētījumā iegūto datu uzglabāšanā tiks ievērota pilnīga konfidencialitāte, tie būs pieejami tikai slēgtai pētnieku grupai, kas saistīta ar pētījumu. Pacientam, piekrītot piedalīties pētījumā, tiks piešķirts identifikācijas kods, ar kuru viņa dati tiks uzglabāti speciāli pētījumam izveidotā datu bāzē. Piekļuve šai datubāze būs tikai slēgtai pētnieku grupai. Projektā tiks ievērota pacientu datu aizsardzība un konfidencialitāte atbilstoši 1998. gada Datu Aizsardzības Likumam, Helsinku Deklarācijai un Eiropas Padomes Cilvēktiesību un Biomedicīnas konvencijai un Latvijas Republikas likumdošanai.

03

PIEKRIŠANAS FORMA PĒTĪJUMAM "MĀTES PIENA SASTĀVA IZPĒTE"

TIESĪBAS ATTEIKTIES VAI PĀRTRAUKT DALĪBU PĒTĪJUMĀ

Jūsu piedalīšanās pētījumā ir brīvprātīga, un Jūs variet jebkurā laikā no tā izstāties. Jūsu lēmums piedalīties vai izstāties no pētījuma neietekmēs Jūsu medicīniskās aprūpes kvalitāti.

KONTANTINFORMĀCIJA JAUTĀJUMU GADĪJUMĀ

Ja Jums ir kādi jautājumi, Jūs tos variet uzdot Jums ērtā laikā pētniecei Līvai Aumeisterei (mob. [redacted]; [redacted]) par jebkurām neskaidrībām, kas radušās saistībā ar pētījumu.

Esmu izlasījusi iepriekš minēto informāciju. Esmu iepazīstināta ar pētījuma mērķi un norises gaitu. Man ir bijusi iespēja uzdot jautājumus, un esmu saņēmusi atbildes uz sev interesējošajiem jautājumiem. Esmu informēta, ka jebkurā brīdī varu izstāties no pētījuma un tas neietekmēs manu turpmāko medicīnisko aprūpi. Piekrītu brīvprātīgi piedalīties pētījumā par mātes piena sastāva izpēti.

Dalībnieces vārds, uzvārds	**Dalībnieces paraksts**
____________________	____________________
	_____/_____/_____ (dd.mm.gggg.)

Rezultātu saņemšana

Lūdzu, norādiet, vai vēlaties saņemt piena analīžu un 72h uztura dienasgrāmatas rezultātus, kā arī norādiet rezultātu saņemšanas veidu! Vai vēlaties iegūt datus par Jūsu piena ķīmisko sastāvu un uzturvielu nodrošinājumu Jūsu diētā?

☐ *Jā* ☐ *Nē*

Rezultātus vēlos saņemt uz sekojošu e-pasta adresi:

____ *(Norādiet e-pasta adresi)*

Pētnieka vārds, uzvārds	**Pētnieka paraksts**
____________________	____________________
	_____/_____/_____ (dd.mm.gggg.)

04

A consent form for the second study period /
Pētījuma piekrišanas forma 2. pētījuma posma ietvaros

Latvijas Lauksaimniecības universitāte

Rīgas Stradiņa universitāte

PIEKRIŠANAS FORMA PĒTĪJUMAM "TAUKSKĀBJU SASTĀVA VARIĀCIJAS MĀTES PIENĀ"

PĒTĪJUMS "TAUKSKĀBJU SASTĀVA VARIĀCIJAS MĀTES PIENĀ" TIEK VEIKTS PROGRAMMAS "FUNDAMENTĀLO PĒTĪJUMU VEIKŠANA LLU" IETVAROS. PROJEKTA NR. G1. LĪGUMA NR. 3.2-10/2019/LLU/.

PĒTĪJUMA SKAIDROJUMS

Mātes piens ir vispiemērotākais uzturvielu avots bērnam pirmajos sešos dzīves mēnešos un, vienlaicīgi ar citu uzturu, līdz 2 gadu vecumam (PVO, 2018). Piens krūts dziedzeros tiek sintezēts no izejvielām mātes asinīs, kas tiek uzņemtas ar uzturu zīdīšanas periodā. Tādēļ sievietes uzturā lietotie pārtikas produkti zīdīšanas laikā var ietekmēt mātes piena sastāvu.

PĒTĪJUMA MĒRĶIS

Izzināt mātes piena taukskābju sastāva un satura mainību uztura ietekmē.

PĒTĪJUMA UZDEVUMI:

1. Analizēt kopējo tauku saturu, taukskābju sastāvu un saturu mātes pienā.
2. Izzināt un izvērtēt sieviešu uztura paradumus zīdīšanas laikā.
3. Novērtēt saistību starp mātes uzturu un taukskābju sastāvu un saturu pienā.
4. Izstrādāt uztura rekomendācijas sievietēm zīdīšanas laikā (*Latvijā ir izstrādātas rekomendācijas tikai grūtniecēm*).

IEGUVUMI PIEDALOTIES PĒTĪJUMĀ:

1. Pētījumā iekļautajām dalībniecēm laboratorijā bez maksas tiks noteikts kopējais tauku saturs un taukskābju kvalitatīvais un kvantitatīvais sastāvs mātes pienā.
2. Pētījumā iekļautajām dalībniecēm būs iespēja iegūt datus par uzturvielu nodrošinājumu viņu uztura racionā.

PĒTĪJUMA IEKĻAUŠANAS UN IZSLĒGŠANAS KRITĒRIJI:

Jūs varat tikt iekļauta pētījumā, ja:

☐ Esiet parakstījusi piekrišanas formu dalībai pētījumā;

☐ Šobrīd dzīvojat Latvijā;

☐ Dzemdībās Jums ir piedzims viens bērns;

☐ Jūs esiet jaunā māmiņa, kas ekskluzīvi* zīda mazuli vai paralēli zīdīšanai mazulis saņem arī mātes piena aizstājēju vai paralēli zīdīšanai esiet ieviesusi mazulim papildpuzturu;

* mazulis saņem tikai mātes pienu un nesaņem nekādus citus šķidrumus vai cietu barību, izņemot medicīniski indicētus medikamentus, minerālvielas vai vitamīnus.

☐ Jūsu mazulis ir vismaz 28 dienas vecs;

☐ Jūs šobrīd zīdāt tikai vienu mazuli;

☐ pašlaik Jūs un Jūsu mazulis esiet veseli.

PIEKRIŠANAS FORMA PĒTĪJUMAM “TAUKSKĀBJU SASTĀVA VARIĀCIJAS MĀTES PIENĀ”

Jūs neatbilstat pētījuma iekļaušanas kritērijiem, ja:

☐ Jūs neparakstāt piekrišanas formu;

☐ Jūsu mazulis tiek ēdināts tikai ar mātes piena aizstājēju vai esiet beigusi zīdīt mazuli;

☐ Jums vai Jūsu mazulim pašlaik ir kādas veselības problēmas.

ĒTIKAS KOMITEJAS ATZINUMS

Šo pētījumu ir apstiprinājusi Rīgas Stradiņa universitātes Ētikas komiteja (Nr. 6-1/01/6).

PĒTĪJUMA ILGUMS

Pētījuma laikā Jums paredzētas divas tikšanās ar pētnieku. Pirmās tikšanās laikā Jums tiks izskaidrota pētījuma norise, Jūs kopīgi ar pētnieku aizpildīsiet dalības piekrišanas formu, pētnieks atstās nepieciešamos materiālus, rakstiskas instrukcijas, kontaktinformāciju saziņai.

Tālāk Jums pēc ērtības principa būs jāizvēlas 4 secīgas dienas pētījuma veikšanai. Pirmās trīs dienas būs jāaizpilda uztura dienasgrāmatas un citas nepieciešamās anketas. 4. dienā Jums mājās patstāvīgi būs jāievāc 50 ml piena parauga (24 h perioda ietvaros).

Otrās tikšanās laikā pētnieks paņems no Jums sasaldēto mātes pienu plastmasas stobriņos un anketas, ja tās būs aizpildītas papīrveidā.

ANKETAS

Jums būs jāatbild uz dažiem jautājumiem par sevi, mazuli un pašreizējo mazuļa ēdināšanas veidu. Vēl būs jāaizpilda arī 72 stundu uztura dienasgrāmatu par patērētajiem pārtikas produktiem, dzērieniem un lietotajiem uztura bagātinātājiem trīs dienas pirms parauga ņemšanas. Precizitātes dēļ ieteicams dienasgrāmatu aizpildīt katrā konkrētajā dienā. Pētnieks Jūs nodrošinās ar materiāliem un informēs kā pareizi aizpildīt dienasgrāmatas. Anketu aizpildīšanu varēs uzsākt sev ērtā laikā, bet uztura dienasgrāmatas jāaizpilda **3 secīgas dienas pēc kārtas**. Pētījuma ietvaros nebūs nepieciešams ievērot speciālu diētu, Jūs drīkstēsiet lietot uzturā visu ko vēlaties.

Tāpat būs jāaizpilda arī anketa par biežāk lietotajiem pārtikas produktiem pēdējā mēneša ietvaros. Anketas un uztura dienasgrāmatas varēs aizpildīt elektroniski vai papīrveidā (vienojoties ar pētnieku par Jums ērtāko veidu).

PIENA PARAUGA IEVĀKŠANA

Pēc 72 h (3 dienu) uztura dienasgrāmatas aizpildīšanas, nākamo 24 h periodā (4. diena) Jums būs standartizēti jāiegūst piena paraugs analīzēm **(~50 ml)**. Piena paraugu iespējams iegūt, manuāli noslaucot ar roku, izmantojot piena pumpīti vai kombinējot abas metodes (dalībnieces brīva izvēle). Jāatceras, ka rokām un krūtīm jābūt tīrām. Kosmētiskie līdzekļi (tai skaitā ziepes) satur dažādas ķimikālijas, kas var ietekmēt analīžu rezultātus, tādēļ pēc to izmantošanas krūtis un rokas rūpīgi jānoskalo ar ūdeni.

PIEKRIŠANAS FORMA PĒTĪJUMAM “TAUKSKĀBJU SASTĀVA VARIĀCIJAS MĀTES PIENĀ”

Kad un kā ievākt piena paraugu?
Katrā barošanas reizē, pēc tam, **kad ir pabarots mazulis**, ir jānoslauc nedaudz piena **no tās krūts, kuru ir zīdis mazulis**. Ja mazulis ir zīdis no abām krūtīm, tad pienu noslauc no tās krūts, kuru mazulis ir zīdis ilgāk. Noslaukto mātes pienu salej kopā vienā atsevišķā traukā analīzēm (nepieciešamības gadījumā trauku izsniegs pētnieks). Starp barošanas reizēm trauku ar piena paraugu jāuzglabā **ledusskapī.** Nav nepieciešams pienu noslaukt katrā zīdīšanas reizē, bet vēlams, lai 24 h piena kopparaugā būtu piens gan no rīta, gan dienas, gan vakara un vēlams arī nakts zīdīšanas, jo tauku saturs mātes pienā diennakts ietvaros svārstās.

Svarīgi atcerēties, ka piena noslaukšana pētījumam neatņems pienu Jūsu mazulim!

Pēc 24 h piena kopparauga iegūšanas (~50 ml), ledusskapī uzglabātais piens būs jāsalej divos plastmasas stobriņos:

- **~40 ml** 1. stobriņā (līdz augšējai atzīmei uz stobriņa) (tauku satura noteikšanai). Atzīme uz trauciņa – Tauki/LLU;
- **~10 ml** 2. stobriņā (taukskābju kvalitatīvās un kvantitatīvās analīzes). Atzīme uz trauciņa – TS/BIOR.

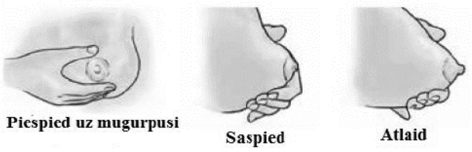
Plastmasas stobriņi ar pienu līdz nodošanai pētniekam būs jāuzglabā **saldētavā!**

Ja izdevies ievākt vairāk par 50 ml parauga, rīkoties var sekojoši:

- paraugu stobriņos ieliet vairāk piena un/vai
- atlikušo mātes pienu sasaldēt un izmantot vēlāk sava mazuļa barošanai.

Paraugu transportu uz laboratoriju ar Jums saskaņos pētnieks.

RISKI UN NEĒRTĪBAS
Jūs variet izjust nelielu diskomfortu piena noslaukšanas laikā. Sekojošie ieteikumi palīdzēs vieglāk, ātrāk un ērtāk iegūt piena paraugu, ja izvēlēsieties pienu noslaukt manuāli ar roku:



Trīs dienu uztura dienasgrāmatas un pārējo anketu aizpildīšana prasīs atvēlēt laiku, taču tas nebūs ilgāks par 30 minūtēm dienā. Pētnieks ar Jums sazināsies, ja būs kādi jautājumi par anketās ietvertajiem datiem.

PIEKRIŠANAS FORMA PĒTĪJUMAM
"TAUKSKĀBJU SASTĀVA VARIĀCIJAS MĀTES PIENĀ"

KONFIDENCIALITĀTE

Apliecinājums, ka ņemtais materiāls netiks izmantots citiem nolūkiem kā norādīts pētījumā. Pētījumā iegūto datu uzglabāšanā tiks ievērota pilnīga konfidencialitāte. Dalībniecei, piekrītot piedalīties pētījumā, tiks piešķirts unikāls identifikācijas kods. Paraugu trauciņi un anketas tiks šifrētas, izmantojot tikai šo identifikācijas kodu. Dalībnieču sensitīvie dati tiks uzglabāti speciāli pētījumam izveidotā datu bāzē. Piekļuve šai datubāzei būs tikai konkrētajam pētniekam – Līva Aumeisterei. Projektā tiks ievērota pacientu datu aizsardzība un konfidencialitāte atbilstoši 1998. gada Datu Aizsardzības Likumam, Helsinku Deklarācijai un Eiropas Padomes Cilvēktiesību un Biomedicīnas konvencijai un Latvijas Republikas likumdošanai. Pētījuma rezultāti tiks publicēti tikai apkopotā veidā.

TIESĪBAS ATTEIKTIES VAI PĀRTRAUKT DALĪBU PĒTĪJUMĀ

Jūsu piedalīšanās pētījumā ir brīvprātīga, un Jūs variet jebkurā laikā no tā izstāties. Jūsu lēmums piedalīties vai izstāties no pētījuma neietekmēs Jūsu medicīniskās aprūpes kvalitāti.

KONTANTINFORMĀCIJA JAUTĀJUMU GADĪJUMĀ

Ja Jums ir kādi jautājumi vai radušās neskaidrības saistībā ar pētījumu, Jūs tos variet uzdot Jums ērtā laikā pētniecei Līvai Aumeisterei ([redacted]; [redacted]).

Esmu izlasījusi iepriekš minēto informāciju. Esmu iepazīstināta ar pētījuma mērķi un norises gaitu. Man ir bijusi iespēja uzdot jautājumus un esmu saņēmusi atbildes uz sev interesējošajiem jautājumiem. Esmu informēta, ka jebkurā brīdī varu izstāties no pētījuma un tas neietekmēs manu turpmāko medicīnisko aprūpi. Piekrītu brīvprātīgi piedalīties pētījumā par mātes piena sastāva izpēti.

Dalībnieces vārds, uzvārds, paraksts, ______________________________

_____/_____/_____(dd.mm.gggg.)

Pētnieka vārds, uzvārds, paraksts, ______________________________

_____/_____/_____(dd.mm.gggg.)

Latvijas Lauksaimniecības universitāte

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PIEKRIŠANAS FORMA PĒTĪJUMAM "TAUKSKĀBJU SASTĀVA VARIĀCIJAS MĀTES PIENĀ"

Šī piekrišanas formas daļa (5. lapa) jānodod pētniekam!
Pārējā piekrišanas formas daļa (1. – 4. lapa) paliek dalībniecei!

Esmu izlasījusi iepriekš minēto informāciju. Esmu iepazīstināta ar pētījuma mērķi un norises gaitu. Man ir bijusi iespēja uzdot jautājumus un esmu saņēmusi atbildes uz sev interesējošajiem jautājumiem. Esmu informēta, ka jebkurā brīdī varu izstāties no pētījuma un tas neietekmēs manu turpmāko medicīnisko aprūpi. Piekrītu brīvprātīgi piedalīties pētījumā par mātes piena sastāva izpēti.

Dalībnieces vārds, uzvārds, paraksts, ______________________________

_____/_____/_____ (dd.mm.gggg.)

Rezultātu saņemšana
Lūdzu, norādiet, vai vēlaties saņemt piena analīžu un 72h uztura dienasgrāmatas rezultātus, kā arī norādiet rezultātu saņemšanas veidu!

☐ *Jā* ☐ *Nē*

Rezultātus vēlos saņemt uz sekojošu e-pasta adresi:

______________________________________ *(Norādiet e-pasta adresi)*

Pētnieka vārds, uzvārds, paraksts, ______________________________

_____/_____/_____ (dd.mm.gggg.)

72-hour food diary / *72-stundu uztura dienasgrāmata*

72 STUNDU UZTURA DIENASGRĀMATAS ANKETA - PARAUGS

1. diena=3 dienas PIRMS parauga iegūšanas

Metode paredzēta, informācijas iegūšanai par pēdējās trīs dienās (pirms piena paraugu iegūšanas (noslaukšanas)) uzņemto pārtiku, dzērienu daudzumu un lietotajiem uztura bagātinātājiem.

Dalībnieces kods 85903
Anketas aizpildīšanas datums (dd.mm.gggg.) - 07.01.2020.
Nedēļas diena - Otrdiena
Šī diena jums ir (vajadzīgo iekrāsot):
ikdienišķa
svētku diena (ēsts vairāk kā parasti)
diēta (ierobežota produktu lietošana), ja jā – norādīt kādu ____________________

Ko Jūs ēdāt un dzērāt pēdējo 24 stundu laikā? (plkst. 0.00 līdz 23.59)

Ēdienreize, plkst.	Apēstās pārtikas, tajā skaitā uztura bagātinātāju un izdzerto dzērienu saraksts. Saliktiem ēdieniem un dzērieniem sastāvdaļas, lūdzu, norādiet	Daudzums	Pārtikas sagatavošanas veids (svaigā veidā, cepts*, vārīts, utt.)	Produktu ražotājs (ja zināms)
Naksniņas pēc mazuļa barošanas plkst. 3.00	*Krievijas siers*	*2 šķēles*		*"Siera nams"*
	Kiršu tomātiņi	*2 gab*		
Brokastis (plkst. 8.00)	*Ātri vārāmo auzu pārslu putra (vārīta pienā (2% tauku saturs)) ar upeņu ievārījumu*	*3 ēdamkarotes auzu pārslas (sausā veidā)* *300 ml piens* *Ēdamkarote ievārījums*	*Vārīta auzu pārslu putra*	*"Hercogs"auzu pārslas* *"Valmieras piens" piens ar 2% tauku saturu* *""Pūre" ievārījums*
	D vitamīna kapsulas	*1 kapsula*		*D-pearls - "Pharma Nord"*
	Melnā tēja ar cukuru	*tējkarote cukurs, tēja - 250 ml*		
Uzkoda(plkst. 10.30)	*Mandarīni*	*3 gab, vidēji*		
	Piena spēks ar zemeņu garšu	*1 iepakojums - 250 grami*		*"Smiltenes piens"*
Pusdienas (plkst. 12.15)	*Makaroni ar malto gaļu (makaroni+liellopu maltā gaļa, tomātu mērce, paprika, burkāni, jodētā sāls)*	*Šķīvis(kods 24.2)*	*Makaroni - vārīti, maltā gaļa, paprika, burkāni - cepti (rapšu eļļā)*	*Makaroni - "Dobeles dzirnavnieks", tomātu mērce - "Spilva"*
	Apelsīnu sula	*glāze(kodsG29C)*		*Cido*
Launags (plkst. 15.15)	*Biezpiena sieriņš klasiskais(šokolādes glazūrā)*	*45 g*		*Kārums*
	Melnā tēja ar cukuru	*tējkarote cukurs, tēja - 250 ml*		
Vakariņas (plkst. 20.30)	*Krievijas siers*	*1 šķēle*		*"Siera nams"*
	Rupjmaize	*1 šķēle, vidēja*		*"Ķelmēni"*
	Sviests	*10 g*		*"Rīgas piensaimnieks"*
	Krila eļļa	*2 kapsulas*		*Lyl*
Pa visu dienu kopā izdzerti 1500 ml filtrēts krāna ūdens				
Augstāk minētais ir tikai paraugs, kā pierakstīt diennakts ietvaros patērēto! Dalībniece drīkst uzturā brīvi lietot sevis izvēlētos pārtikas produktus, dzērienus un uztura bagātinātājus!				

72 STUNDU UZTURA DIENASGRĀMATAS ANKETA

1. diena=3 dienas PIRMS parauga iegūšanas

Metode paredzēta, informācijas iegūšanai par pēdējās trīs dienās (pirms piena paraugu iegūšanas (noslaukšanas)) uzņemto pārtiku, dzērienu daudzumu un lietotajiem uztura bagātinātājiem.

Dalībnieces kods
Anketas aizpildīšanas datums (dd.mm.gggg.) -
Nedēļas diena -
Šī diena jums ir (vajadzīgo iekrāsot):
ikdienišķa
svētku diena (ēsts vairāk kā parasti)
diēta (ierobežota produktu lietošana), ja jā – norādīt kādu ____________________

Ko Jūs ēdāt un dzērāt pēdējo 24 stundu laikā? (plkst. 0.00 līdz 23.59)

Ēdienreize, plkst.	Apēstās pārtikas, tajā skaitā uztura bagātinātāju un izdzerto dzērienu saraksts. Saliktiem ēdieniem un dzērieniem sastāvdaļas, lūdzu, norādiet	Daudzums	Pārtikas sagatavošanas veids (svaigā veidā, cepts*, vārīts, utt.)	Produktu ražotājs (ja zināms)

72 STUNDU UZTURA DIENASGRĀMATAS ANKETA
2. diena=2 dienas PIRMS parauga iegūšanas

Metode paredzēta, informācijas iegūšanai par pēdējās trīs dienās (pirms piena paraugu iegūšanas (noslaukšanas)) uzņemto pārtiku, dzērienu daudzumu un lietotajiem uztura bagātinātājiem.

Dalībnieces kods
Anketas aizpildīšanas datums (dd.mm.gggg.) -
Nedēļas diena -
Šī diena jums ir (vajadzīgo iekrāsot):
ikdienišķa
svētku diena (ēsts vairāk kā parasti)
diēta (ierobežota produktu lietošana), ja jā – norādīt kādu ______________________________

Ko Jūs ēdāt un dzērāt pēdējo 24 stundu laikā? (plkst. 0.00 līdz 23.59)

Ēdienreize, plkst.	Apēstās pārtikas, tajā skaitā uztura bagātinātāju un izdzerto dzērienu saraksts. Saliktiem ēdieniem un dzērieniem sastāvdaļas, lūdzu, norādiet	Daudzums	Pārtikas sagatavošanas veids (svaigā veidā, cepts*, vārīts, utt.)	Produktu ražotājs (ja zināms)

72 STUNDU UZTURA DIENASGRĀMATAS ANKETA
3. diena=1 diena PIRMS parauga iegūšanas

Metode paredzēta, informācijas iegūšanai par pēdējās trīs dienās (pirms piena paraugu iegūšanas (noslaukšanas)) uzņemto pārtiku, dzērienu daudzumu un lietotajiem uztura bagātinātājiem.

Dalībnieces kods
Anketas aizpildīšanas datums (dd.mm.gggg.) -
Nedēļas diena -
Šī diena jums ir (vajadzīgo iekrāsot):
ikdienišķa
svētku diena (ēsts vairāk kā parasti)
diēta (ierobežota produktu lietošana), ja jā – norādīt kādu ______________________________

Ko Jūs ēdāt un dzērāt pēdējo 24 stundu laikā? (plkst. 0.00 līdz 23.59)

Ēdienreize, plkst.	Apēstās pārtikas, tajā skaitā uztura bagātinātāju un izdzerto dzērienu saraksts. Saliktiem ēdieniem un dzērieniem sastāvdaļas, lūdzu, norādiet	Daudzums	Pārtikas sagatavošanas veids (svaigā veidā, cepts*, vārīts, utt.)	Produktu ražotājs (ja zināms)

Food frequency questionnaire / *Pārtikas produktu lietošanas biežuma anketa*

PĀRTIKAS PRODUKTU LIETOŠANAS BIEŽUMA ANKETA

Dalībnieces kods

Anketas aizpildīšanas datums

Lūdzu atzīmējiet, cik bieži **pēdējā mēneša** laikā esiet patērējusi graudaugus?

	Nekad (neēd, jo negaršo, izraisa veselības problēmas, u.tml.)	Retāk kā reizi nedēļā	1x nedēļā	2x nedēļā	Biežāk kā 2x nedēļā, bet ne katru dienu	Katru dienu
Graudaugu pārslas (*Kellogs* , musli)						
Baltmaize						
Rupjmaize, saldskābmaize						
Maize ar sēklām, graudiem						
Makaroni						
Pilngraudu makaroni						
Baltie rīsi						
Brūnie rīsi						
Ātri vārāmās auzu pārslas						
Pilngraudu auzu pārslas						
Griķi						
Kvinoja						
Amarants						
Kuskus						
Bulgurs						
Grūbas						
	Nekad (neēd, jo negaršo, izraisa veselības problēmas, u.tml.)	Retāk kā reizi nedēļā	1x nedēļā	2x nedēļā	Biežāk kā 2x nedēļā, bet ne katru dienu	Katru dienu

Lūdzu pievērsiet uzmanību, ka jāaizpilda arī citas lapas (sheets), par citām pārtikas produktu grupām. Paldies!

PĀRTIKAS PRODUKTU LIETOŠANAS BIEŽUMA ANKETA

Lūdzu atzīmējiet cik bieži pēdējā mēneša laikā esiet patērējusi gaļu, zivis, olas?

	Nekad (neēd, jo negaršo, izraisa veselības problēmas, u.tml.)	Retāk kā reizi nedēļā	1x nedēļā	2x nedēļā	Biežāk kā 2x nedēļā, bet ne katru dienu	Katru dienu
Olas						
Vistas, tītra gaļa						
Cūkgaļa						
Liellopa gaļa						
Gaļas izstrādājumi (cīsiņi, desas, pastētes, naggeti (nuggets), utt.)						
Zivis*						
Garneles, kalmāri, mīdijas, u.c.						

*Lūdzu, nosauciet kādas (piemēram, forele, lasis, tuncis, utt.) ______________________

Kur pārsvarā iegādājieties gaļu, zivis, jūras veltes? ______________________

PĀRTIKAS PRODUKTU LIETOŠANAS BIEŽUMA ANKETA

Lūdzu atzīmējiet, cik bieži pēdējā mēneša laikā esiet patērējusi piena produktus?

	Nekad (neēd, jo negaršo, izraisa veselības problēmas, u.tml.)	Retāk kā reizi nedēļā	1x nedēļā	2x nedēļā	Biežāk kā 2x nedēļā, bet ne katru dienu	Katru dienu
Piens ar dažādu tauku saturu						
*Raudzētie piena produkti (kefīrs, jogurts, Lakto, paniņas)						
Biezpiens ar dažādu tauku saturu						
Sieri (gan svaigie, gan nogatavinātie) ar dažādu tauku saturu						
Skābais krējums ar dažādu tauku saturu						
Saldais krējums (10%, 35% tauku saturs)						
Piena deserti (biezpiena sieriņi, pudiņi, krēmi, saldējums, u.c.)						

*Dodiet priekšroku raudzētajiem piena produktiem ar vai bez dažādām piedevām? ____________________

Kur pārsvarā iegādājieties piena produktus? ____________________

PĀRTIKAS PRODUKTU LIETOŠANAS BIEŽUMA ANKETA

Lūdzu atzīmējiet, cik bieži pēdējā mēneša laikā esiet patērējusi augļus, dārzeņus, ogas, u.c.?

	Nekad (neēd, jo negaršo, izraisa veselības problēmas, u.tml.)	Retāk kā reizi nedēļā	1x nedēļā	2x nedēļā	Biežāk kā 2x nedēļā, bet ne katru dienu	Katru dienu
Dārzeņi svaigā veidā						
Dārzeņi apstrādātā veidā (cepti, sautēti, vārīti, utt), izņemot kartupeļus						
Vārīti kartupeļi						
Cepti kartupeļi, Frī, kartupeļu biezenis						
Zupas, t. sk. biezzupas						
Zaļie lapu salāti (spināti, salātlapas, rukola, u.c.)						
Diedzējumi						
Pākšaugi (lēcas, zirņi, pupiņas), svaigi, vārīti						
Pākšaugi, konservēti						
Avokado						
Augļi, svaigā veidā						
Žāvēti augļi						
Ogas, svaigā veidā						
Žāvētas ogas						
Rieksti (lazdu rieksti, mandeles, valrieksti, u.c.)						
Dažādas sēklas (linsēklas, čia sēklas, sezama sēklas, u.c.)						
	Nekad (neēd, jo negaršo, izraisa veselības problēmas, u.tml.)	Retāk kā reizi nedēļā	1x nedēļā	2x nedēļā	Biežāk kā 2x nedēļā, bet ne katru dienu	Katru dienu

Kur pārsvarā iegādājieties augļus, dārzeņus, ogas? Varbūt ko audzējiet pati vai draugi, radinieki? ____________________

PĀRTIKAS PRODUKTU LIETOŠANAS BIEŽUMA ANKETA

Lūdzu atzīmējiet, cik bieži pēdējā mēneša laikā esi patērējusi taukvielas, mērces, saldumus, pusfabrikātus?

	Nekad (neēd, jo negaršo, izraisa veselības problēmas, u.tml.)	Retāk kā reizi nedēļā	1x nedēļā	2x nedēļā	Biežāk kā 2x nedēļā, bet ne katru dienu	Katru dienu
Sviests						
Margarīns						
Tauku pastas						
Augu eļļas*						
Pašas gatavota mērce**						
Majonēze						
Kečups						
Ievārījumi						
Šokolāde						
Šokolādes batoniņi						
Virtuļi, *pončiki* , *žagariņi****						
Cepumi***						
Vafeles, pankūkas***						
Bulciņas, kēksiņi, kruasāni, utt.***						
Tortes, ruletes, pīrāgi***						
Picas						
Čipsi, sāļie riekstiņi						
Kebabi, burgeri, hot-dogi						
Pašas gatavoti vai veikalā iegādāti salāti (piemēram, Cēzara salāti, rasols, siera salāti, u.tml.) ****						
	Nekad (neēd, jo negaršo, izraisa veselības problēmas, u.tml.)	Retāk kā reizi nedēļā	1x nedēļā	2x nedēļā	Biežāk kā 2x nedēļā, bet ne katru dienu	Katru dienu

*Kādas eļļas visbiežāk patērējiet?

Lūdzu, norādiet kādu(-as) ______________________

**Kādas mērces mēdziet gatavot?

Lūdzu, norādiet kādu(-as) ______________________

***minētos izstrādājumus parasti pagatavojiet pati vai pērciet veikalā? ______________

Kādas izejvielas izmantojiet, ja gatavojiet našķus mājās (sviests, margarīns, olas, utt.)? ______________

Vai pievērsiet uzmanību veikalos nopērkamo našķu sastāvam, piemēram, vai tie satur augu taukus? ______________

****kādus salātus visbiežāk izvēlieties gatavot vai iegādāties (sastāvdaļas, ar majonēzi, krējumu, augu eļļu?) ______________

PĀRTIKAS PRODUKTU LIETOŠANAS BIEŽUMA ANKETA

Lūdzu atzīmējiet, cik bieži pēdējā mēneša laikā esiet patērējusi sekojošos dzērienus?

	Nekad (neēd, jo negaršo, izraisa veselības problēmas, u.tml.)	Retāk kā reizi nedēļā	1x nedēļā	2x nedēļā	Biežāk kā 2x nedēļā, bet ne katru dienu	Katru dienu
Augļu sulas*						
Dārzeņu sulas*						
Gāzētie dzērieni (*Coca cola* , *Sprite* , *Fanta* , u.c.)						
Kafija*						
Kapučino, Latte, karstā šokolāde, u.c.						
Tēja (zaļā, baltā, melnā)						
Zāļu tējas (kumelīšu, piparmētru, u.c.)						
Minerālūdens						
Ūdens (ūdensvada, fasēts)						
Alkohols**						

Kādām sulām dodiet priekšroku - svaigi spiestām vai rūpnieciski ražotajām? ______________________

*Kādu kafiju lietojiet ? (šķīstošā, bez kofeīna, zaļā, utt.) ______________________

*Vai ierobežojiet kafijas patēriņu zīdīšanas periodā? jā/nē

Cik bieži lietojiet kafiju zīdīšanas periodā? ______________________

*Vai ievērojiet kādu noteiktu laika periodu starp kafijas lietošanu un nākamo zīdīšanas reizi? ______________________

**Vai ierobežojiet alkohola patēriņu zīdīšanas periodā? jā/nē

Cik bieži un kādu alkoholu lietojiet zīdīšanas periodā? ______________________

**Vai ievērojiet kādu noteiktu laika periodu starp alkohola lietošanu un nākamo zīdīšanas reizi? ______________________

Questionnaire about participants characteristics / *Vispārīgo jautājumu anketa*

VISPĀRĪGIE JAUTĀJUMI UN JAUTĀJUMI PAR ZĪDĪŠANU

Lūdzu, atbildiet uz zemāk norādītajiem jautājumiem! Atbildes palīdzēs izvērtēt, kādi faktori vēl bez uztura var ietekmē mātes piena sastāvu.

1. Dalībnieces kods ______________

2. Anketas aizpildīšanas datums (dd.mm.gggg.) ________________

3. Jūsu vecums ir _____ gadi.

4. Pašlaik ar ģimeni dzīvojat:

   ☐ pilsētā
   ☐ laukos

5. Vai pašlaik lietojat kādu uztura bagātinātāju (vitamīni, minerālvielas, zivju eļļa, u.tml.) vai produktus ar paaugstinātu uzturvērtību (ziedputekšņi, minerālūdens, spirulīna, u.tml.)
   ☐ nē ☐ jā (lūdzu uzskaitiet kādus)
   ____
   ____
   ____
   ____

6. Vai Jūs zināt savu pašreizējo svaru un garumu?

   _________kg un _______cm

7. Mazuļa dzimums?

   ☐ S  ☐ V 

8. Mazuļa vecums pašlaik ir _______ mēneši.

9. Mazuļa svars un augums dzimšanas brīdī bija _________kg un _______cm.

10. Mazulis man ir ☐ pirmais ☐ otrais ☐ trešais ☐ (__) bērns ģimenē?

1 no 3

VISPĀRĪGIE JAUTĀJUMI UN JAUTĀJUMI PAR ZĪDĪŠANU

11. Mazuli pašlaik:
    ☐ ekskluzīvi* zīdu ☐ daļēji** zīdu ☐ esmu uzsākusi papildus uztura*** došanu.
    **mazulis saņem tikai krūts pienu un nesaņem nekādus citus šķidrumus vai cietu barību, izņemot medicīniski indicētus medikamentus, minerālvielas vai vitamīnus;*
    ***bērnu gan zīda, gan ēdina ar mākslīgo maisījumu;*
    ****cits ēdiens, ko dod papildus, zīdītam vai ar mākslīgo maisījumu ēdinātam mazulim.*

12. Cik apmēram reizēs diennaktī mazulis saņem mātes pienu?
    __________reizes

13. Ja paralēli zīdīšanai barojiet mazuli arī ar mākslīgo maisīju, tad kādu? Aptuveni cik reizes dienā mazulis tiek ēdināts ar mātes pienu un cik bieži ar mākslīgo maisījumu?
    ____
    ____
    ____
    ____

14. Ja mazuli esiet uzsākusi piebarot, tad no cik mēnešu vecuma tika uzsākta piebarošana?

15. Aptuveni cik reizes dienā mazulis tiek ēdināts ar mātes pienu un cik bieži ar papildus uzturu? Lūdzu, raksturo papildus uzturu, ko dot savam mazulim *(piemēram, pašas gatavots dārzeņu biezenītis 1x dienā, ap pusdienlaiku).*
    ____
    ____
    ____
    ____

16. Pētījuma ietvaros pienu noslaucu izmantojot:
    ☐ manuālo metodi (noslaucu ar roku);
    ☐ izmantoju piena pumpīti;
    ☐ kombinēju abas metodes.

VISPĀRĪGIE JAUTĀJUMI UN JAUTĀJUMI PAR ZĪDĪŠANU

17. Lūdzu, īsumā aprakstiet paraugu ņemšanas procesu (apmēram no cik barošanas reizēm tika noslaukts pieniņš pētījumam, vai visas reizes izdevās noslaukt "beigu pienu" no krūts, kuru bija zīdis mazulis)
____
____
____
____
____
____
____

Paldies!
Saziņai: [redacted]
mob. [redacted]

Food & drinks groups and items listed in the groups / *Pārtikas produktu & dzērienu grupas*

Food & drinks groups / *Pārtikas produktu & dzērienu grupas*	**Items listed in the groups / *Produkti, ietverti grupās***
Cereals, cereal products & potatoes / *Graudaugi, graudaugu produkti & kartupeļi*	Breakfast cereals (corn flakes, muesli, etc.); white wheat bread; rye bread, sourdough bread; bread with seeds, grains; pasta (macaroni) from white flour; wholegrain pasta (macaroni); white rice; brown rice; instant oat flakes; whole-grain oat flakes; buckwheat; quinoa; amaranth; cous-cous; bulgur; pearl barley; boiled potatoes; fried potatoes or mashed potatoes / *Brokastu pārslas (kukurūzas pārslas, musli u.c.); baltmaize; rupjmaize, saldskābmaize; maize ar sēklām, graudiem; makaroni no baltajiem miltiem; pilngraudu makaroni; baltie rīsi; brūnie rīsi; ātri vārāmās auzu pārslas; pilngraudu auzu pārslas; griķi; kvinoja; amarants; kus-kus; bulgurs; grūbas; vārīti kartupeļi; cepti kartupeļi, kartupeļu biezenis*
Eggs, meat & processed meat / *Olas, gala, gaļas izstrādājumi*	Eggs; poultry; turkey meat; pork; beef; meat products (sausages, nuggets, etc.) / *Olas; vistas gala; tītara gala; cūkgaļa; liellopu gaļa; gaļas izstrādājumi (cīsiņi, nageti u.tml.)*
Fish & seafood / *Zivis & jūras veltes*	Fish (both fresh water and sea water), jūras veltes (shrimps, mussels, etc.) / *Zivis (gan saldūdens, gan jūras zivis); jūras veltes (garneles, mīdijas u.c.)*
Milk & dairy products / *Piens & piena produkti*	Milk (with different fat content); fermented dairy products (yoghurt, kefir, etc.); cottage cheese (with different fat content); cheese (cream cheese, ripened cheese, brined cheese, etc.); sour cream (with different fat content); sweet cream (with different fat content) / *Piens (ar dažādu tauku saturu); raudzētie piena produkti (jogurts, kefīrs u.c.); biezpiens (ar dažādu tauku saturu); siers (krēmsiers, nogatavināts siers, siers nogatavināts sālījumā u.c.); skābais krējums (ar dažādu tauku saturu); saldais krējums (ar dažādu tauku saturu)*
Pulses / *Pākšaugi*	Pulses (fresh & cooked); canned pulses / *Pākšaugi (svaigi & pagatavoti); konservēti pākšaugi*
Vegetables / *Dārzeņi*	Fresh vegetables; cooked vegetables (fried, baked, steamed, etc.); vegetable soups; lettuces; vegetable juices (freshly squeezed or store bought) / *Svaigi dārzeņi; pagatavoti dārzeņi; dārzeņu zupas; lapu salāti; dārzeņu sulas (svaigi spiestas vai rūpnieciski ražotas)*
Fruits & berries / *Augļi & ogas*	Fresh fruits; dried fruits; fresh berries; dried berries; fruit and / or berry juices (freshly squeezed or manufactured) / *Svaigi augļi; žāvēti augļi; svaigas ogas; kaltētas ogas; augļu un / vai ogu sulas (svaigi spiestas vai rūpnieciski ražotas)*
Plant-based fats / *Augu izcelsmes taukvielas*	Avocado; nuts; seeds; plant oils / *Avokado; rieksti; sēklas; augu eļļas*

Food & drinks groups / *Pārtikas produktu & dzērienu grupas*	**Items listed in the groups / *Produkti, ietverti grupās***
Condiments / *Piedevas ēdienam*	Butter; margarine; blended fat spreads; sauces (home-made or store-bought); mayonnaise; ketchup; jam / *Sviests; margarīns; tauku pastas; mērces (mājās gatavotas vau rūpnieciski ražotas); majonēze; kečups; ievārījums*
Sweets & baked goods / *Saldumi & konditorejas izstrādājumi*	Chocolate (milk, dark, etc.); chocolate bars and candies; doughnuts and similar deep-fried products; cookies; waffles, pancakes; buns, muffins, croissants; cakes, swiss rolls, pies; milk-based desserts (ice cream, puddings, etc.) / *Šokolāde (piena, tumšā u.tml.); šokolādes batoniņi un konfektes; virtuļi un citi fritēti produkti; cepumi; vafeles, pankūkas; smalkmaizītes, kēksiņi, kruasāni; kūkas, ruletes, pīrāgi; deserti no piena (saldējums, pudiņi u.c.)*
Salty snacks & fast food / *Sāļās uzkodas &"ātrās" uzkodas*	Pizza; chips & salty nuts etc.; kebabs, burgers & hot dogs etc. / *Pica, čipsi, sāļie riekstiņi un tamlīdzīgi produkti, kebabi, burgeri, hot dogi un tamlīdzīgi produkti*
Soft drinks / *Limonādes*	Soft drinks / *Limonādes*
Caffeine containing drinks / *Kofeīnu saturošie dzērieni*	Coffee, cappuccino, latte, hot chocolate etc.; tea containing caffeine (black, green, white etc.) / *Kafija; kapučino, latte, karstā šokolāde un tamlīdzīgi dzērieni; tēja, kas satur kofeīnu (melnā, zaļā, baltā u.c.)*
Herbal teas / *Zāļu tējas*	Herbal teas / *Zāļu tējas*
Alcohol / *Alkohols*	Alcohol / *Alkohols*

Fatty acid composition of human milk / ***Taukskābju sastāvs mātes pienā* (n=141)**

Fatty acids (% of total fatty acids) / *Taukskābes (% no kopējām taukskābēm)*	**First study period / *Pirmais pētījuma posms* (n=71)**	**Second study period / *Otrais pētījuma posms* (n=70)**	***p*-value comparing distribution across both periods / *p-vērtība, salīdzinot abus pētījuma posmus***
	Median (IQR) / *Mediāna (SKI)* (Range / *Diapazons)*	**Median (IQR) / *Mediāna (SKI)* (Range / *Diapazons)***	
Saturated fatty acids *⁄ Piesātinātās taukskābes*			
Caproic acid / *Kapronskābe* (C6:0)	0.10 (0.10) (<0.10–0.20)	0.10 (0.10) (<0.10–0.30)	0.106
Caprylic acid / *Kaprilskābe* (C8:0)	0.10 (0.10) (0.10–0.30)	0.10 (0.10) (0.10–0.50)	**0.002**
Capric acid / *Kaprīnskābe* (*C10:0)*	1.10 (0.40) (0.50–2.40)	1.40 (0.30) (0.60–2.40)	**<0.0005**
Undecanoic acid / *Undekānskābe* (C11:0)	0.10 (0.10) (<0.10–0.20)	<0.10 (0.10) (<0.10–0.30)	0.728
Lauric acid / *Laurīnskābe* (*C12:0)*	4.70 (1.70) (2.20–10.90)	5.20 (1.80) (2.80–12.50)	0.130
Tridecanoic acid / *Tridekānskābe* (C13:0)	<0.10 (0.10) (<0.10–0.20)	<0.10 (0.10) (<0.10–0.20)	0.571
Myristic acid / *Miristīnskābe* (C14:0)	6.60 (2.20) (3.40–12.20)	5.20 (2.0) (2.50–9.50)	**<0.0005**
Pentadecanoic acid / *Pentadekānskābe* (C15:0)	0.40 (0.20) (0.10–0.90)	0.30 (0.20) (0.10–0.60)	**<0.0005**
Palmitic acid / *Palmitīnskābe* (C16:0)	23.80 (4.30) (13.20–30.60)	18.70 (4.90) (10.60–25.0)	**<0.0005**
Heptadecanoic acid / *Heptadekānskābe* (C17:0)	0.30 (0.10) (<0.10–0.50)	0.30 (1.50) (<0.10–4.30)	0.530
Stearic acid / *Stearīnskābe* (C18:0)	7.70 (2.20) (3.30–10.50)	5.60 (1.80) (2.90–9.10)	**<0.0005**
Arachidic acid / *Arahīnskābe* (C20:0)	0.10 (0.10) (0.10–0.40)	0.20 (0.10) (0.10–0.30)	**0.017**
Heneicosanoic acid / *Heneikozānskābe* (C21:0)	<0.10 (0.10) (<0.10–0.30)	0.10 (0.10) (<0.10–0.40)	**<0.0005**
Behenic acid / *Behenskābe* (C22:0)	0.10 (0.10) (<0.10–0.60)	0.10 (0.10) (<0.10–0.40)	0.052
Tricosanoic acid / *Trihozānskābe* (C23:0)	0.10 (<0.10) (<0.10–0.80)	0.10 (0.50) (<0.10–0.80)	0.869
Lignoceric acid / *Lignocerīnskābe* (C24:0)	<0.10 (<0.10) (<0.10–0.10)	0.10 (0.10) (<0.10–0.60)	**<0.0005**
Total medium chain fatty acids *⁄ Kopējais vidēji garo ķēžu taukskābju saturs* (C10-C14)	12.40 (4.00) (6.20–24.50)	12.10 (3.20) (6.50–21.70)	0.149
Total SFA *⁄ Kopējais PS saturs*	45.70 (6.40) (27.20–60.80)	38.60 (7.60) (21.80–49.10)	**<0.0005**

Fatty acids (% of total fatty acids) / *Taukskābes (% no kopējām taukskābēm)*	**First study period / *Pirmais pētījuma posms* (n=71)**	**Second study period / *Otrais pētījuma posms* (n=70)**	***p*-value comparing distribution across both periods / *p-vērtība, salīdzinot abus pētījuma posmus***
	Median (IQR) / *Mediāna (SKI)* (Range / *Diapazons*)	**Median (IQR) / *Mediāna (SKI)* (Range / *Diapazons*)**	
Monounsaturated fatty acids */ Mononepiesātinātās taukskābes*			
Myristoleic acid / *Miristioleīnskābe* (C14:1)	0.30 (0.10) (0.10–0.60)	0.20 (0.10) (<0.10–0.40)	0.074
***cis*-10-pentadecenoic acid / *cis-10-pentadekānskābe* (C15:1)**	0.10 (<0.10) (<0.10–0.30)	<0.10 (0.10) (<0.10–0.50)	**<0.0005**
Palmitoleic acid / *Palmitoleīnskābe* (C16:1)	1.90 (0.60) (1.10–3.50)	1.70 (2.00) (0.30–3.90)	**0.026**
***cis*-10-heptadecenoic acid / *cis*-10-*heptadekānskābe* (C17:1)**	0.10 (0.10) (0.10–0.40)	0.10 (0.10) (<0.10–0.30)	0.519
Oleic acid / *Oleīnskābe* (C18:1 n-9*c*)	34.50 (4.80) (26.10–41.40)	38.20 (5.70) (25.20–49.40)	**<0.0005**
***cis*-11-eicosenoic acid / *cis-11-eikozānskābe* (C20:1)**	0.40 (0.10) (0.10–2.60)	0.10 (0.10) (<0.10–0.30)	**<0.0005**
Erucic acid / *Erukskābe* (C22:1)	0.10 (<0.10) (<0.10–3.50)	0.10 (0.10) (<0.10–0.30)	**0.006**
Nervonic acid / *Nervonskābe* (C24:1)	0.20 (<0.10) (<0.10–0.80)	0.10 (<0.10) (<0.10–0.40)	**<0.0005**
Total MUFA */ Kopējais MNT saturs*	38.80 (4.60) (29.20–45.60)	40.30 (5.60) (25.80–51.40)	0.132
Polyunsaturated fatty acids */ Polinepiesātinātās taukskābes*			
Linoleic acid / *Linolskābe* (C18:2 n-6*c*)	11.20 (4.30) (5.00–26.50)	14.40 (5.80) (8.60–36.80)	**<0.0005**
α-linolenic acid / *α-linolēnskābe* (C18:3 n-3)	1.00 (0.60) (0.50–9.60)	1.70 (0.70) (0.80–5.50)	**<0.0005**
γ-linolenic acid / *γ-linolēnskābe* (C18:3 n-6)	0.10 (<0.10) (<0.10–1.10)	0.10 (0.10) (0.10–0.30)	**<0.0005**
cis*-11,14-eicosadienoic acid / *cis-11,14-eikozāndiēnskābe* (C20:2 n-6*)	0.20 (0.10) (<0.10–0.50)	0.30 (0.10) (0.10–0.50)	**0.034**
cis*-11,14,17-eicosatrienoic acid / *cis-11,14,17-eikozān-triēnskābe* (C20:3 n-3*)	0.10 (<0.10) (<0.10–0.30)	0.10 (<0.10) (<0.10–0.40)	0.486
***cis*-8,11,14-eicosatrienoic acid / *cis-8,11,14-eikozān-triēnskābe* (C20:3 n-6)**	0.20 (0.10) (0.10–0.40)	0.30 (0.10) (0.10–0.60)	**<0.0005**
Arachidonic acid / *Arahidonskābe* (C20:4 n-6)	0.30 (0.20) (0.10–0.50)	0.40 (0.30) (0.10–2.10)	**0.021**
***cis*-5,8,11,14,17-eicosapentaeonic acid / *cis-5,8,11,14,17-eikoza-pentaēnskābe* (C20:5 n-3)**	0.10 (0.10) (<0.10–2.70)	0.10 (<0.10) (<0.10–0.30)	**<0.0005**

Annex X continued / *X pielikuma turpinājums*

Fatty acids (% of total fatty acids) / *Taukskābes (% no kopējām taukskābēm)*	**First study period / *Pirmais pētījuma posms* (n=71)**	**Second study period / *Otrais pētījuma posms* (n=70)**	***p*-value comparing distribution across both study periods / *p-vērtība, salīdzinot abus pētījuma posmus***
	Median (IQR) / *Mediāna (SKI)* (Range / *Diapazons)*	**Median (IQR) / *Mediāna (SKI)* (Range / *Diapazons)***	
***cis*-13,16-docosadieonic acid / *cis-13,16-dokoza-diēnskābe* (C22:2 n-6)**	<0.10 (<0.10) (<0.10–0.30)	0.10 (<0.10) (<0.10–0.20)	**<0.0005**
***cis*-4,7,10,13,16,19-docosahexaenoic acid / *cis-4,7,10,13,16,19-dokoza-heksaēnskābe (*C22:6 n-3)**	0.30 (0.20) (0.10–4.30)	0.30 (0.30) (0.10–1.00)	0.883
Total PUFA / *Kopējais PNT saturs*	14.10 (6.00) (7.50–31.70)	18.10 (7.20) (12.40–39.60)	**<0.0005**
Total n-6 PUFA, *cis / Kopējais cis n-6 PNT saturs*	12.10 (4.50) (5.60–27.30)	15.40 (5.70) (9.80–38.00)	**<0.0005**
Total n-3 PUFA, *cis / Kopējais cis n-3 PNT saturs*	1.70 (0.80) (0.90–10.30)	2.30 (0.90) (1.20–6.10)	**<0.0005**
LA / ALA ratio */ LS / ALS attiecība*	9.80 (5.10) (2.10–42.60)	8.30 (3.40) (2.40–44.10)	**0.008**
n-6 / n-3 PUFA ratio / *n-6 / n-3 PNT attiecība*	6.90 (3.00) (1.90–22.70)	6.70 (3.50) (2.30–30.80)	0.679
trans* fatty acids / *trans taukskābes			
Elaidic acid / *Elaidīnskābe* (C18:1 n-9*t*)	<0.10 (all values / *visas vērtības*)	0.50 (0.40) (0.10–1.40)	**<0.0005**
Vaccenic acid / *Vakcēnskābe* (C18:1 n-11*t*)	1.20 (0.30) (<0.10–1.90)	1.70 (0.50) (0.90–2.20)	**<0.0005**
Linolelaidic acid / *Linolelaidīnskānbe* (C18:2 n-9*t*,12*t*)	0.10 (0.10) (<0.10–1.50)	0.10 (0.10) (<0.10–0.30)	**<0.0005**
Conjugated linoleic acid / *Konjugētā linolskābe* (C18:2 n9*c*, n11*t*)	not analysed in this study period / *netika noteikta šī pētījuma posma ietvaros*	0.10 (<0.10) (<0.10–0.30)	not computed / *nav aprēķināts*
Total *trans* fatty acids / *Kopējais TT saturs*	1.40 (0.30) (<0.10–2.80)	2.40 (0.60) (1.00–3.20)	**<0.0005**

Fatty acids composition of human milk among different countries /
Taukskābju sastāvs mātes pienā. Dati no dažādām valstīm*

Fatty acids / ***Taukskābes***	**Latvia / *Latvija* (n=141)**	**Poland / *Polija* (n=100)**	**Greece / *Grieķija* (n=127)**	**Spain / *Spānija* (n=39)**	**Croatia / *Horvātija* (n=83)**	**Germany / *Vācija* (n=40)**	**Turkey / *Turcija* (n=50)**	**Iran / *Irāna* (n=120)**	**China / *Ķīna* (n=477)**	**Taiwan / *Taivāna* (n=240)**	**United States / *Amerikas Savienotās Valstis* (n=81)**	**Brazil / *Brazīlija* (n=47)**	**Malaysia / *Malaizija* (n=101)**	**Nigeria / *Nigērija* (n=82)**
PA / *PS*	21.60 %	21.23 %	19.15 %	21.16 %	20.38 %	25.28 %	20.90 %	25.50 %	19.24 %	19.59 %	20.80 %	19.50 %	29.00 %	25.30 %
OA / *OS*	36.20 %	35.49 %	32.77 %	42.80 %	39.89 %	33.68 %	27.31 %	29.47 %	33.53 %	27.73 %	29.40 %	26.46 %	32.50 %	29.20 %
LA / *LS*	12.80 %	8.76 %	14.95 %	9.43 %	17.18 %	10.63 %	24.31 %	16.17 %	22.00 %	23.08 %	12.70 %	20.96 %	7.53 %	7.00 %
ALA / *ALS*	1.40 %	0.85 %	0.12 %	0.46 %	1.39 %	0.87 %	0.59 %	0.81 %	2.81 %	1.76 %	0.95 %	1.54 %	0.35 %	0.77 %
ARA / *AS*	0.30 %	0.25 %	0.88 %	0.25 %	0.42 %	0.60 %	0.46 %	1.36 %	0.62 %	0.10 %	0.47 %	0.48 %	2.57 %	0.48 %
EPA / *EPS*	0.10 %	NI / *NI*	0.10 %	0.04 %	0.13 %	0.05 %	NI / *NI*	1.33 %	0.41 %	0.19 %	0.02 %	0.08 %	1.59 %	0.08 %
DHA / *DHS*	0.30 %	0.07 %	0.51 %	0.33 %	0.21 %	0.52 %	0.15 %	0.58 %	0.38 %	0.94 %	0.23 %	0.09 %	0.82 %	0.40 %
SFA / *PT*	42.30 %	45.91 %	45.53 %	40.04 %	34.10 %	45.70 %	40.70 %	40.05 %	35.13 %	34.93 %	40.60 %	42.67 %	50.70 %	56.43 %
MCFA / *VGĶT*	12.20 %	NI / *NI*	18.94 %	11.79 %	NI / *NI*	10.13 %	13.45 %	5.76 %	9.52 %	8.91 %	11.80 %	16.22 %	16.04 %	25.20 %
MUFA / *MNT*	39.50 %	38.19 %	35.82 %	48.79 %	43.10 %	38.10 %	30.76 %	32.25 %	36.88 %	33.46 %	42.40 %	29.15 %	35.52 %	37.27 %
PUFA / *PNT*	16.00 %	10.88 %	17.98 %	12.06 %	19.95 %	14.90 %	26.89 %	20.80 %	27.55 %	28.71 %	17.00 %	24.47 %	12.86 %	2.91 %
n-6 PUFA / *n-6 PNT*	14.00 %	NI / *NI*	17.25 %	10.50 %	18.10 %	NI / *NI*	25.98 %	17.55 %	23.91 %	24.92 %	NI / *NI*	21.87 %	10.10 %	1.43 %
n-3 PUFA / *n-3 PNT*	2.00 %	NI / *NI*	0.73 %	0.98 %	1.66 %	NI / *NI*	0.82 %	3.20 %	3.86 %	3.38 %	NI / *NI*	2.11 %	1.76 %	1.42 %

*in the following order / *šādā secībā* – this study / *šis pētījums*; Mojska et al. (2003); Antonakou et al. (2013); Luna, Juárez & de la Fuente (2007); Krešić et al. (2013); Precht & Molkentin (1999); Samur, Topcu & Turan (2009); Olang et al. (2012); Jiang et al. (2016); Wu et al. (2010); Mosley et al. (2005); Nishimura et al. (2013); Daud et al. (2013); Glew et al. (2006).

Annex XI continued / *XI pielikuma turpinājums*

Fatty acids / *Taukskābes*	**Latvia / *Latvija* (n=141)**	**Poland / *Polija* (n=100)**	**Greece / *Grieķija* (n=127)**	**Spain / *Spānija* (n=39)**	**Croatia / *Horvātija* (n=83)**	**Germany / *Vācija* (n=40)**	**Turkey / *Turcija* (n=50)**	**Iran / *Irāna* (n=120)**	**China / *Ķīna* (n=477)**	**Taiwan / *Taivāna* (n=240)**	**United States / *Amerikas Savienotās Valstis* (n=81)**	**Brazil / *Brazīlija* (n=47)**	**Malaysia / *Malaizija* (n=101)**	**Nigeria / *Nigērija* (n=82)**
LA / ALA ratio / *LS / ALS attiecība*	9.10	10.31	53.68	20.50	12.14	12.22	41.20	19.96	7.83	13.11	13.37	13.61	21.51	9.09
n-6 / n-3 PUFA ratio / *n-6 PNT / n-3 PNT attiecība*	6.80	NI / *NI*	17.48	10.71	11.02	NI / *NI*	32.08	5.48	7.28	7.37	NI / *NI*	10.36	5.74	1.01
EA / *ES*	<0.10 %	NI / *NI*	0.57 %	0.21 %	NI / *NI*	0.37 %	NI / *NI*	NI / *NI*	NI / *NI*	NI / *NI*	0.65 %	0.28 %	0.22 %	0.08 %
VC / *VS*	1.40 %	NI / *NI*	NI / *NI*	0.31 %	NI / *NI*	0.68 %	NI / *NI*	NI / *NI*	NI / *NI*	NI / *NI*	1.10 %	1.68 %	0.15 %	0.15 %
LEA / *LES*	0.10 %	NI / *NI*	0.11 %	0.09 %	NI / *NI*	NI / *NI*	NI / *NI*	NI / *NI*	NI / *NI*	NI / *NI*	0.91 %	0.09 %	1.44 %	0.01 %
CLA / *KLS*	0.10 %	NI / *NI*	NI / *NI*	0.19 %	NI / *NI*	0.80 %	NI / *NI*	NI / *NI*	NI / *NI*	NI / *NI*	0.34 %	NI / *NI*	NI / *NI*	0.08 %
TFA / *TT*	1.70 %	2.53 %	2.30 %	0.80 %	2.49 %	2.40 %	2.13 %	NI / *NI*	NI / *NI*	NI / *NI*	7.00 %	2.05 %	2.93 %	0.34 %

*in the following order / *šādā secībā* – this study / *šis pētījums*; Mojska et al. (2003); Antonakou et al. (2013); Luna, Juárez & de la Fuente (2007); Krešić et al. (2013); Precht & Molkentin (1999); Samur, Topcu & Turan (2009); Olang et al. (2012); Jiang et al. (2016); Wu et al. (2010); Mosley et al. (2005); Nishimura et al. (2013); Daud et al. (2013); Glew et al. (2006).

Partial non-parametric correlation between fatty acid levels in human milk / *Daļēja neparametriskā korelācija starp dažādu taukskābju saturu mātes pienā* (n=139)[6]

Fatty acids / *Taukskābes*		**PA / *PS***	**MCFA / *VGĶT***	**SFA / *PT***	**OA / *OS***	**MUFA / *MNT***	**LA / *LS***	**ARA / *AS***	**n-6 PUFA / *n-6 PNT***	**ALA / *ALS***	**EPA / *EPS***	**DHA / *DHS***	**n-3 PUFA / *n-3 PNT***	**n-6 / n-3 PUFA ratio / *n-6 / n-3 PNT attiecība***	**LA/ALA ratio / *LS / ALS attiecība***	**PUFA / *PNT***	**EA / *ES*[7]**	**VA / *VS***	**LEA / *LES***	**CLA / *KLS*[7]**	**TFA / *TT***
PA / *PS*	ρ[8]	NA / *NP*	-0.019	0.848	-0.454	-0.234	-0.688	-0.193	-0.702	-0.598	-0.443	0.000	-0.545	-0.013	0.108	-0.735	-0.511	-0.340	0.545	0.116	-0.336
	p-value		0.828	<0.0005	<0.0005	0.007	<0.0005	0.028	<0.0005	<0.0005	<0.0005	0.996	<0.0005	0.884	0.220	<0.0005	<0.0005	<0.0005	<0.0005	0.372	<0.0005
MCFA / *VGĶT*	ρ	-0.019	NA / *NP*	0.409	-0.452	-0.530	-0.173	-0.033	-0.165	-0.067	0.114	0.074	0.005	-0.122	-0.037	-0.162	-0.032	-0.320	-0.005	-0.082	-0.173
	p-value	0.828		<0.0005	<0.0005	<0.0005	0.049	0.710	0.061	0.447	0.198	0.403	0.952	0.166	0.679	0.066	0.717	<0.0005	0.958	0.530	0.050
SFA / *PT*	ρ	0.848	0.409	NA / *NP*	-0.611	-0.481	-0.752	-0.284	-0.764	-0.554	-0.325	0.087	-0.454	-0.135	0.038	-0.779	-0.398	-0.412	0.468	0.099	-0.318
	p-value	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	0.001	<0.0005	<0.0005	<0.0005	0.323	<0.0005	0.126	0.664	<0.0005	<0.0005	<0.0005	<0.0005	0.449	<0.0005
OA / *OS*	ρ	-0.454	-0.452	-0.611	NA / *NP*	0.907	0.069	0.058	0.076	0.249	0.124	-0.028	0.175	-0.051	-0.158	0.066	0.227	0.400	-0.272	0.004	0.260
	p-value	<0.0005	<0.0005	<0.0005		<0.0005	0.433	0.512	0.391	0.004	0.161	0.751	0.047	0.565	0.073	0.452	0.009	<0.0005	0.002	0.978	0.003
MUFA / *MNT*	ρ	-0.234	-0.530	-0.481	0.907	NA / *NP*	-0.094	0.153	-0.086	0.053	0.014	-0.002	0.037	-0.040	-0.086	-0.091	-0.012	0.368	-0.116	0.014	0.153
	p-value	0.007	<0.0005	<0.0005	<0.0005		0.288	0.083	0.331	0.550	0.873	0.979	0.678	0.653	0.331	0.302	0.891	<0.0005	0.187	0.916	0.083
LA / *LS*	ρ	-0.688	-0.173	-0.752	0.069	-0.094	NA / *NP*	0.176	0.997	0.504	0.250	-0.224	0.329	0.387	0.179	0.969	0.282	0.094	-0.389	-0.221	0.092
	p-value	<0.0005	0.049	<0.0005	0.433	0.288		0.045	<0.0005	<0.0005	0.004	0.010	<0.0005	<0.0005	0.042	<0.0005	0.001	0.286	<0.0005	0.087	0.300
ARA / *AS*	ρ	-0.193	-0.033	-0.284	0.058	0.153	0.176	NA / *NP*	0.220	0.086	0.100	0.056	0.112	0.092	0.043	0.209	0.249	0.332	-0.251	0.017	0.279
	p-value	0.028	0.710	0.001	0.512	0.083	0.045		0.012	0.329	0.255	0.529	0.204	0.298	0.630	0.017	0.004	<0.0005	0.004	0.896	0.001
n-6 PUFA / *n-6 PNT*	ρ	-0.702	-0.165	-0.764	0.076	-0.086	0.997	0.220	NA / *NP*	0.506	0.268	-0.210	0.339	0.380	0.175	0.973	0.309	0.119	-0.402	-0.211	0.122
	p-value	<0.0005	0.061	<0.0005	0.391	0.331	<0.0005	0.012		<0.0005	0.002	0.017	<0.0005	<0.0005	0.046	<0.0005	<0.0005	0.178	<0.0005	0.103	0.165

[6] Number of participants who submitted questionnaire about maternal & child characteristics, as well donated human milk for fatty acid composition analysis. Partial non-parametric correlation analysis was controlled for following variables – maternal age, maternal BMI, child's age, child's birth weight & birth length, child's sex, parity, feeding pattern, milk expression manner / *Dalībnieču skaits, kas iesniedza anketu par mātes & bērna parametriem un ziedoja mātes pienu taukskābju analīzēm. Daļēja neparametriska korelācija veikta kontrolējot pēc sekojošiem mainīgajiem – mātes vecums, mātes ĶMI, bērna vecums, bērna dzimšanas svars & garums, bērna dzimums, kopējais bērnu skaits mātei, ēdināšanas veids bērnam, piena noslaukšanai izvēlētā metode.*

[7] Evaluated only based on the results from the second study period (n=70) / *Izvērtēts ņemot vērā datus tikai no otrā pētījuma posma (n=70).*

[8] 0.1 < | ρ | < 0.3 – weak correlation / *vāja sakarība*;
0.3 < | ρ | < 0.5 – moderate correlation / *vidēji cieša sakarība*;
| ρ | ≥ 0.5 – strong correlation / *cieša sakarība* (Laerd Statistics, 2017).

Fatty acids / *Taukskābes*		**PA / *PS***	**MCFA / *VGĶT***	**SFA / *PT***	**OA / *OS***	**MUFA / *MNT***	**LA / *LS***	**ARA / *AS***	**n-6 PUFA / *n-6 PNT***	**ALA / *ALS***	**EPA / *EPS***	**DHA / *DHS***	**n-3 PUFA / *n-3 PNT***	**n-6 / n-3 PUFA ratio / *n-6 / n-3 PNT attiecība***	**LA/ALA ratio / *LS / ALS attiecība***	**PUFA / *PNT***	**EA / *ES*[7]**	**VA / *VS***	**LEA / *LES***	**CLA / *KLS*[7]**	**TFA / *TT***
ALA / *ALS*	ρ[9]	-0.598	-0.067	-0.554	0.249	0.053	0.504	0.086	0.506	NA / *NP*	0.327	0.013	0.865	-0.422	-0.702	0.577	0.498	0.364	-0.291	0.032	0.408
	p-value	<0.0005	0.447	<0.0005	0.004	0.550	<0.0005	0.329	<0.0005		<0.0005	0.880	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.001	0.806	<0.0005
EPA / *EPS*	ρ	-0.443	0.114	-0.325	0.124	0.014	0.250	0.100	0.268	0.327	NA / *NP*	0.141	0.425	-0.168	-0.128	0.312	0.427	0.304	-0.218	0.106	0.376
	p-value	<0.0005	0.198	<0.0005	0.161	0.873	0.004	0.255	0.002	<0.0005		0.109	<0.0005	0.056	0.146	<0.0005	<0.0005	<0.0005	0.013	0.415	<0.0005
DHA / *DHS*	ρ	0.000	0.074	0.087	-0.028	-0.002	-0.224	0.056	-0.210	0.013	0.141	NA / *NP*	0.406	-0.574	-0.205	-0.105	0.073	0.147	0.019	0.181	0.172
	p-value	0.996	0.403	0.323	0.751	0.979	0.010	0.529	0.017	0.880	0.109		<0.0005	<0.0005	0.019	0.236	0.408	0.096	0.827	0.163	0.051
n-3 PUFA / *n-3 PNT*	ρ	-0.545	0.005	-0.454	0.175	0.037	0.329	0.112	0.339	0.865	0.425	0.406	NA / *NP*	-0.677	-0.702	0.483	0.441	0.379	-0.238	0.131	0.418
	p-value	<0.0005	0.952	<0.0005	0.047	0.678	<0.0005	0.204	<0.0005	<0.0005	<0.0005	<0.0005		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.006	0.314	<0.0005
n-6 / n-3 PUFA ratio / *n-6 / n-3 PNT attiecība*	ρ	-0.013	-0.122	-0.135	-0.051	-0.040	0.387	0.092	0.380	-0.422	-0.168	-0.574	-0.677	NA / *NP*	0.834	0.219	-0.120	-0.198	-0.069	-0.248	-0.222
	p-value	0.884	0.166	0.126	0.565	0.653	<0.0005	0.298	<0.0005	<0.0005	0.056	<0.0005	<0.0005		<0.0005	0.012	0.173	0.024	0.436	0.054	0.011
LA / ALA ratio / *LS / ALS attiecība*	ρ	0.108	-0.037	0.038	-0.158	-0.086	0.179	0.043	0.175	-0.702	-0.128	-0.205	-0.702	0.834	NA / *NP*	0.064	-0.279	-0.286	0.015	-0.172	-0.333
	p-value	0.220	0.679	0.664	0.073	0.331	0.042	0.630	0.046	<0.0005	0.146	0.019	<0.0005	<0.0005		0.466	0.001	0.001	0.863	0.186	<0.0005
PUFA / *PNT*	ρ	-0.735	-0.162	-0.779	0.066	-0.091	0.969	0.209	0.973	0.577	0.312	-0.105	0.483	0.219	0.064	NA / *NP*	0.315	0.146	-0.378	-0.154	0.152
	p-value	<0.0005	0.066	<0.0005	0.452	0.302	<0.0005	0.017	<0.0005	<0.0005	<0.0005	0.236	0.000	0.012	0.466		<0.0005	0.098	<0.0005	0.237	0.084

Annex XII continued / *XII pielikuma turpinājums*

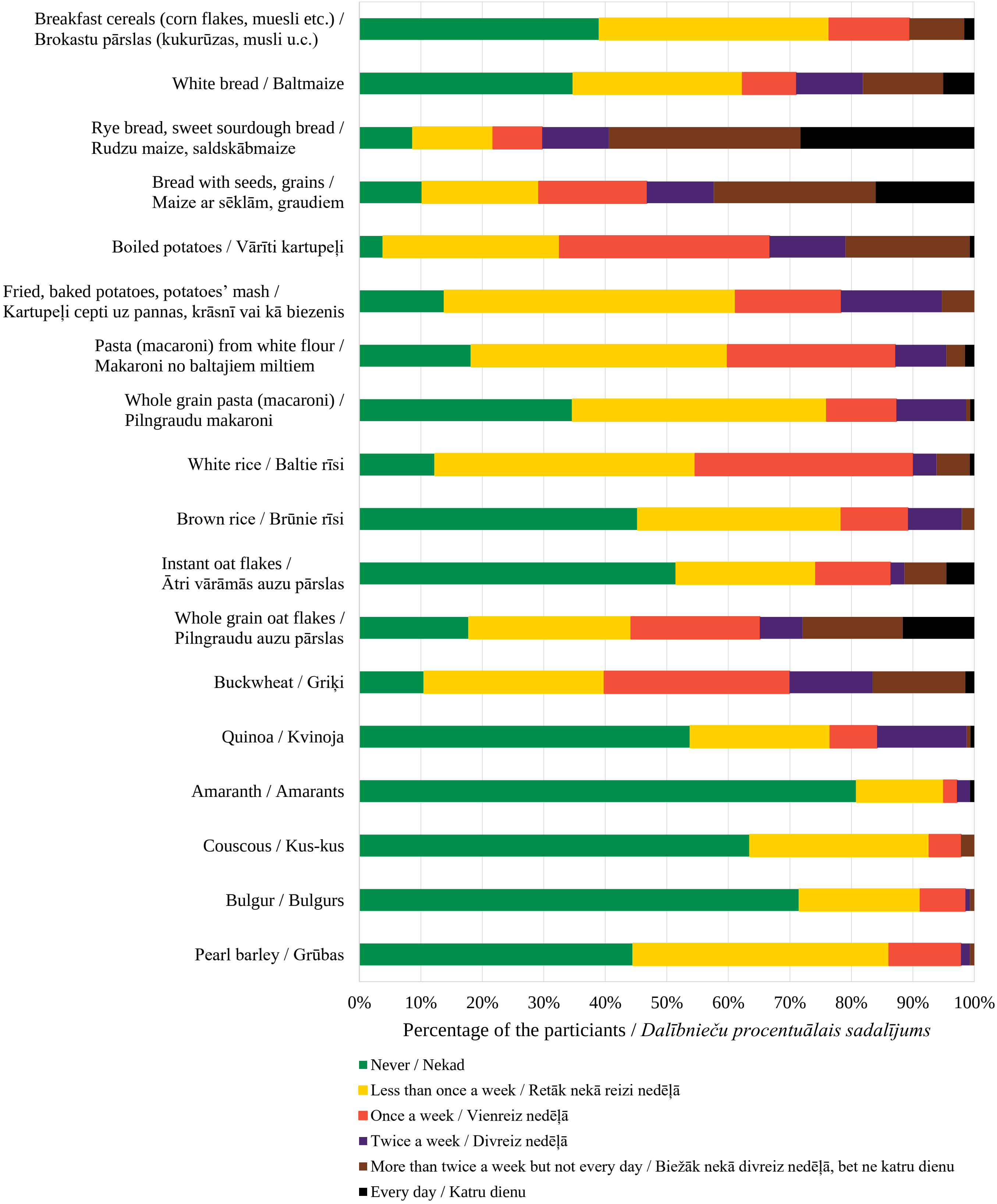
[9] 0.1 < | ρ | < 0.3 – weak correlation / *vāja sakarība*;
0.3 < | ρ | < 0.5 – moderate correlation / *vidēji cieša sakarība*;
| ρ | ≥ 0.5 – strong correlation / *cieša sakarība* (Laerd Statistics, 2017).

Fatty acids / *Taukskābes*		PA / *PS*	MCFA / *VGĶT*	SFA / *PT*	OA / *OS*	MUFA / *MNT*	LA / *LS*	ARA / *AS*	n-6 PUFA / *n-6 PNT*	ALA / *ALS*	EPA / *EPS*	DHA / *DHS*	n-3 PUFA / *n-3 PNT*	n-6 / n-3 PUFA ratio / *n-6 / n-3 PNT attiecība*	LA/ALA ratio / *LS / ALS attiecība*	PUFA / *PNT*	EA / *ES*[7]	VA / *VS*	LEA / *LES*	CLA / *KLS*[7]	TFA / *TT*
EA/ *ES*	ρ[10]	-0.511	-0.032	-0.398	0.227	-0.012	0.282	0.249	0.309	0.498	0.427	0.073	0.441	-0.120	-0.279	0.315	NA / *NP*	0.582	-0.404	0.332	0.834
	p-value	<0.0005	0.717	<0.0005	0.009	0.891	0.001	0.004	<0.0005	<0.0005	<0.0005	0.408	0.000	0.173	0.001	<0.0005		<0.0005	<0.0005	0.009	<0.0005
VA / *VS*	ρ	-0.340	-0.320	-0.412	0.400	0.368	0.094	0.332	0.119	0.364	0.304	0.147	0.379	-0.198	-0.286	0.146	0.582	NA / *NP*	-0.350	0.023	0.853
	p-value	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.286	<0.0005	0.178	<0.0005	<0.0005	0.096	0.000	0.024	0.001	0.098	<0.0005		<0.0005	0.860	<0.0005
LEA / *LES*	ρ	0.545	-0.005	0.468	-0.272	-0.116	-0.389	-0.251	-0.402	-0.291	-0.218	0.019	-0.238	-0.069	0.015	-0.378	-0.404	-0.350	NA / *NP*	0.458	-0.225
	p-value	<0.0005	0.958	<0.0005	0.002	0.187	<0.0005	0.004	<0.0005	0.001	0.013	0.827	0.006	0.436	0.863	<0.0005	<0.0005	<0.0005		<0.0005	0.010
CLA / *KLS*	ρ	0.116	-0.082	0.099	0.004	0.014	-0.221	0.017	-0.211	0.032	0.106	0.181	0.131	-0.248	-0.172	-0.154	0.332	0.023	0.458	NA / *NP*	0.432
	p-value	0.372	0.530	0.449	0.978	0.916	0.087	0.896	0.103	0.806	0.415	0.163	0.314	0.054	0.186	0.237	0.009	0.860	<0.0005		0.001
TFA / *TT*	ρ	-0.336	-0.173	-0.318	0.260	0.153	0.092	0.279	0.122	0.408	0.376	0.172	0.418	-0.222	-0.333	0.152	0.834	0.853	-0.225	0.432	NA / *NP*
	p-value	<0.0005	0.050	<0.0005	0.003	0.083	0.300	0.001	0.165	<0.0005	<0.0005	0.051	<0.0005	0.011	<0.0005	0.084	<0.0005	<0.0005	0.010	0.001	

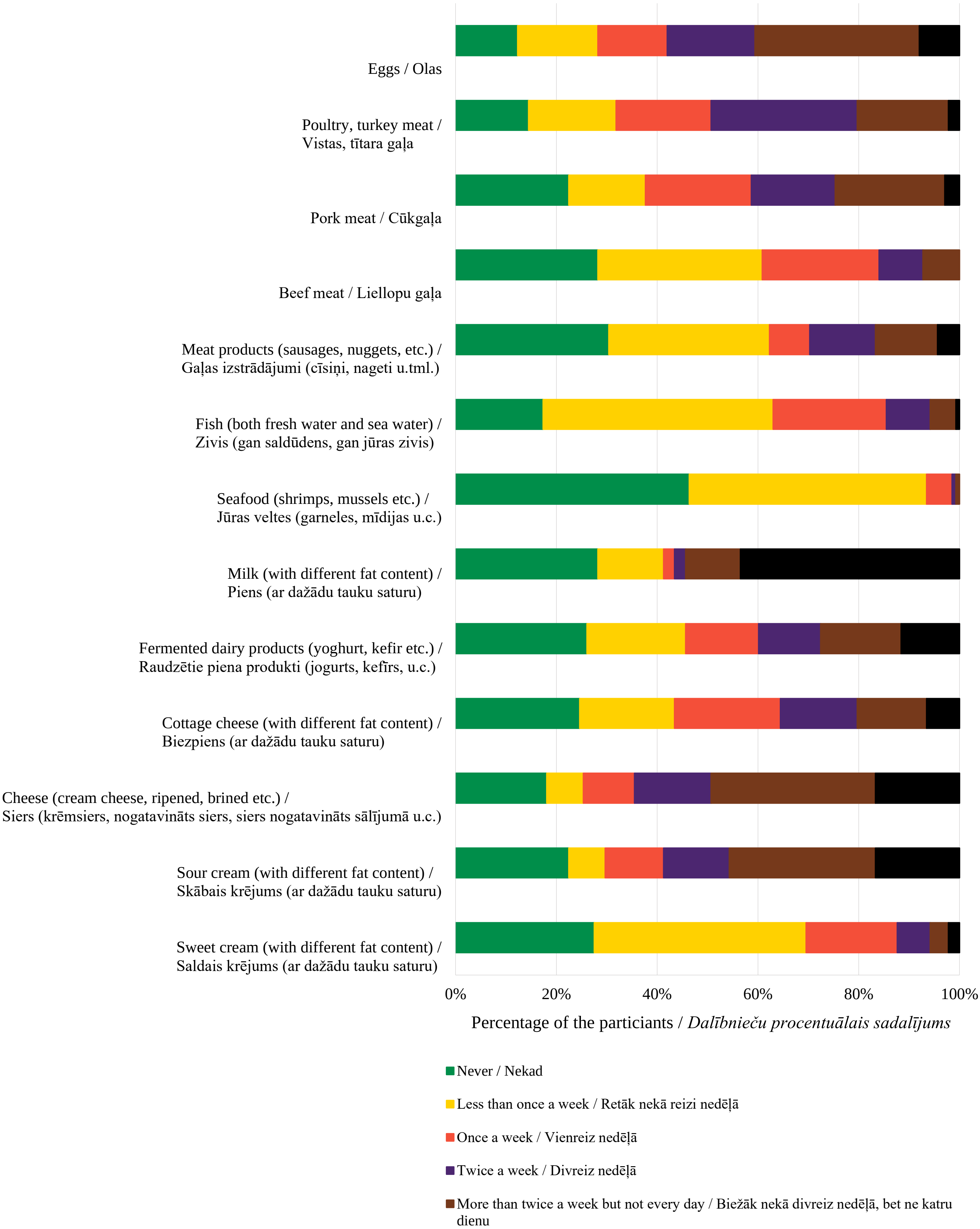
[10] 0.1 < | ρ | < 0.3 – weak correlation / *vāja sakarība*;
0.3 < | ρ | < 0.5 – moderate correlation / *vidēji cieša sakarība*;
| ρ | ≥ 0.5 – strong correlation / *cieša sakarība* (Laerd Statistics, 2017).

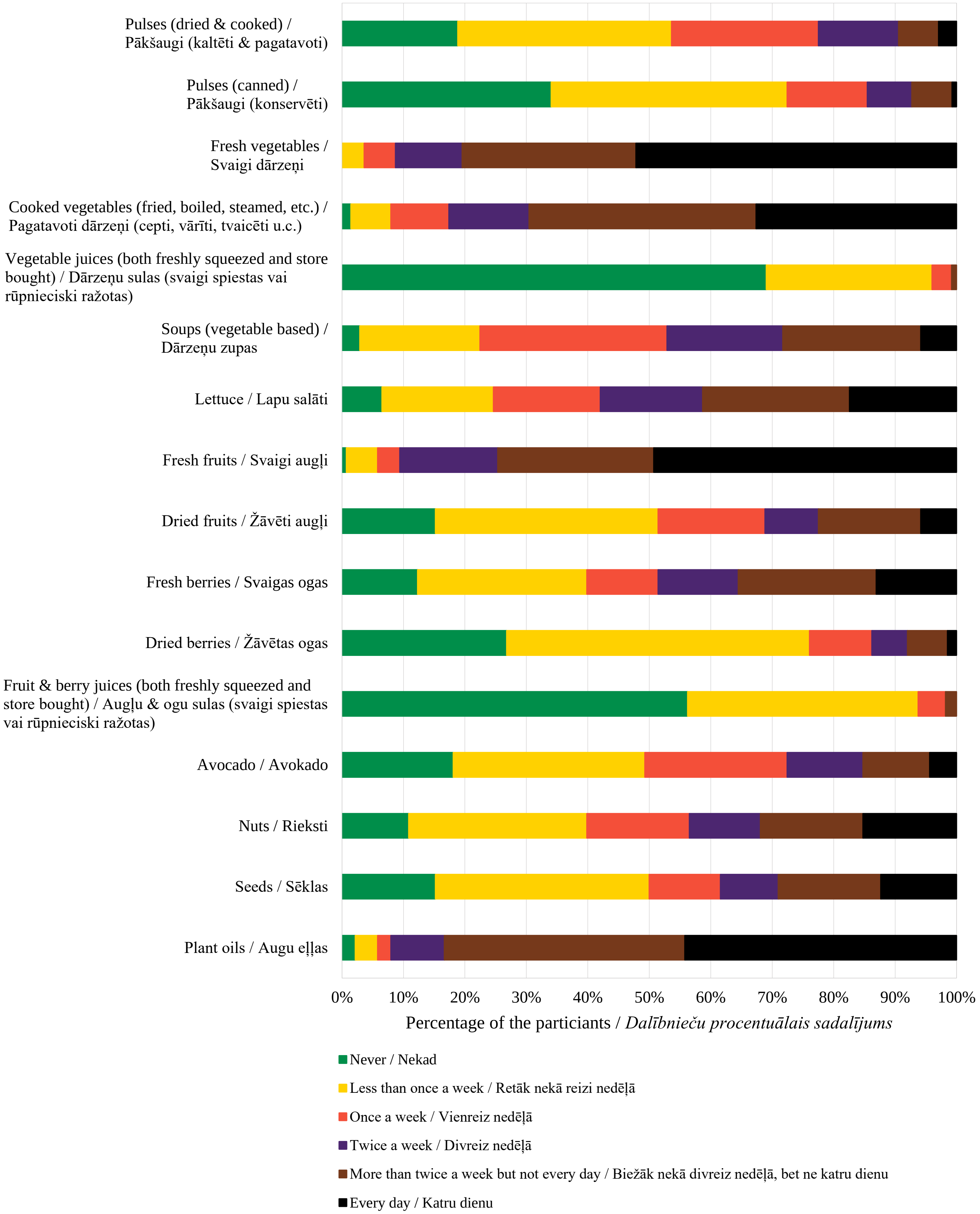
Annex XIII / *XIII pielikums*

Habitual food & drink intake among the participants / *Pārtikas produktu & dzērienu lietošanas biežums pētījuma dalībniecēm* (n=138)[11]

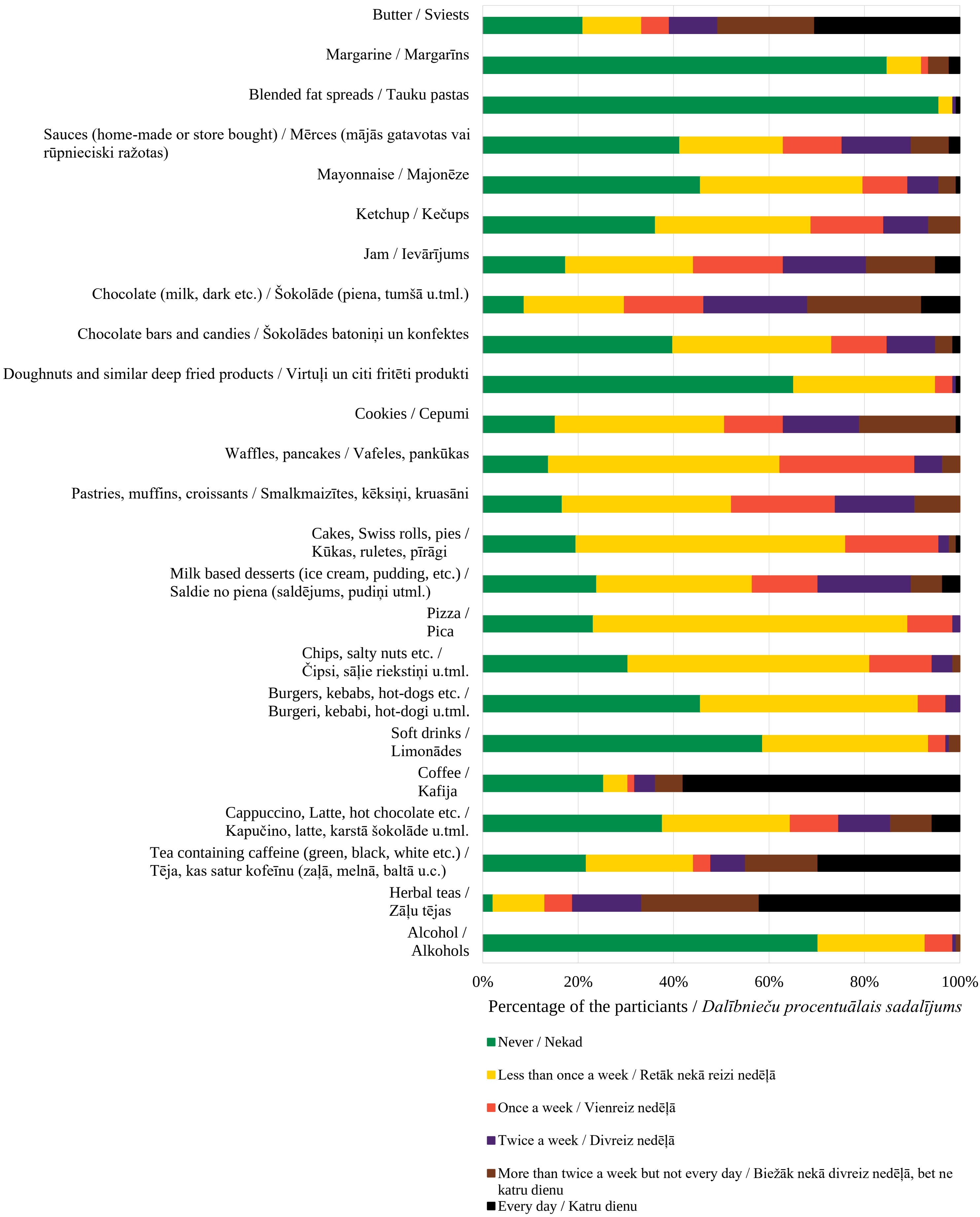


[11] Three out of 141 participants did not submit FFQ / *Trīs no 141 dalībniecēm neiesniedza pārtikas produktu lietošanas biežuma anketas*


Eggs / Olas
Poultry, turkey meat / Vistas, tītara gaļa
Pork meat / Cūkgaļa
Beef meat / Liellopu gaļa
Meat products (sausages, nuggets, etc.) / Gaļas izstrādājumi (cīsiņi, nageti u.tml.)
Fish (both fresh water and sea water) / Zivis (gan saldūdens, gan jūras zivis)
Seafood (shrimps, mussels etc.) / Jūras veltes (garneles, mīdijas u.c.)
Milk (with different fat content) / Piens (ar dažādu tauku saturu)
Fermented dairy products (yoghurt, kefir etc.) / Raudzētie piena produkti (jogurts, kefīrs, u.c.)
Cottage cheese (with different fat content) / Biezpiens (ar dažādu tauku saturu)
Cheese (cream cheese, ripened, brined etc.) / Siers (krēmsiers, nogatavināts siers, siers nogatavināts sālījumā u.c.)
Sour cream (with different fat content) / Skābais krējums (ar dažādu tauku saturu)
Sweet cream (with different fat content) / Saldais krējums (ar dažādu tauku saturu)
0%
20%
40%
60%
80%
100%
Percentage of the particiants / *Dalībnieču procentuālais sadalījums*
Never / Nekad
Less than once a week / Retāk nekā reizi nedēļā
Once a week / Vienreiz nedēļā
Twice a week / Divreiz nedēļā
More than twice a week but not every day / Biežāk nekā divreiz nedēļā, bet ne katru dienu


Pulses (dried & cooked) / Pākšaugi (kaltēti & pagatavoti)
Pulses (canned) / Pākšaugi (konservēti)
Fresh vegetables / Svaigi dārzeņi
Cooked vegetables (fried, boiled, steamed, etc.) / Pagatavoti dārzeņi (cepti, vārīti, tvaicēti u.c.)
Vegetable juices (both freshly squeezed and store bought) / Dārzeņu sulas (svaigi spiestas vai rūpnieciski ražotas)
Soups (vegetable based) / Dārzeņu zupas
Lettuce / Lapu salāti
Fresh fruits / Svaigi augļi
Dried fruits / Žāvēti augļi
Fresh berries / Svaigas ogas
Dried berries / Žāvētas ogas
Fruit & berry juices (both freshly squeezed and store bought) / Augļu & ogu sulas (svaigi spiestas vai rūpnieciski ražotas)
Avocado / Avokado
Nuts / Rieksti
Seeds / Sēklas
Plant oils / Augu eļļas
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percentage of the particiants / *Dalībnieču procentuālais sadalījums*
Never / Nekad
Less than once a week / Retāk nekā reizi nedēļā
Once a week / Vienreiz nedēļā
Twice a week / Divreiz nedēļā
More than twice a week but not every day / Biežāk nekā divreiz nedēļā, bet ne katru dienu
Every day / Katru dienu

Annex XIII continued / *XIII pielikuma turpinājums*



Energy and nutrient intake among the participants according to the data from 72-hour diary (n=69 in the first study period, n=70 in the second study period) / *Uzņemtais enerģijas un uzturvielu daudzums pētījuma daībniecēm. Dati no 72-stundu uztura dienasgrāmatas (n=69 pirmais pētījuma posms, n=70 otrais pētījuma posms)*

	Energy / *Enerģija* (kcal)			**Fat / *Tauki* (g)**			**Protein / *Olbaltumvielas* (g)**		
Median / *Mediāna*	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***
	1996.76	2007.42	0.946	84.85	93.36	0.179	79.22	77.91	0.818
IQR / *SKD*	625.24	498.31		37.47	36.38		34.19	33.58	
Min / *Min*	1088.51	827.09		36.95	35.13		26.77	29.83	
Max / *Maks*	3807.20	3191.99		193.68	179.42		149.90	180.85	
	Carbohydrates / *Ogļhidrāti* (g)			**Sugars, total / *Cukuri, kopā* (g)**			**Fructose / *Fruktoze* (g)**		
Median / *Mediāna*	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***
	204.22	196.40	0.057	99.19	81.18	**0.001**	18.29	13.30	**0.022**
IQR / *SKD*	85.37	76.33		59.08	47.04		13.73	13.89	
Min / *Min*	111.38	57.03		35.79	3.23		2.90	0.31	
Max / *Maks*	356.64	333.58		226.76	167.98		59.87	37.93	
	Galactose / *Galaktoze* (g)			**Glucose / *Glikoze* (g)**			**Lactose / *Laktoze* (g)**		
Median / *Mediāna*	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***
	0.14	0.00	0.111	15.98	12.44	**0.003**	6.07	4.95	0.112
IQR / *SKD*	0.71	0.41		13.42	10.11		12.28	10.72	
Min / *Min*	0.00	0.00		3.05	0.55		0.00	0.00	
Max / *Maks*	6.03	4.49		66.23	36.57		33.74	22.74	
	Maltose / *Maltoze* (g)			**Sucrose / *Sukroze* (g)**			**Starch / *Ciete* (g)**		
Median / *Mediāna*	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***
	0.31	0.40	0.149	45.57	36.90	**0.012**	102.41	98.84	0.948
IQR / *SKD*	0.41	0.53		37.31	29.07		47.79	52.63	
Min / *Min*	0.00	0.00		13.16	0.98		6.85	25.43	
Max / *Maks*	1.83	2.45		122.94	109.27		186.43	210.61	

Annex XIV continued / *XIV pielikuma turpinājums*

	Fibre, total / *Šķiedrvielas, kopējās* (g)			**Alcohol / *Alkohols* (g)**			**SFA / *PT* (g)**		
	FSP / *PPP*	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***
Median / *Mediāna*	21.82	22.72	0.593	0.00	0.00	0.552	29.42	30.98	0.933
IQR / *SKD*	13.55	12.01		0.00	0.00		19.44	22.40	
Min / *Min*	8.62	7.05		0.00	0.00		12.07	6.92	
Max / *Maks*	95.93	48.84		7.50	2.03		80.76	71.88	
	MUFA / *MNT* (g)			**PUFA / *PNT* (g)**			**n-6 PUFA / *n-6 PNT* (g)**		
	FSP / *PPP*	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***
Median / *Mediāna*	30.25	33.86	**0.031**	13.92	16.11	0.197	10.70	12.44	0.284
IQR / *SKD*	16.48	14.28		9.62	10.28		8.44	6.74	
Min / *Min*	9.95	10.69		4.01	5.16		3.33	2.93	
Max / *Maks*	81.35	63.11		60.20	37.51		32.07	34.06	
	n-3 PUFA / *n-3 PNT* (g)			**n-6 PUFA/n-3 PUFA ratio / *n-6 PNT un n-3 PNT attiecība***			**LA / *LS* (mg)**		
	FSP / *PPP*	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***
Median / *Mediāna*	2.27	2.59	0.168	4.50	4.65	0.621	10958.31	12092.55	0.419
IQR / *SKD*	2.49	1.95		2.92	2.66		8032.51	7194.28	
Min / *Min*	0.19	0.12		0.85	0.82		3305.99	2694.05	
Max / *Maks*	19.99	8.06		63.61	47.19		32011.14	34022.25	
	ALA / *ALS* (mg)			**LA/ALA ratio / *LS un ALS attiecība***			**LA + ALA / *LS + ALS***		
	FSP / *PPP*	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***
Median / *Mediāna*	1897.51	2553.88	0.086	4.43	4.74	0.775	6.27	6.57	0.203
IQR / *SKD*	1874.34	1979.74		3.52	2.26		3.50	3.36	
Min / *Min*	365.99	388.72		0.92	1.56		2.01	2.81	
Max / *Maks*	19874.27	8308.12		28.95	24.01		18.77	17.81	

Annex XIV continued / *XIV pielikuma turpinājums*

	EPA / *EPS* (mg)			**DHA / *DHS* (mg)**			**TFA / *TT* (mg)**		
	FSP / *PPP*	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***
Median / *Mediāna*	19.69	18.01	0.907	73.00	117.87	0.161	0.62	0.54	0.858
IQR / *SKD*	70.93	255.35		139.20	234.39		0.63	0.79	
Min / *Min*	0.00	0.00		0.00	0.00		0.00	0.00	
Max / *Maks*	1962.00	1222.69		4260.84	3369.78		2.13	1.82	
	Cholesterol / *Holesterīns* (mg)			**Calcium / *Kalcijs* (mg)**			**Phosphorus / *Fosfors* (mg)**		
	FSP / *PPP*	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***
Median / *Mediāna*	234.51	275.87	0.294	848.23	796.44	0.304	1431.67	1373.11	0.596
IQR / *SKD*	203.83	235.26		503.23	478.30		660.08	414.28	
Min / *Min*	0.99	0.00		165.64	205.25		659.03	573.86	
Max / *Maks*	840.43	926.87		2765.26	1713.05		3051.46	2261.63	
	Potassium / *Kālijs* (mg)			**Sodium / *Nātrijs* (mg)**			**Salt / *Sāls* (mg)**		
	FSP / *PPP*	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***
Median / *Mediāna*	3329.75	3250.42	0.598	2302.06	2510.82	0.686	5401.45	6397.65	**0.039**
IQR / *SKD*	1720.96	1259.64		1239.15	1508.80		3419.98	3844.43	
Min / *Min*	1670.13	1330.15		671.37	650.33		1033.50	1657.51	
Max / *Maks*	12442.25	5348.34		6003.25	5494.30		11941.55	13999.55	
	Magnesium / *Magnijs* (mg)			**Iron / *Dzelzs* (mg)**			**Zinc / *Cinks* (mg)**		
	FSP / *PPP*	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***
Median / *Mediāna*	351.91	367.71	0.593	12.67	12.90	0.518	10.42	11.81	0.073
IQR / *SKD*	199.32	155.46		10.10	7.34		4.90	5.13	
Min / *Min*	188.30	156.22		4.34	4.41		4.92	4.12	
Max / *Maks*	1299.83	891.29		107.13	113.35		27.99	41.45	

Annex XIV continued / *XIV pielikuma turpinājums*

Selenium / *Selēns* (µg)				Iodine / *Jods* (µg)			Vitamin C / *Vitamīns C* (mg)		
Median / *Mediāna*	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***
	76.73	88.34	0.071	167.72	166.76	0.778	115.47	97.65	0.217
IQR / *SKD*	44.28	53.80		102.38	98.98		141.57	86.92	
Min / *Min*	16.03	26.91		46.47	15.38		18.37	0.58	
Max / *Maks*	225.57	1494.43		381.94	356.89		1015.15	1046.16	
Vitamin B_1 / *Vitamīns B_1* (mg)				**Vitamin B_2 / *Vitamīns B_2* (mg)**			**Vitamin B_3 (NE) / *Vitamīns B_3 (NE)* (mg)**		
Median / *Mediāna*	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***
	1.37	1.37	0.541	1.69	1.49	0.092	29.56	33.45	0.337
IQR / *SKD*	1.04	0.69		1.08	0.93		15.53	15.30	
Min / *Min*	0.51	0.43		0.41	0.53		10.18	12.31	
Max / *Maks*	26.43	10.43		26.66	5.88		91.40	69.20	
Vitamin B_6 / *Vitamīns B_6* (mg)				**Vitamin B_9 (DFE) / *Vitamīns B_9 (UFE)* (µg)**			**Vitamin$_{12}$ / *Vitamīns B_{12}* (µg)**		
Median / *Mediāna*	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***
	1.94	2.20	0.195	263.85	323.87	0.730	4.34	4.38	0.575
IQR / *SKD*	1.49	1.35		242.97	188.60		4.89	4.15	
Min / *Min*	0.68	0.67		100.72	95.13		0.00	0.00	
Max / *Maks*	21.63	22.71		1822.45	1966.42		50.59	23.81	

Vitamin A (RAE) / *Vitamīns A (RAE)* (µg)				**Vitamin D / *Vitamīns D* (µg)**			**Vitamin E / *Vitamīns E* (mg)**		
Median / *Mediāna*	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***
	868.10	722.54	0.257	4.38	6.54	**0.017**	12.75	12.71	0.719
IQR / *SKD*	717.44	606.16		9.92	24.80		10.01	8.30	
Min / *Min*	82.35	35.63		0.16	0.00		3.90	2.71	
Max / *Maks*	12828.07	2540.96		155.53	256.67		160.76	49.37	

Vitamin K / *Vitamīns K* (µg)				**Carotenoids, total / *Karotinoīdi, kopējie* (µg)**		
Median / *Mediāna*	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***	**FSP / *PPP***	**SSP / *OPP***	***p*-value / *p-vērtība***
	117.65	116.62	0.373	9635.46	9862.99	0.664
IQR / *SKD*	87.59	78.93		8864.70	10311.99	
Min / *Min*	27.97	24.33		568.64	362.04	
Max / *Maks*	1060.79	445.00		247642.87	27281.15	

Partial non-parametric correlation* between habitual food & drink intake and total energy and nutrient intake among participants /
***Daļēja neparametriska korelācija starp pārtikas produktu & dzērienu lietošanas biežumu un kopējās enerģētiskās vērtības un uzturvielu uzņemšanu pētījuma dalībniecēm* (n=137)[12]**

Food & drink groups / ***Pārtikas produktu un dzērienu grupas***	**Energy and nutrients /** ***Enerģija un uzturvielas***	**Energy /** ***Enerģija***	**Fat/** ***Tauki***	**Protein /** ***Olbaltumvielas***	**Carbohydrates /** ***Ogļhidrāti***	**Sugars, total /** ***Cukuri, kopā***	**Fructose /** ***Fruktoze***	**Galactose /** ***Galaktoze***	**Glucose /** ***Glikoze***	**Lactose /** ***Lactose***	**Maltose /** ***Maltoze***	**Sucrose /** ***Sukroze***	**Starch /** ***Ciete***	**Fibre, total /** ***Šķiedrvielas, kopējās***
Cereals, cereal products & potatoes / ***Graudaugi, graudaugu produkti & kartupeļi***	ρ[13]	-0.001	-0.091	-0.097	0.114	-0.026	0.006	-0.104	0.016	0.001	-0.023	-0.039	0.156	0.102
	p-value	0.993	0.309	0.278	0.201	0.767	0.944	0.245	0.856	0.991	0.800	0.661	0.078	0.250
Eggs, meat & meat products / ***Olas, gaļa, gaļas izstrādājumi***	ρ	0.081	0.153	0.281	-0.070	-0.168	-0.237	0.010	-0.233	0.166	0.088	-0.062	-0.038	-0.325
	p-value	0.362	0.085	0.001	0.433	0.058	0.007	0.912	0.008	0.061	0.321	0.485	0.668	0.000
Fish & seafood / ***Zivis & jūras veltes***	ρ	-0.036	0.040	0.279	-0.159	-0.184	-0.009	0.163	0.010	0.097	-0.117	-0.259	-0.127	-0.037
	p-value	0.685	0.654	0.001	0.072	0.038	0.917	0.066	0.910	0.278	0.187	0.003	0.153	0.680
Milk & dairy products / ***Piens & piena produkti***	ρ	0.167	0.199	0.333	0.039	0.068	-0.004	0.436	0.079	0.654	0.039	-0.034	-0.037	-0.217
	p-value	0.060	0.024	0.000	0.660	0.444	0.960	0.000	0.373	0.000	0.658	0.705	0.679	0.014
Pulses / ***Pākšaugi***	ρ	-0.028	-0.092	-0.149	0.126	0.127	0.144	-0.100	0.143	-0.108	0.035	0.071	0.029	0.278
	p-value	0.750	0.301	0.093	0.155	0.152	0.105	0.262	0.107	0.227	0.694	0.428	0.748	0.001
Vegetables / ***Dārzeņi***	ρ	-0.067	-0.156	0.036	-0.029	-0.009	0.258	-0.055	0.310	-0.338	-0.127	-0.142	-0.022	0.313
	p-value	0.452	0.079	0.690	0.748	0.922	0.003	0.538	0.000	0.000	0.153	0.110	0.803	0.000
Fruits & berries / ***Augļi & ogas***	ρ	0.182	0.049	0.031	0.258	0.257	0.238	0.059	0.308	-0.006	0.006	0.140	0.174	0.317
	p-value	0.039	0.580	0.729	0.003	0.003	0.007	0.506	0.000	0.944	0.944	0.114	0.049	0.000
Plant-based fats / ***Augu izcelsmes taukvielas***	ρ	0.199	0.170	0.104	0.068	0.128	0.250	-0.019	0.278	-0.115	-0.066	0.013	0.013	0.436
	p-value	0.024	0.055	0.244	0.444	0.148	0.004	0.835	0.001	0.195	0.461	0.888	0.881	0.000

12 Number of participants who submitted both FFQ and 72-hour food diary as well questionnaire about maternal & child characteristics. Partial non-parametric correlation analysis was controlled for following variables – maternal age, maternal BMI, child's age, child's birth weight & birth length, child's sex, parity, feeding pattern, milk expression manner / *Dalībnieču skaits, kuras iesniedza gan pārtikas produktu lietošanas biežuma anketu, gan 72-stundu uztura dienasgrāmatu un anketu par mātes & bērna parametriem. Daļēja neparametriska korelācija veikta kontrolējot pēc sekojošiem mainīgajiem – mātes vecums, mātes ĶMI, bērna vecums, bērna dzimšanas svars & garums, bērna dzimums, kopējais bērnu skaits mātei, ēdināšanas veids bērnam, piena noslaukšanai izvēlētā metode.*

13 $0.1 < |\rho| < 0.3$ – weak correlation / *vāja sakarība*;
$0.3 < |\rho| < 0.5$ – moderate correlation / *vidēji cieša sakarība*;
$|\rho| \geq 0.5$ – strong correlation / *cieša sakarība* (Laerd Statistics, 2017).

Annex XV continued / *XV pielikuma turpinājums*

Food & drink groups / ***Pārtikas produktu un dzērienu grupas***	**Energy and nutrients /** ***Enerģija un uzturvielas***	**Energy /** ***Enerģija***	**Fat/** ***Tauki***	**Protein /** ***Olbaltumvielas***	**Carbohydrates /** ***Ogļhidrāti***	**Sugars, total /** ***Cukuri, kopā***	**Fructose /** ***Fruktoze***	**Galactose /** ***Galaktoze***	**Glucose /** ***Glikoze***	**Lactose /** ***Lactose***	**Maltose /** ***Maltoze***	**Sucrose /** ***Sukroze***	**Starch /** ***Ciete***	**Fibre, total /** ***Šķiedrvielas, kopējās***
Condiments / ***Piedevas ēdienam***	ρ[14]	0.152	0.144	0.008	0.166	0.041	-0.049	-0.041	-0.071	0.125	0.233	0.084	0.101	-0.021
	p-value	0.086	0.105	0.926	0.060	0.648	0.581	0.642	0.427	0.160	0.008	0.346	0.259	0.810
Sweets & baked goods / ***Saldumi & konditorejas izstrādājumi***	ρ	0.229	0.279	0.028	0.157	0.136	-0.120	-0.041	-0.128	0.364	0.312	0.185	0.082	-0.091
	p-value	0.009	0.001	0.756	0.076	0.126	0.177	0.649	0.151	0.000	0.000	0.037	0.358	0.307
Salty snacks & fast food / ***Sāļās uzkodas & "ātrās" uzkodas***	ρ	0.146	0.191	0.035	0.038	-0.024	-0.097	-0.089	-0.111	0.057	0.125	0.015	0.056	0.035
	p-value	0.100	0.030	0.693	0.670	0.788	0.276	0.319	0.213	0.524	0.161	0.862	0.532	0.696
Soft drinks / ***Limonādes***	ρ	0.116	0.076	0.046	0.152	0.048	-0.064	0.083	-0.085	0.161	0.180	0.091	0.151	-0.168
	p-value	0.192	0.393	0.606	0.086	0.592	0.474	0.354	0.341	0.070	0.043	0.305	0.088	0.058
Caffeine containing drinks / ***Kofeīnu saturošie dzērieni***	ρ	-0.028	0.054	0.041	-0.050	-0.046	-0.137	0.258	-0.046	0.203	0.004	-0.029	-0.116	-0.144
	p-value	0.756	0.546	0.643	0.576	0.607	0.124	0.003	0.606	0.021	0.966	0.744	0.194	0.106
Herbal teas / ***Zāļu tējas***	ρ	-0.012	0.028	-0.057	-0.040	-0.057	0.039	-0.014	0.010	-0.047	0.084	-0.026	-0.018	0.019
	p-value	0.894	0.754	0.524	0.652	0.521	0.662	0.878	0.906	0.596	0.348	0.773	0.836	0.829
Alcohol / ***Alkohols***	ρ	0.074	0.065	0.091	0.079	0.096	-0.030	0.142	-0.032	0.206	0.077	0.107	0.017	-0.156
	p-value	0.460-0.091	0.464	0.309	0.373	0.282	0.733	0.109	0.718	0.019	0.385	0.228	0.852	0.079

[14] 0.1 < | ρ | < 0.3 – weak correlation / *vāja sakarība*;
0.3 < | ρ | < 0.5 – moderate correlation / *vidēji cieša sakarība*;
| ρ | ≥ 0.5 – strong correlation / *cieša sakarība* (Laerd Statistics, 2017).

Food & drink groups / ***Pārtikas produktu un dzērienu grupas***	**Energy and nutrients /** ***Enerģija un uzturvielas***	**Alcohol /** ***alkohols***	**SFA /** ***PT***	**MUFA /** ***MNT***	**PUFA /** ***PNT***	**n-6 PUFA /** ***n-6 PNT***	**n-3 PUFA /** ***n-3 PNT***	**n-6 / n-3 PUFA ratio /** ***n-6 / n-3 PNT attiecība***	**LA /** ***LS***	**ALA /** ***ALS***	**LA/ALA ratio /** ***LS un ALS attiecība***	**EPA /** ***EPS***	**DHA /** ***DHS***	**TFA /** ***TT***
Cereals, cereal products & potatoes / ***Graudaugi, graudaugu produkti & kartupeļi***	ρ[15]	-0.110	-0.076	-0.102	-0.029	-0.037	-0.074	0.067	-0.055	-0.007	-0.009	-0.150	-0.226	-0.113
	p-value	0.216	0.395	0.251	0.748	0.675	0.405	0.450	0.541	0.933	0.923	0.090	0.010	0.203
Eggs, meat & meat products / ***Olas, gaļa, gaļas izstrādājumi***	ρ	-0.103	0.285	0.103	-0.036	-0.018	-0.061	0.042	-0.011	-0.071	0.064	0.126	0.139	0.164
	p-value	0.248	0.001	0.248	0.683	0.836	0.493	0.634	0.899	0.427	0.476	0.156	0.117	0.064
Fish & seafood / ***Zivis & jūras veltes***	ρ	-0.060	0.054	0.051	-0.152	-0.173	-0.106	0.037	-0.158	-0.256	0.187	0.236	0.224	0.026
	p-value	0.500	0.543	0.565	0.087	0.050	0.234	0.682	0.074	0.003	0.035	0.007	0.011	0.770
Milk & dairy products / ***Piens & piena produkti***	ρ	0.021	0.438	0.024	-0.097	-0.133	-0.002	-0.026	-0.118	-0.096	-0.015	0.116	0.183	0.421
	p-value	0.811	0.000	0.790	0.278	0.136	0.979	0.769	0.184	0.283	0.870	0.191	0.038	0.000
Pulses / ***Pākšaugi***	ρ	-0.144	-0.178	-0.032	0.026	0.002	0.023	0.031	-0.013	0.076	-0.013	-0.086	-0.071	-0.219
	p-value	0.105	0.045	0.722	0.770	0.984	0.793	0.732	0.887	0.391	0.882	0.332	0.427	0.013
Vegetables / ***Dārzeņi***	ρ	-0.091	-0.368	-0.064	0.091	0.077	0.071	-0.009	0.068	0.030	0.039	0.096	0.096	-0.434
	p-value	0.305	0.000	0.471	0.306	0.387	0.428	0.916	0.446	0.740	0.662	0.281	0.283	0.000
Fruits & berries / ***Augļ & ogas***	ρ	-0.149	0.030	0.016	0.175	0.163	0.080	0.070	0.158	0.102	0.109	-0.017	0.000	-0.004
	p-value	0.094	0.733	0.857	0.049	0.067	0.371	0.436	0.075	0.251	0.219	0.850	1.000	0.963
Plant-based fats / ***Augu izcelsmes taukvielas***	ρ	-0.126	-0.079	0.214	0.287	0.269	0.242	-0.078	0.262	0.303	-0.040	0.004	0.037	-0.157
	p-value	0.155	0.374	0.015	0.001	0.002	0.006	0.382	0.003	0.001	0.657	0.964	0.677	0.077
Condiments / ***Piedevas ēdienam***	ρ	-0.084	0.171	0.134	0.048	0.064	0.010	0.123	0.046	0.062	0.110	-0.098	-0.104	0.029
	p-value	0.346	0.054	0.132	0.591	0.472	0.913	0.168	0.606	0.488	0.217	0.273	0.244	0.742
Sweets & baked goods / ***Saldumi & konditorejas izstrādājumi***	ρ	-0.046	0.328	0.162	0.080	0.106	-0.016	0.108	0.106	0.077	0.084	-0.059	-0.091	0.312
	p-value	0.603	0.000	0.068	0.368	0.235	0.858	0.225	0.235	0.387	0.345	0.509	0.305	0.000
Salty snacks & fast food / ***Sāļās uzkodas & "ātrās" uzkodas***	ρ	0.053	0.138	0.204	0.052	0.085	-0.078	0.155	0.072	0.053	0.103	-0.098	-0.147	0.171
	p-value	0.551	0.119	0.021	0.561	0.338	0.380	0.080	0.418	0.555	0.248	0.271	0.098	0.054
Soft drinks / ***Limonādes***	ρ	0.061	0.202	0.000	0.023	0.037	-0.023	0.089	0.041	-0.014	0.086	-0.092	-0.060	0.131
	p-value	0.497	0.022	0.999	0.795	0.682	0.797	0.319	0.646	0.878	0.334	0.304	0.499	0.139
Caffeine containing drinks / ***Kofeīnu saturošie dzērieni***	ρ	-0.011	0.063	0.080	-0.116	-0.116	-0.099	0.051	-0.114	-0.102	0.073	0.018	-0.027	0.128
	p-value	0.906	0.478	0.368	0.191	0.194	0.268	0.566	0.201	0.252	0.410	0.844	0.763	0.151
Herbal teas / ***Zāļu tējas***	ρ	-0.052	-0.062	0.030	0.097	0.081	0.049	0.012	0.065	0.057	-0.049	-0.095	-0.025	-0.074
	p-value	0.561	0.485	0.737	0.274	0.365	0.584	0.891	0.469	0.521	0.581	0.285	0.780	0.406
Alcohol / ***Alkohols***	ρ	0.010	0.146	0.062	-0.021	-0.027	-0.071	0.091	-0.021	-0.108	0.106	-0.013	-0.069	0.154
	p-value	0.907	0.100	0.487	0.813	0.761	0.427	0.306	0.817	0.224	0.234	0.888	0.437	0.083

[15] 0.1 < | ρ | < 0.3 – weak correlation / *vāja sakarība*;
0.3 < | ρ | < 0.5 – moderate correlation / *vidēji cieša sakarība*;
| ρ | ≥ 0.5 – strong correlation / *cieša sakarība* (Laerd Statistics, 2017).

Annex XV continued / *XV pielikuma turpinājums*

Food & drink groups / *Pārtikas produktu un dzērienu grupas*	**Energy and nutrients / *Enerģija un uzturvielas***	**Cholesterol / *Holesterīns***	**Calcium / *Kalcijs***	**Phosphorus / *Fosfors***	**Potassium / *Kālijs***	**Sodium / *Nātrijs***	**Salt / *Sāls***	**Magnesium / *Magnijs***	**Iron / *Dzelzs***	**Zinc / *Cinks***	**Selenium / *Selēns***	**Iodine / *Jods***
Cereals, cereal products & potatoes / *Graudaugi, graudaugu produkti & kartupeļi*	ρ[16]	-0.283	-0.091	-0.033	0.031	0.017	0.051	0.083	0.036	-0.051	-0.200	-0.057
	p-value	0.001	0.306	0.708	0.727	0.845	0.569	0.353	0.691	0.565	0.023	0.525
Eggs, meat & meat products / *Olas, gaļa, gaļas izstrādājumi*	ρ	0.345	-0.029	0.035	-0.125	0.306	0.257	-0.255	-0.285	0.094	0.174	0.153
	p-value	0.000	0.745	0.698	0.159	0.000	0.003	0.004	0.001	0.293	0.050	0.085
Fish & seafood / *Zivis & jūras veltes*	ρ	0.190	0.129	0.088	0.077	0.090	0.013	-0.010	-0.031	0.071	0.122	0.190
	p-value	0.031	0.147	0.323	0.391	0.312	0.881	0.912	0.728	0.423	0.169	0.032
Milk & dairy products / *Piens & piena produkti*	ρ	0.395	0.520	0.346	0.137	0.196	0.175	-0.033	-0.072	0.123	0.298	0.400
	p-value	0.000	0.000	0.000	0.124	0.026	0.048	0.715	0.420	0.167	0.001	0.000
Pulses / *Pākšaugi*	ρ	-0.208	0.029	-0.031	0.111	-0.144	-0.086	0.222	0.224	-0.109	-0.076	-0.077
	p-value	0.018	0.747	0.732	0.211	0.104	0.332	0.012	0.011	0.219	0.394	0.386
Vegetables / *Dārzeņi*	ρ	-0.188	-0.024	0.090	0.325	-0.128	-0.141	0.336	0.272	0.046	0.045	-0.035
	p-value	0.034	0.790	0.314	0.000	0.149	0.113	0.000	0.002	0.606	0.614	0.692
Fruits & berries / *Augļi & ogas*	ρ	-0.044	0.125	0.136	0.245	-0.083	-0.153	0.300	0.358	0.136	-0.024	-0.021
	p-value	0.625	0.160	0.126	0.005	0.351	0.086	0.001	0.000	0.125	0.787	0.817
Plant-based fats / *Augu izcelsmes taukvielas*	ρ	-0.121	0.219	0.241	0.388	-0.113	-0.114	0.466	0.375	0.208	0.116	-0.035
	p-value	0.173	0.013	0.006	0.000	0.203	0.202	0.000	0.000	0.019	0.193	0.694
Condiments / *Piedevas ēdienam*	ρ	-0.011	0.069	-0.021	-0.085	0.163	0.181	-0.069	-0.073	-0.050	-0.016	0.004
	p-value	0.901	0.440	0.810	0.342	0.066	0.041	0.440	0.414	0.575	0.859	0.961
Sweets & baked goods / *Saldumi & konditorejas izstrādājumi*	ρ	0.069	0.146	0.081	-0.049	0.135	0.113	-0.014	-0.100	0.082	-0.010	0.133
	p-value	0.437	0.101	0.366	0.581	0.130	0.203	0.875	0.259	0.357	0.908	0.135
Salty snacks & fast food / *Sāļās uzkodas & "ātrās" uzkodas*	ρ	0.003	0.005	0.000	-0.065	0.118	0.135	-0.043	-0.040	0.030	-0.065	-0.165
	p-value	0.971	0.958	0.997	0.463	0.185	0.128	0.632	0.654	0.740	0.465	0.063
Soft drinks / *Limonādes*	ρ	0.087	0.079	0.060	-0.129	0.218	0.237	-0.161	-0.159	-0.010	0.092	0.061
	p-value	0.330	0.375	0.505	0.145	0.013	0.007	0.070	0.073	0.915	0.301	0.491
Caffeine containing drinks / *Kofeīnu saturošie dzērieni*	ρ	0.053	0.026	-0.000	-0.047	0.084	0.006	-0.087	-0.106	-0.042	0.050	0.022
	p-value	0.556	0.770	0.998	0.598	0.344	0.949	0.327	0.232	0.639	0.573	0.805
Herbal teas / *Zāļu tējas*	ρ	-0.048	-0.068	-0.007	-0.016	-0.055	-0.023	0.021	-0.091	-0.068	-0.063	0.007
	p-value	0.593	0.447	0.935	0.856	0.536	0.800	0.812	0.306	0.448	0.478	0.939
Alcohol / *Alkohols*	ρ	0.057	0.113	0.080	-0.006	0.069	0.054	-0.113	-0.132	-0.004	0.031	0.043
	p-value	0.521	0.206	0.372	0.948	0.438	0.544	0.205	0.137	0.965	0.725	0.633

[16] 0.1 < | ρ | < 0.3 – weak correlation / *vāja sakarība*;
0.3 < | ρ | < 0.5 – moderate correlation / *vidēji cieša sakarība*;
| ρ | ≥ 0.5 – strong correlation / *cieša sakarība* (Laerd Statistics, 2017).

Food & drink groups / *Pārtikas produktu un dzērienu grupas*	**Energy and nutrients / *Enerģija un uzturvielas***	**Vitamin C / *Vitamīns C***	**Vitamin B_1 / *Vitamin B_1***	**Vitamin B_2 / *Vitamin B_2***	**Vitamin B_3 / *Vitamin B_3***	**Vitamin B_6 / *Vitamin B_6***	**Vitamin B_9 / *Vitamin B_9***	**Vitamin B_{12} / *Vitamin B_{12}***	**Vitamin A / *Vitamīns A***	**Vitamin D / *Vitamin D***	**Vitamin E / *Vitamīns E***	**Vitamin K / *Vitamīns K***	**Carotenoids, total / *Karotinoīdi, kopējie***
Cereals, cereal products & potatoes / *Graudaugi, graudaugu produkti & kartupeļi*	ρ[17]	0.061	0.014	-0.090	-0.121	-0.102	-0.021	-0.245	-0.030	-0.129	-0.171	0.102	-0.022
	p-value	0.494	0.872	0.314	0.172	0.254	0.816	0.005	0.740	0.148	0.054	0.250	0.808
Eggs, meat & meat products / *Olas, gaļa, gaļas izstrādājumi*	ρ	-0.139	0.041	0.048	0.210	-0.041	-0.272	0.200	0.106	0.078	-0.097	-0.075	-0.111
	p-value	0.117	0.645	0.589	0.017	0.643	0.002	0.024	0.234	0.379	0.278	0.400	0.214
Fish & seafood / *Zivis & jūras veltes*	ρ	-0.004	-0.007	0.145	0.229	0.107	0.025	0.328	0.100	0.056	0.022	0.022	0.138
	p-value	0.962	0.941	0.102	0.009	0.228	0.780	0.000	0.261	0.526	0.802	0.809	0.120
Milk & dairy products / *Piens & piena produkti*	ρ	0.090	-0.112	0.465	0.243	0.082	0.127	0.408	0.284	0.105	0.031	0.082	0.020
	p-value	0.313	0.206	0.000	0.006	0.359	0.154	0.000	0.001	0.240	0.731	0.359	0.822
Pulses / *Pākšaugi*	ρ	0.157	-0.153	-0.124	-0.192	-0.006	0.185	-0.219	-0.031	-0.066	0.012	0.093	0.145
	p-value	0.077	0.085	0.164	0.030	0.943	0.036	0.013	0.725	0.460	0.891	0.297	0.102
Vegetables / *Dārzeņi*	ρ	0.277	0.181	-0.022	0.094	0.275	0.289	0.022	0.115	0.109	0.109	0.257	0.305
	p-value	0.002	0.041	0.804	0.290	0.002	0.001	0.805	0.197	0.220	0.221	0.003	0.000
Fruits & berries / *Augļi & ogas*	ρ	0.244	0.179	0.190	0.081	0.182	0.321	-0.016	0.096	0.026	0.141	0.195	0.088
	p-value	0.006	0.043	0.032	0.364	0.040	0.000	0.860	0.279	0.770	0.113	0.027	0.323
Plant-based fats / *Augu izcelsmes taukvielas*	ρ	0.252	0.197	0.116	0.142	0.283	0.338	-0.096	0.202	0.117	0.247	0.342	0.266
	p-value	0.004	0.026	0.191	0.110	0.001	0.000	0.283	0.022	0.190	0.005	0.000	0.002
Condiments / *Piedevas ēdienam*	ρ	-0.117	-0.124	-0.060	-0.096	-0.082	-0.118	-0.057	-0.008	-0.159	-0.016	-0.022	-0.087
	p-value	0.188	0.163	0.501	0.283	0.356	0.184	0.519	0.924	0.073	0.857	0.803	0.328
Sweets & baked goods / *Saldumi & konditorejas izstrādājumi*	ρ	-0.110	-0.082	0.065	-0.105	-0.152	0.039	-0.054	0.089	-0.091	0.041	0.045	-0.071
	p-value	0.216	0.360	0.469	0.238	0.087	0.659	0.548	0.315	0.307	0.643	0.617	0.426
Salty snacks & fast food / *Sāļās uzkodas & "ātrās" uzkodas*	ρ	-0.120	-0.105	-0.049	-0.072	-0.110	-0.120	-0.152	-0.090	-0.194	-0.061	-0.035	-0.033
	p-value	0.177	0.236	0.584	0.417	0.215	0.177	0.087	0.315	0.029	0.493	0.699	0.710
Soft drinks / *Limonādes*	ρ	-0.200	-0.089	0.016	-0.053	-0.118	-0.152	0.115	-0.117	-0.072	-0.084	-0.176	-0.039
	p-value	0.023	0.315	0.860	0.554	0.186	0.086	0.195	0.189	0.416	0.347	0.046	0.659
Caffeine containing drinks / *Kofeīnu saturošie dzērieni*	ρ	-0.143	-0.159	-0.006	-0.039	-0.133	-0.143	-0.056	0.014	-0.097	-0.120	-0.011	-0.104
	p-value	0.106	0.074	0.951	0.662	0.133	0.107	0.534	0.871	0.275	0.177	0.901	0.242
Herbal teas / *Zāļu tējas*	ρ	-0.071	0.012	-0.006	-0.038	-0.033	-0.025	-0.107	0.183	-0.039	0.016	0.037	0.095
	p-value	0.426	0.891	0.945	0.670	0.708	0.778	0.229	0.039	0.659	0.856	0.679	0.288
Alcohol / *Alkohols*	ρ	-0.046	-0.059	0.090	0.004	-0.082	-0.076	0.155	-0.035	-0.155	-0.024	-0.015	-0.010
	p-value	0.604	0.506	0.311	0.964	0.358	0.395	0.081	0.696	0.082	0.785	0.866	0.914

[17] 0.1 < | ρ | < 0.3 – weak correlation / *vāja sakarība*;
0.3 < | ρ | < 0.5 – moderate correlation / *vidēji cieša sakarība*;
| ρ | ≥ 0.5 – strong correlation / *cieša sakarība* (Laerd Statistics, 2017).

Partial non-parametric correlation between habitual food intake and fatty acid levels in human milk / *Daļēja neparametriska korelācija starp pārtikas produktu lietošanas biežumu un taukskābju saturu mātes pienā* (n=137)[18]

Fatty acids / *Taukskābes*	**Food & drink groups / *Pārtikas produktu un dzērienu grupas***	**Cereals, cereal products & potatoes / *Graudaugi, graudaugu produkti & kartupeļi***	**Eggs, meat & meat products / *Olas, gaļa, gaļas izstrādājumi***	**Fish & seafood / *Zivis & jūras veltes***	**Milk & dairy products / *Piens & piena produkti***	**Pulses / *Pākšaugi***	**Vegetables / *Dārzeņi***	**Fruits & berries / *Augļi & ogas***	**Plant-based fats / *Augu izcelsmes taukvielas***	**Condiments / *Piedevas ēdienam***	**Sweets & baked goods / *Saldumi & konditorejas izstrādājumi***	**Salty snacks & fast food / *Sāļās uzkodas & ātrās” uzkodas***	**Soft drinks / *Limonādes***	**Caffeine containing drinks / *Kofeīnu saturošie dzērieni***	**Herbal teas / *Zāļu tējas***	**Alcohol / *Alkohols***
PA / *PA*	ρ[19]	-0.030	0.355	0.121	0.509	-0.196	-0.267	-0.123	-0.241	0.041	0.267	0.037	0.117	0.120	-0.043	0.120
	p-value	0.733	0.000	0.173	0.000	0.027	0.002	0.166	0.006	0.646	0.002	0.679	0.187	0.177	0.628	0.176
MCFA / *VDĶT*	ρ	0.110	-0.133	0.101	-0.124	0.184	0.214	0.128	-0.011	-0.058	-0.008	0.040	-0.146	-0.034	-0.088	0.043
	p-value	0.218	0.134	0.258	0.162	0.038	0.015	0.151	0.900	0.513	0.933	0.658	0.099	0.706	0.323	0.628
SFA / *PT*	ρ	0.053	0.211	0.217	0.368	-0.053	-0.055	-0.015	-0.164	-0.032	0.187	0.017	-0.017	0.005	-0.076	0.093
	p-value	0.553	0.017	0.014	0.000	0.556	0.535	0.869	0.064	0.724	0.034	0.853	0.851	0.951	0.396	0.295
OA / *OS*	ρ	-0.047	-0.120	-0.014	-0.158	0.022	-0.031	-0.046	0.133	0.070	-0.023	0.131	-0.016	0.124	0.098	0.086
	p-value	0.597	0.178	0.878	0.075	0.805	0.732	0.605	0.135	0.430	0.795	0.140	0.857	0.163	0.273	0.334
MUFA / *MNT*	ρ	-0.084	-0.104	-0.029	-0.110	0.012	-0.035	-0.015	0.105	0.043	-0.045	0.108	-0.007	0.125	0.087	0.060
	p-value	0.348	0.242	0.745	0.217	0.890	0.697	0.867	0.238	0.633	0.611	0.224	0.941	0.160	0.329	0.501
LA / *LS*	ρ	0.048	-0.113	-0.248	-0.288	0.045	0.057	0.064	0.102	0.077	-0.112	-0.045	0.031	-0.100	0.017	-0.154
	p-value	0.587	0.204	0.005	0.001	0.617	0.525	0.470	0.252	0.387	0.208	0.615	0.726	0.263	0.845	0.084

[18] Number of participants who submitted both FFQ and questionnaire about maternal & child characteristics, as well donated human milk for fatty acid composition analysis. Partial non-parametric correlation analysis was controlled for following variables – maternal age, maternal BMI, child’s age, child’s birth weight, and birth length, child’s sex, parity, feeding pattern, milk expression manner / *Dalībnieču skaits, kuras iesniedza gan pārtikas produktu lietošanas biežuma anketu, gan anketu par mātes & bērna parametriem, kā arī ziedoja mātes pienu taukskābju analīzēm. Daļēja neparametriska korelācija veikta kontrolējot pēc sekojošiem mainīgajiem – mātes vecums, mātes ĶMI, bērna vecums, bērna dzimšanas svars un garums, bērna dzimums, kopējais bērnu skaits mātei, ēdināšanas veids bērnam, piena noslaukšanai izvēlētā metode.*

[19] 0.1 < | ρ | < 0.3 – weak correlation / *vāja sakarība*;
0.3 < | ρ | < 0.5 – moderate correlation / *vidēji cieša sakarība*;
| ρ | ≥ 0.5 – strong correlation / *cieša sakarība* (Laerd Statistics, 2017).

Fatty acids / ***Taukskābes***	**Food & drink groups /** ***Pārtikas produktu un dzērienu grupas***	**Cereals, cereal products & potatoes /** ***Graudaugi, graudaugu produkti & kartupeļi***	**Eggs, meat & meat products /** ***Olas, gaļa, gaļas izstrādājumi***	**Fish & seafood /** ***Zivis & jūras veltes***	**Milk & dairy products /** ***Piens & piena produkti***	**Pulses /** ***Pākšaugi***	**Vegetables /** ***Dārzeņi***	**Fruits & berries /** ***Augļi & ogas***	**Plant-based fats /** ***Augu izcelsmes taukvielas***	**Condiments /** ***Piedevas ēdienam***	**Sweets & baked goods /** ***Saldumi & konditorejas izstrādājumi***	**Salty snacks & fast food /** ***Sāļās uzkodas & „ātrās" uzkodas***	**Soft drinks /** ***Limonādes***	**Caffeine containing drinks /** ***Kofeīnu saturošie dzērieni***	**Herbal teas /** ***Zāļu tējas***	**Alcohol /** ***Alkohols***
ARA / ***AS***	ρ[20]	-0.254	0.051	-0.124	-0.098	-0.248	-0.024	0.006	-0.100	-0.126	-0.094	-0.066	0.036	0.027	-0.014	0.019
	p-value	0.004	0.570	0.163	0.272	0.005	0.791	0.944	0.262	0.156	0.293	0.461	0.687	0.765	0.874	0.830
ALA / ***ALS***	ρ	0.084	-0.076	-0.146	0.027	0.090	0.076	0.080	0.180	0.019	0.075	0.075	0.014	0.018	0.152	-0.018
	p-value	0.345	0.394	0.099	0.765	0.310	0.395	0.370	0.042	0.828	0.401	0.401	0.872	0.842	0.086	0.837
EPA / ***EPS***	ρ	-0.069	0.007	0.168	-0.210	0.038	0.170	0.159	-0.034	-0.144	-0.217	-0.162	-0.068	0.017	0.091	-0.090
	p-value	0.439	0.939	0.058	0.017	0.669	0.055	0.074	0.701	0.105	0.014	0.067	0.444	0.848	0.304	0.311
DHA / ***DHS***	ρ	-0.229	-0.008	0.287	0.053	-0.098	0.144	-0.095	-0.001	-0.250	-0.089	-0.288	-0.097	0.051	0.001	-0.019
	p-value	0.009	0.927	0.001	0.550	0.270	0.104	0.286	0.995	0.004	0.319	0.001	0.278	0.567	0.987	0.836
n-6 PUFA / ***n-6 PNT***	ρ	0.033	-0.118	-0.252	-0.299	0.039	0.068	0.065	0.091	0.065	-0.130	-0.055	0.033	-0.093	0.011	-0.148
	p-value	0.715	0.183	0.004	0.001	0.665	0.444	0.468	0.309	0.465	0.145	0.536	0.714	0.299	0.903	0.096
n-3 PUFA / ***n-3 PNT***	ρ	-0.034	-0.086	-0.011	-0.017	0.020	0.136	0.014	0.087	-0.095	-0.045	-0.097	-0.034	0.066	0.111	-0.054
	p-value	0.701	0.335	0.905	0.853	0.825	0.125	0.875	0.331	0.287	0.615	0.275	0.701	0.456	0.213	0.545
n-6 / n-3 PUFA ratio / ***n-6 / n-3 PNT attiecība***	ρ	0.103	0.023	-0.125	-0.178	0.002	-0.065	0.064	-0.015	0.197	-0.022	0.154	0.092	-0.071	-0.092	-0.034
	p-value	0.248	0.792	0.159	0.044	0.979	0.463	0.471	0.869	0.026	0.805	0.083	0.299	0.429	0.301	0.703
LA / ALA ratio / ***LS / ALS attiecība***	ρ	-0.016	-0.022	0.010	-0.252	-0.064	-0.002	0.009	-0.065	0.081	-0.161	-0.024	0.011	-0.091	-0.130	-0.087
	p-value	0.857	0.803	0.913	0.004	0.473	0.985	0.923	0.463	0.362	0.069	0.785	0.904	0.308	0.142	0.330
PUFA / ***PNT***	ρ	0.012	-0.127	-0.248	-0.301	0.018	0.066	0.030	0.069	0.044	-0.119	-0.089	0.033	-0.074	0.025	-0.156
	p-value	0.894	0.155	0.005	0.001	0.837	0.460	0.737	0.439	0.625	0.182	0.316	0.715	0.404	0.777	0.080

[20] 0.1 < | ρ | < 0.3 – weak correlation / *vāja sakarība*;
0.3 < | ρ | < 0.5 – moderate correlation / *vidēji cieša sakarība*;
| ρ | ≥ 0.5 – strong correlation / *cieša sakarība* (Laerd Statistics, 2017).

Fatty acids / *Taukskābes*	**Food & drink groups / *Pārtikas produktu un dzērienu grupas***	**Cereals, cereal products & potatoes / *Graudaugi, graudaugu produkti & kartupeļi***	**Eggs, meat & meat products / *Olas, gaļa, gaļas izstrādājumi***	**Fish & seafood / *Zivis & jūras veltes***	**Milk & dairy products / *Piens & piena produkti***	**Pulses / *Pākšaugi***	**Vegetables / *Dārzeņi***	**Fruits & berries / *Augļi & ogas***	**Plant-based fats / *Augu izcelsmes taukvielas***	**Condiments / *Piedevas ēdienam***	**Sweets & baked goods / *Saldumi & konditorejas izstrādājumi***	**Salty snacks & fast food / *Sāļās uzkodas & ātrās” uzkodas***	**Soft drinks / *Limonādes***	**Caffeine containing drinks / *Kofeīnu saturošie dzērieni***	**Herbal teas / *Zāļu tējas***	**Alcohol / *Alkohols***
EA / *EA*[21]	ρ[22]	-0.170	0.211	0.227	0.607	-0.133	-0.092	-0.111	-0.114	0.043	0.109	-0.095	0.156	0.266	-0.143	-0.035
	p-value	0.191	0.102	0.079	0.000	0.307	0.480	0.396	0.382	0.744	0.404	0.466	0.230	0.038	0.273	0.788
VA / *VS*	ρ	-0.040	0.260	0.106	0.078	-0.180	-0.040	-0.102	-0.107	-0.047	-0.063	-0.022	0.033	0.137	0.083	-0.004
	p-value	0.655	0.003	0.234	0.379	0.042	0.653	0.253	0.231	0.598	0.477	0.807	0.712	0.124	0.351	0.966
LEA / *LES*	ρ	-0.019	0.061	0.138	0.436	0.030	-0.073	0.021	-0.083	-0.006	0.166	0.062	0.046	0.078	-0.013	0.214
	p-value	0.831	0.496	0.120	0.000	0.740	0.411	0.818	0.352	0.944	0.061	0.485	0.607	0.380	0.883	0.015
CLA / *KLS*[21]	ρ	-0.039	-0.083	0.006	0.178	0.080	0.027	0.030	-0.051	0.035	0.004	0.080	-0.130	0.004	0.009	-0.059
	p-value	0.768	0.524	0.965	0.171	0.539	0.839	0.820	0.696	0.789	0.977	0.538	0.318	0.979	0.947	0.652
TFA / *TT*	ρ	-0.034	0.283	0.193	0.257	-0.136	-0.067	-0.077	-0.169	-0.007	0.053	0.023	0.080	0.181	0.010	0.059
	p-value	0.705	0.001	0.029	0.003	0.125	0.452	0.389	0.057	0.935	0.556	0.801	0.369	0.041	0.910	0.505

[21] Evaluated only based on the results from the second study period (n=70) / *Izvērtēts ņemot vērā datus tikai no otrā pētījuma posma (n=70).*

[22] 0.1 < | ρ | < 0.3 – weak correlation / *vāja sakarība*;
0.3 < | ρ | < 0.5 – moderate correlation / *vidēji cieša sakarība*;
| ρ | ≥ 0.5 – strong correlation / *cieša sakarība* (Laerd Statistics, 2017).

Partial non-parametric correlation between maternal energy & nutrient intake and fatty acid level in human milk / *Daļēja neparametriska korelācija starp uzņemto enerģijas & uzturvielu daudzumu un taukskābju saturu mātes pienā* (n=137)[23]

Fatty acids / *Taukskābes*	**Energy and nutrients / *Enerģija un uzturvielas***	**Energy / *Enerģija***	**Fat/ *Tauki***	**Protein / *Olbaltumvielas***	**Carbohydrates / *Ogļhidrāti***	**Sugars, total / *Cukuri, kopā***	**Fructose / *Fruktoze***	**Galactose / *Galaktoze***	**Glucose / *Glikoze***	**Lactose / *Lactose***	**Maltose / *Maltoze***	**Sucrose / *Sukroze***	**Starch / *Ciete***	**Fibre, total / *Šķiedrvielas, kopējās***	**Alcohol / *alkohols***
PA / *PA*	ρ[24]	-0.067	0.161	0.119	-0.238	-0.202	-0.289	0.226	-0.256	0.478	0.037	-0.200	-0.181	-0.387	0.053
	p-value	0.454	0.070	0.181	0.007	0.022	0.001	0.010	0.004	0.000	0.680	0.024	0.041	0.000	0.551
MCFA / *VDĶT*	ρ	-0.037	-0.242	-0.053	0.114	0.075	0.133	-0.142	0.167	-0.097	-0.047	0.079	0.098	0.101	0.068
	p-value	0.680	0.006	0.553	0.199	0.401	0.135	0.110	0.060	0.277	0.599	0.374	0.270	0.258	0.447
SFA / *PT*	ρ	-0.015	0.046	0.143	-0.112	-0.103	-0.141	0.150	-0.081	0.348	0.017	-0.106	-0.064	-0.205	0.051
	p-value	0.867	0.603	0.106	0.208	0.247	0.113	0.091	0.363	0.000	0.851	0.234	0.475	0.020	0.568
OA / *OS*	ρ	0.046	0.125	0.017	-0.053	-0.004	0.053	-0.018	0.011	-0.208	0.071	0.015	-0.051	0.088	0.011
	p-value	0.605	0.159	0.849	0.556	0.963	0.555	0.844	0.902	0.018	0.428	0.865	0.567	0.322	0.903
MUFA / *MNT*	ρ	0.017	0.089	0.021	-0.063	-0.003	0.054	-0.010	0.021	-0.172	0.044	-0.009	-0.068	0.059	0.024
	p-value	0.846	0.319	0.810	0.483	0.977	0.547	0.913	0.813	0.053	0.623	0.923	0.449	0.507	0.792
LA / *LS*	ρ	0.006	-0.108	-0.185	0.156	0.076	0.054	-0.224	0.017	-0.218	-0.022	0.135	0.108	0.165	-0.094
	p-value	0.946	0.225	0.037	0.079	0.394	0.548	0.011	0.849	0.013	0.805	0.128	0.226	0.062	0.294

[23] Number of participants who submitted both 72-hour food diary and questionnaire about maternal & child characteristics, as well donated human milk for fatty acid composition analysis. Partial non-parametric correlation analysis was controlled for following variables – maternal age, maternal BMI, child's age, child's birth weight & birth length, child's sex, parity, feeding pattern, milk expression manner / *Dalībnieču skaits, kuras iesniedza gan 72-stundu uztura dienasgrāmatu un anketu par mātes & bērna parametriem, kā arī ziedoja mātes pienu taukskābju analīzēm. Daļēja neparametriska korelācija veikta kontrolējot pēc sekojošiem mainīgajiem – mātes vecums, mātes ĶMI, bērna vecums, bērna dzimšanas svars & garums, bērna dzimums, kopējais bērnu skaits mātei, ēdināšanas veids bērnam, piena noslaukšanai izvēlētā metode.*

[24] 0.1 < | ρ | < 0.3 – weak correlation / *vāja sakarība*;
0.3 < | ρ | < 0.5 – moderate correlation / *vidēji cieša sakarība*;
| ρ | ≥ 0.5 – strong correlation / *cieša sakarība* (Laerd Statistics, 2017).

Fatty acids / *Taukskābes*	**Energy and nutrients / *Enerģija un uzturvielas***	**Energy / *Enerģija***	**Fat/ *Tauki***	**Protein / *Olbaltumvielas***	**Carbohydrates / *Ogļhidrāti***	**Sugars, total / *Cukuri, kopā***	**Fructose / *Fruktoze***	**Galactose / *Galaktoze***	**Glucose / *Glikoze***	**Lactose / *Lactose***	**Maltose / *Maltoze***	**Sucrose / *Sukroze***	**Starch / *Ciete***	**Fibre, total / *Šķiedrvielas, kopējās***	**Alcohol / *alkohols***
ARA / *AS*	ρ[25]	-0.079	-0.157	0.014	-0.090	-0.079	-0.064	-0.044	-0.055	-0.075	-0.071	-0.138	-0.081	-0.111	0.036
	p-value	0.375	0.076	0.871	0.312	0.374	0.472	0.619	0.534	0.399	0.429	0.120	0.364	0.212	0.683
ALA / *ALS*	ρ	0.207	0.105	0.047	0.233	0.078	0.098	0.061	0.142	-0.036	0.031	0.074	0.223	0.104	0.123
	p-value	0.019	0.237	0.601	0.008	0.383	0.269	0.493	0.111	0.685	0.731	0.407	0.011	0.242	0.168
EPA / *EPS*	ρ	0.007	-0.094	0.003	0.058	0.060	0.106	-0.036	0.113	-0.195	-0.053	0.095	0.010	0.040	0.092
	p-value	0.936	0.292	0.970	0.515	0.499	0.232	0.685	0.205	0.027	0.551	0.287	0.909	0.656	0.302
DHA / *DHS*	ρ	0.065	0.034	0.319	-0.069	0.023	0.098	0.148	0.115	-0.010	-0.075	-0.098	-0.080	0.012	0.041
	p-value	0.464	0.699	0.000	0.436	0.799	0.271	0.097	0.197	0.910	0.398	0.273	0.368	0.892	0.649
n-6 PUFA / *n-6 PNT*	ρ	-0.003	-0.125	-0.182	0.154	0.076	0.061	-0.221	0.025	-0.226	-0.017	0.127	0.106	0.167	-0.092
	p-value	0.975	0.159	0.040	0.083	0.397	0.497	0.012	0.777	0.010	0.848	0.153	0.234	0.060	0.304
n-3 PUFA / *n-3 PNT*	ρ	0.182	0.064	0.134	0.191	0.078	0.129	0.110	0.170	-0.069	0.010	0.065	0.182	0.086	0.143
	p-value	0.040	0.475	0.133	0.031	0.383	0.146	0.218	0.054	0.437	0.910	0.469	0.039	0.337	0.108
n-6 / n-3 PUFA ratio / *n-6 / n-3 PNT attiecība*	ρ	-0.133	-0.106	-0.210	-0.052	-0.065	-0.089	-0.258	-0.148	-0.084	-0.033	0.008	-0.046	0.041	-0.168
	p-value	0.133	0.234	0.017	0.557	0.465	0.320	0.003	0.095	0.349	0.713	0.927	0.608	0.647	0.058
LA / ALA ratio / *LS / ALS attiecība*	ρ	-0.196	-0.188	-0.166	-0.109	-0.064	-0.049	-0.236	-0.130	-0.146	-0.062	-0.023	-0.110	0.032	-0.205
	p-value	0.026	0.033	0.061	0.221	0.474	0.585	0.007	0.144	0.099	0.486	0.801	0.218	0.722	0.020
PUFA / *PNT*	ρ	0.004	-0.131	-0.169	0.169	0.068	0.052	-0.196	0.024	-0.227	-0.008	0.126	0.139	0.148	-0.074
	p-value	0.964	0.142	0.057	0.056	0.449	0.558	0.027	0.786	0.010	0.929	0.157	0.118	0.095	0.409

[25] 0.1 < | ρ | < 0.3 – weak correlation / *vāja sakarība*;
0.3 < | ρ | < 0.5 – moderate correlation / *vidēji cieša sakarība*;
| ρ | ≥ 0.5 – strong correlation / *cieša sakarība* (Laerd Statistics, 2017).

Annex XVII continued / *XVII pielikuma turpinājums*

Fatty acids / *Taukskābes*	**Energy and nutrients / *Enerģija un uzturvielas***	**Energy / *Enerģija***	**Fat/ *Tauki***	**Protein / *Olbaltumvielas***	**Carbohydrates / *Ogļhidrāti***	**Sugars, total / *Cukuri, kopā***	**Fructose / *Fruktoze***	**Galactose / *Galaktoze***	**Glucose / *Glikoze***	**Lactose / *Lactose***	**Maltose / *Maltoze***	**Sucrose / *Sukroze***	**Starch / *Ciete***	**Fibre, total / *Šķiedrvielas, kopējās***	**Alcohol / *alkohols***
EA / *EA*[26]	ρ[27]	-0.331	-0.129	-0.266	-0.256	-0.076	0.086	-0.070	0.051	-0.141	-0.182	-0.133	-0.240	-0.090	0.047
	p-value	0.009	0.322	0.038	0.046	0.563	0.508	0.591	0.699	0.278	0.161	0.307	0.062	0.491	0.717
VA / *VS*	ρ	0.070	0.113	0.219	-0.028	-0.055	-0.006	0.152	0.006	0.019	-0.011	-0.113	-0.037	-0.114	0.064
	p-value	0.434	0.205	0.013	0.750	0.535	0.947	0.087	0.947	0.833	0.901	0.205	0.680	0.198	0.473
LEA / *LES*	ρ	-0.005	0.111	0.049	-0.114	-0.038	-0.021	0.259	0.031	0.262	0.037	-0.103	-0.086	-0.198	0.101
	p-value	0.954	0.212	0.582	0.202	0.673	0.815	0.003	0.729	0.003	0.676	0.248	0.334	0.025	0.255
CLA / *KLS*[26]	ρ	-0.279	-0.014	-0.179	-0.290	-0.095	0.030	0.117	0.065	0.045	-0.000	-0.240	-0.222	-0.226	-0.036
	p-value	0.030	0.914	0.168	0.023	0.469	0.819	0.369	0.620	0.731	0.999	0.063	0.085	0.080	0.785
TFA / *TT*	ρ	0.128	0.175	0.295	0.014	-0.027	0.033	0.225	0.069	0.211	0.050	-0.102	0.016	-0.136	0.080
	p-value	0.150	0.048	0.001	0.875	0.766	0.708	0.011	0.441	0.017	0.577	0.253	0.856	0.126	0.368

[26] Evaluated only based on the results from the second study period (n=70) / *Izvērtēts ņemot vērā datus tikai no otrā pētījuma posma (n=70).*

[27] 0.1 < | ρ | < 0.3 – weak correlation / *vāja sakarība*;
0.3 < | ρ | < 0.5 – moderate correlation / *vidēji cieša sakarība*;
| ρ | ≥ 0.5 – strong correlation / *cieša sakarība* (Laerd Statistics, 2017).

Fatty acids / *Taukskābes*	**Energy and nutrients / *Enerģija un uzturvielas***	**SFA / *PT***	**MUFA / *MNT***	**PUFA / *PNT***	**n-6 PUFA / *n-6 PNT***	**n-3 PUFA / *n-3 PNT***	**n-6 / n-3 PUFA ratio / *n-6 / n-3 PNT attiecība***	**LA / *LS***	**ALA / *ALS***	**LA / ALA ratio / *LS / ALS attiecība***	**EPA / *EPS***	**DHA / *DHS***	**TFA / *TT***	**Cholesterol / *Holesterīns***
PA / *PA*	ρ[28]	0.410	-0.017	-0.277	-0.247	-0.233	0.071	-0.232	-0.229	0.083	0.045	0.077	0.490	0.361
	p-value	0.000	0.852	0.002	0.005	0.008	0.425	0.009	0.009	0.349	0.617	0.388	0.000	0.000
MCFA / *VDĶT*	ρ	-0.152	-0.217	-0.113	-0.165	0.003	-0.158	-0.158	-0.078	-0.036	-0.001	0.050	-0.120	-0.090
	p-value	0.086	0.014	0.203	0.063	0.976	0.075	0.075	0.380	0.683	0.992	0.574	0.178	0.311
SFA / *PT*	ρ	0.278	-0.089	-0.254	-0.264	-0.115	-0.072	-0.251	-0.187	0.037	0.105	0.145	0.294	0.256
	p-value	0.002	0.319	0.004	0.003	0.197	0.421	0.004	0.035	0.682	0.240	0.104	0.001	0.004
OA / *OS*	ρ	-0.158	0.346	0.107	0.115	0.066	0.052	0.104	0.143	-0.072	-0.002	-0.011	-0.190	-0.019
	p-value	0.076	0.000	0.231	0.197	0.462	0.560	0.243	0.108	0.419	0.986	0.899	0.032	0.835
MUFA / *MNT*	ρ	-0.161	0.294	0.050	0.057	0.049	0.033	0.046	0.110	-0.095	-0.007	-0.007	-0.193	0.008
	p-value	0.070	0.001	0.576	0.523	0.585	0.709	0.605	0.218	0.286	0.936	0.938	0.029	0.932
LA / *LS*	ρ	-0.194	-0.095	0.292	0.312	0.115	0.114	0.302	0.157	0.048	-0.099	-0.177	-0.174	-0.339
	p-value	0.028	0.289	0.001	0.000	0.198	0.200	0.001	0.077	0.594	0.268	0.046	0.050	0.000
ARA / *AS*	ρ	-0.095	-0.155	-0.103	-0.103	-0.005	-0.120	-0.089	-0.056	-0.048	0.054	0.034	-0.109	-0.010
	p-value	0.285	0.080	0.249	0.246	0.957	0.177	0.319	0.527	0.594	0.545	0.702	0.222	0.913
ALA / *ALS*	ρ	-0.002	0.096	0.251	0.177	0.444	-0.342	0.178	0.450	-0.387	-0.008	0.053	-0.043	-0.042
	p-value	0.982	0.281	0.004	0.046	0.000	0.000	0.045	0.000	0.000	0.931	0.555	0.632	0.636
EPA / *EPS*	ρ	-0.112	-0.047	-0.016	-0.024	-0.047	0.016	-0.027	-0.069	0.022	0.006	0.057	-0.145	-0.021
	p-value	0.209	0.596	0.859	0.791	0.600	0.854	0.760	0.438	0.806	0.947	0.524	0.102	0.818
DHA / *DHS*	ρ	-0.070	0.105	-0.027	-0.092	0.176	-0.341	-0.078	0.023	-0.128	0.534	0.570	-0.082	0.203
	p-value	0.433	0.240	0.759	0.302	0.047	0.000	0.383	0.800	0.148	0.000	0.000	0.360	0.022
n-6 PUFA / *n-6 PNT*	ρ	-0.206	-0.107	0.276	0.298	0.102	0.111	0.288	0.143	0.046	-0.096	-0.173	-0.185	-0.337
	p-value	0.020	0.228	0.002	0.001	0.251	0.214	0.001	0.107	0.604	0.279	0.051	0.036	0.000

[28] 0.1 < | ρ | < 0.3 – weak correlation / *vāja sakarība*;
0.3 < | ρ | < 0.5 – moderate correlation / *vidēji cieša sakarība*;
| ρ | ≥ 0.5 – strong correlation / *cieša sakarība* (Laerd Statistics, 2017).

Fatty acids / ***Taukskābes***		**Energy and nutrients /** ***Enerģija un uzturvielas***	**SFA /** ***PT***	**MUFA /** ***MNT***	**PUFA /** ***PNT***	**n-6 PUFA /** ***n-6 PNT***	**n-3 PUFA /** ***n-3 PNT***	**n-6 / n-3 PUFA ratio /** ***n-6 / n-3 PNT attiecība***	**LA /** ***LS***	**ALA /** ***ALS***	**LA / ALA ratio /** ***LS / ALS attiecība***	**EPA /** ***EPS***	**DHA /** ***DHS***	**TFA /** ***TT***	**Cholesterol /** ***Holesterīns***
n-3 PUFA / ***n-3 PNT***	ρ[29]		-0.060	0.089	0.168	0.067	0.451	-0.452	0.072	0.390	-0.404	0.151	0.222	-0.108	0.004
	p-value		0.500	0.317	0.058	0.453	0.000	0.000	0.418	0.000	0.000	0.090	0.012	0.225	0.967
n-6 / n-3 PUFA ratio / ***n-6 / n-3 PNT attiecība***	ρ		-0.063	-0.126	0.063	0.157	-0.300	0.477	0.145	-0.226	0.403	-0.227	-0.325	-0.027	-0.206
	p-value		0.480	0.157	0.483	0.077	0.001	0.000	0.103	0.010	0.000	0.010	0.000	0.761	0.020
LA / ALA ratio / ***LS / ALS attiecība***	ρ		-0.130	-0.172	-0.031	0.058	-0.341	0.420	0.044	-0.328	0.438	-0.075	-0.174	-0.089	-0.177
	p-value		0.143	0.053	0.726	0.517	0.000	0.000	0.622	0.000	0.000	0.403	0.050	0.315	0.045
PUFA / ***PNT***	ρ		-0.231	-0.106	0.277	0.285	0.150	0.048	0.275	0.175	0.000	-0.069	-0.144	-0.209	-0.334
	p-value		0.009	0.234	0.002	0.001	0.091	0.590	0.002	0.048	1.000	0.441	0.106	0.018	0.000
EA / ***EA***[30]	ρ		-0.101	-0.131	-0.057	-0.030	0.025	0.029	-0.034	-0.031	-0.020	-0.075	-0.149	0.013	-0.210
	p-value		0.440	0.314	0.665	0.821	0.849	0.827	0.795	0.814	0.877	0.568	0.253	0.920	0.104
VA / ***VS***	ρ		0.064	0.128	-0.081	-0.101	0.002	-0.119	-0.107	-0.004	-0.110	0.184	0.215	-0.003	0.272
	p-value		0.476	0.149	0.361	0.256	0.984	0.181	0.231	0.967	0.216	0.038	0.015	0.972	0.002
LEA / ***LES***	ρ		0.269	0.005	-0.092	-0.075	-0.074	0.096	-0.067	-0.125	0.057	0.002	-0.014	0.319	0.173
	p-value		0.002	0.958	0.303	0.398	0.408	0.282	0.452	0.159	0.525	0.980	0.871	0.000	0.050
CLA / ***KLS***[30]	ρ		0.071	0.011	-0.156	-0.125	-0.225	0.130	-0.087	-0.113	-0.001	-0.166	-0.114	0.231	0.007
	p-value		0.586	0.934	0.231	0.337	0.081	0.318	0.507	0.385	0.992	0.201	0.381	0.073	0.957
TFA / ***TT***	ρ		0.212	0.093	-0.159	-0.178	-0.059	-0.140	-0.175	-0.092	-0.058	0.217	0.270	0.169	0.318
	p-value		0.016	0.295	0.073	0.045	0.508	0.114	0.048	0.301	0.513	0.014	0.002	0.056	0.000

[29] 0.1 < | ρ | < 0.3 – weak correlation / *vāja sakarība*;
0.3 < | ρ | < 0.5 – moderate correlation / *vidēji cieša sakarība*;
| ρ | ≥ 0.5 – strong correlation / *cieša sakarība* (Laerd Statistics, 2017).
[30] Evaluated only based on the results from the second study period (n=70) / *Izvērtēts ņemot vērā datus tikai no otrā pētījuma posma (n=70).*

Fatty acids / *Taukskābes*	**Energy and nutrients / *Enerģija un uzturvielas***	**Calcium / *Kalcijs***	**Phosphorus / *Fosfors***	**Potassium / *Kālijs***	**Sodium / *Nātrijs***	**Salt / *Sāls***	**Magnesium / *Magnijs***	**Iron / *Dzelzs***	**Zinc / *Cinks***	**Selenium / *Selēns***	**Iodine / *Jods***
PA / *PA*	ρ[31]	0.122	-0.016	-0.205	0.189	0.194	-0.321	-0.255	0.022	0.071	0.254
	p-value	0.169	0.861	0.020	0.033	0.028	0.000	0.004	0.804	0.429	0.004
MCFA / *VDĶT*	ρ	-0.017	-0.006	0.069	0.098	0.073	0.027	0.180	0.027	-0.029	0.081
	p-value	0.846	0.947	0.437	0.269	0.416	0.761	0.042	0.764	0.744	0.364
SFA / *PT*	ρ	0.137	0.061	-0.072	0.244	0.214	-0.168	-0.103	0.060	0.061	0.280
	p-value	0.124	0.494	0.422	0.006	0.015	0.058	0.246	0.504	0.496	0.001
OA / *OS*	ρ	-0.071	-0.009	0.035	-0.056	-0.062	0.105	-0.011	-0.094	-0.082	-0.181
	p-value	0.428	0.920	0.697	0.530	0.488	0.240	0.901	0.289	0.360	0.041
MUFA / *MNT*	ρ	-0.056	-0.011	0.025	-0.105	-0.099	0.081	-0.019	-0.082	-0.058	-0.171
	p-value	0.528	0.905	0.775	0.240	0.267	0.361	0.832	0.358	0.513	0.054
LA / *LS*	ρ	-0.125	-0.084	0.035	-0.194	-0.181	0.124	0.118	-0.014	-0.054	-0.206
	p-value	0.161	0.348	0.693	0.028	0.041	0.163	0.183	0.877	0.548	0.020
ARA / *AS*	ρ	-0.084	0.012	-0.025	-0.084	-0.071	-0.135	-0.062	0.012	0.028	-0.058
	p-value	0.343	0.893	0.782	0.346	0.423	0.130	0.484	0.893	0.753	0.516
ALA / *ALS*	ρ	0.090	0.135	0.107	0.084	0.057	0.110	0.067	0.027	0.072	-0.029
	p-value	0.313	0.128	0.230	0.344	0.521	0.218	0.455	0.765	0.416	0.747
EPA / *EPS*	ρ	-0.069	-0.020	0.015	0.067	0.009	0.098	0.070	0.023	-0.017	-0.049
	p-value	0.439	0.826	0.864	0.453	0.918	0.270	0.431	0.800	0.852	0.583
DHA / *DHS*	ρ	0.221	0.275	0.211	0.045	0.033	0.225	0.061	0.226	0.247	0.346
	p-value	0.012	0.002	0.017	0.614	0.715	0.011	0.493	0.010	0.005	0.000

[31] 0.1 < | ρ | < 0.3 – weak correlation / *vāja sakarība*;
0.3 < | ρ | < 0.5 – moderate correlation / *vidēji cieša sakarība*;
| ρ | ≥ 0.5 – strong correlation / *cieša sakarība* (Laerd Statistics, 2017).

Fatty acids / *Taukskābes*	**Energy and nutrients / *Enerģija un uzturvielas***	**Calcium / *Kalcijs***	**Phosphorus / *Fosfors***	**Potassium / *Kālijs***	**Sodium / *Nātrijs***	**Salt / *Sāls***	**Magnesium / *Magnijs***	**Iron / *Dzelzs***	**Zinc / *Cinks***	**Selenium / *Selēns***	**Iodine / *Jods***
n-6 PUFA / *n-6 PNT*	ρ[32]	-0.128	-0.082	0.041	-0.200	-0.184	0.121	0.121	-0.014	-0.046	-0.204
	p-value	0.150	0.357	0.649	0.024	0.037	0.175	0.174	0.878	0.603	0.021
n-3 PUFA / *n-3 PNT*	ρ	0.110	0.188	0.134	0.102	0.073	0.165	0.070	0.092	0.139	0.073
	p-value	0.217	0.033	0.132	0.253	0.411	0.063	0.435	0.301	0.117	0.415
n-6 / n-3 PUFA ratio / *n-6 / n-3 PNT attiecība*	ρ	-0.223	-0.205	-0.072	-0.193	-0.151	-0.050	0.029	-0.125	-0.156	-0.224
	p-value	0.011	0.020	0.421	0.029	0.089	0.577	0.746	0.160	0.079	0.011
LA / ALA ratio / *LS / ALS attiecība*	ρ	-0.205	-0.195	-0.045	-0.203	-0.183	0.001	0.048	-0.072	-0.132	-0.122
	p-value	0.020	0.028	0.611	0.021	0.039	0.988	0.594	0.419	0.139	0.169
PUFA / *PNT*	ρ	-0.122	-0.061	0.028	-0.183	-0.168	0.123	0.093	-0.018	-0.041	-0.202
	p-value	0.171	0.492	0.751	0.039	0.059	0.167	0.298	0.839	0.645	0.022
EA / *EA*[33]	ρ	-0.130	-0.311	-0.190	-0.426	-0.330	-0.137	-0.097	-0.134	-0.267	-0.272
	p-value	0.318	0.015	0.142	0.001	0.009	0.292	0.456	0.303	0.038	0.034
VA / *VS*	ρ	-0.003	0.066	0.055	0.091	0.088	-0.057	-0.085	-0.004	0.147	0.022
	p-value	0.974	0.460	0.541	0.308	0.324	0.520	0.342	0.966	0.097	0.806
LEA / *LES*	ρ	0.147	0.007	-0.029	0.025	-0.040	-0.144	-0.141	-0.042	0.027	0.132
	p-value	0.099	0.941	0.748	0.777	0.654	0.104	0.114	0.636	0.762	0.136
CLA / *KLS*[33]	ρ	-0.169	-0.262	-0.196	-0.280	-0.303	-0.204	-0.227	-0.121	-0.173	-0.149
	p-value	0.193	0.041	0.130	0.029	0.017	0.115	0.079	0.354	0.183	0.252
TFA / *TT*	ρ	0.110	0.132	0.075	0.229	0.229	-0.056	-0.098	0.020	0.199	0.163
	p-value	0.217	0.137	0.399	0.009	0.009	0.527	0.271	0.825	0.024	0.067

[32] 0.1 < | ρ | < 0.3 – weak correlation / *vāja sakarība*;
0.3 < | ρ | < 0.5 – moderate correlation / *vidēji cieša sakarība*;
| ρ | ≥ 0.5 – strong correlation / *cieša sakarība* (Laerd Statistics, 2017).
[33] Evaluated only based on the results from the second study period (n=70) / *Izvērtēts ņemot vērā datus tikai no otrā pētījuma posma (n=70).*

Fatty acids / ***Taukskābes***	**Energy and nutrients /** ***Enerģija un uzturvielas***	**Vitamin C /** ***Vitamīns C***	**Vitamin B_1 /** ***Vitamin B_1***	**Vitamin B_2 /** ***Vitamin B_2***	**Vitamin B_3 /** ***Vitamin B_3***	**Vitamin B_6 /** ***Vitamin B_6***	**Vitamin B_9 /** ***Vitamin B_9***	**Vitamin B_{12} /** ***Vitamin B_{12}***	**Vitamin A /** ***Vitamīns A***	**Vitamin D /** ***Vitamin D***	**Vitamin E /** ***Vitamīns E***	**Vitamin K /** ***Vitamīns K***	**Carotenoids, total /** ***Karotinoīdi, kopējie***
PA / *PA*	ρ[34]	-0.056	-0.152	0.187	0.099	-0.203	-0.106	0.266	0.132	0.033	-0.094	-0.119	-0.106
	p-value	0.531	0.088	0.035	0.267	0.021	0.232	0.002	0.138	0.711	0.292	0.181	0.234
MCFA / *VDĶT*	ρ	0.098	0.118	-0.008	0.001	0.119	0.201	-0.010	0.070	0.062	0.019	0.069	0.153
	p-value	0.270	0.185	0.933	0.991	0.180	0.023	0.909	0.429	0.484	0.827	0.441	0.085
SFA / *PT*	ρ	0.009	-0.051	0.140	0.100	-0.090	0.039	0.264	0.186	0.027	-0.014	-0.029	0.034
	p-value	0.924	0.564	0.115	0.261	0.314	0.666	0.003	0.035	0.765	0.872	0.747	0.701
OA / *OS*	ρ	-0.048	-0.092	-0.112	-0.090	-0.038	-0.115	-0.127	-0.149	-0.060	0.019	0.015	-0.032
	p-value	0.589	0.300	0.208	0.313	0.671	0.196	0.153	0.092	0.500	0.827	0.864	0.718
MUFA / *MNT*	ρ	-0.025	-0.101	-0.069	-0.068	-0.030	-0.126	-0.068	-0.163	-0.043	-0.027	-0.038	-0.034
	p-value	0.779	0.256	0.441	0.445	0.735	0.155	0.448	0.065	0.630	0.762	0.670	0.706
LA / *LS*	ρ	-0.058	0.106	-0.148	-0.115	0.056	0.011	-0.305	-0.108	-0.044	0.043	0.059	-0.066
	p-value	0.518	0.233	0.097	0.198	0.533	0.902	0.000	0.223	0.624	0.633	0.512	0.461
ARA / *AS*	ρ	-0.071	0.029	-0.009	0.050	0.060	-0.156	0.015	-0.107	0.093	-0.147	-0.101	-0.077
	p-value	0.424	0.749	0.924	0.577	0.501	0.079	0.868	0.230	0.296	0.098	0.257	0.388
ALA / *ALS*	ρ	0.030	0.017	0.043	0.047	0.156	0.102	-0.061	0.092	0.029	-0.020	0.101	0.070
	p-value	0.739	0.847	0.630	0.602	0.079	0.254	0.496	0.304	0.746	0.819	0.255	0.435
EPA / *EPS*	ρ	0.159	0.047	-0.014	0.073	0.179	-0.007	-0.013	-0.162	0.039	0.011	0.042	-0.061
	p-value	0.072	0.602	0.873	0.411	0.044	0.939	0.885	0.068	0.662	0.901	0.640	0.493
DHA / *DHS*	ρ	0.155	0.079	0.214	0.345	0.331	0.215	0.411	0.231	0.335	0.261	0.226	0.176
	p-value	0.080	0.378	0.015	0.000	0.000	0.015	0.000	0.009	0.000	0.003	0.010	0.046

[34] $0.1 < |\rho| < 0.3$ – weak correlation / *vāja sakarība*;
$0.3 < |\rho| < 0.5$ – moderate correlation / *vidēji cieša sakarība*;
$|\rho| \geq 0.5$ – strong correlation / *cieša sakarība* (Laerd Statistics, 2017).

Fatty acids / ***Taukskābes***	**Energy and nutrients** ***/ Enerģija un uzturvielas***	**Vitamin C /** ***Vitamīns C***	**Vitamin B_1 /** ***Vitamin B_1***	**Vitamin B_2 /** ***Vitamin B_2***	**Vitamin B_3 /** ***Vitamin B_3***	**Vitamin B_6 /** ***Vitamin B_6***	**Vitamin B_9 /** ***Vitamin B_9***	**Vitamin B_{12} /** ***Vitamin B_{12}***	**Vitamin A /** ***Vitamīns A***	**Vitamin D /** ***Vitamin D***	**Vitamin E /** ***Vitamīns E***	**Vitamin K /** ***Vitamīns K***	**Carotenoids, total /** ***Karotinoīdi, kopējie***
n-6 PUFA / ***n-6 PNT***	ρ[35]	-0.052	0.107	-0.142	-0.104	0.067	0.008	-0.296	-0.112	-0.029	0.035	0.053	-0.060
	p-value	0.560	0.231	0.111	0.242	0.454	0.924	0.001	0.210	0.745	0.692	0.554	0.502
n-3 PUFA / ***n-3 PNT***	ρ	0.071	0.060	0.080	0.162	0.235	0.128	0.092	0.111	0.127	0.027	0.122	0.090
	p-value	0.428	0.499	0.372	0.068	0.008	0.151	0.303	0.210	0.154	0.766	0.171	0.311
n-6 / n-3 PUFA ratio ***/ n-6 / n-3 PNT attiecība***	ρ	-0.126	0.023	-0.193	-0.220	-0.159	-0.121	-0.274	-0.201	-0.155	-0.020	-0.082	-0.138
	p-value	0.155	0.799	0.029	0.013	0.072	0.173	0.002	0.023	0.081	0.823	0.356	0.120
LA / ALA ratio / ***LS / ALS attiecība***	ρ	-0.095	0.044	-0.167	-0.141	-0.094	-0.059	-0.122	-0.152	-0.054	0.047	-0.055	-0.089
	p-value	0.286	0.620	0.059	0.113	0.291	0.506	0.171	0.087	0.543	0.601	0.535	0.315
PUFA / ***PNT***	ρ	-0.073	0.097	-0.148	-0.100	0.064	0.003	-0.272	-0.109	-0.028	0.025	0.047	-0.071
	p-value	0.410	0.277	0.095	0.263	0.470	0.976	0.002	0.222	0.756	0.779	0.596	0.423
EA / ***EA***[36]	ρ	-0.024	-0.056	-0.127	-0.108	-0.064	-0.143	-0.177	0.046	-0.114	0.040	-0.075	0.139
	p-value	0.852	0.667	0.329	0.409	0.622	0.271	0.171	0.724	0.380	0.760	0.564	0.286
VA / ***VS***	ρ	0.102	-0.014	0.072	0.202	0.151	-0.117	0.216	-0.038	0.066	-0.154	-0.040	-0.078
	p-value	0.252	0.878	0.416	0.023	0.090	0.190	0.014	0.672	0.462	0.082	0.654	0.380
LEA / ***LES***	ρ	-0.069	-0.122	0.155	0.014	-0.212	0.025	0.189	0.031	-0.024	-0.005	-0.092	-0.117
	p-value	0.441	0.170	0.081	0.877	0.016	0.778	0.033	0.729	0.786	0.957	0.300	0.187
CLA / ***KLS***[36]	ρ	-0.119	-0.262	-0.168	-0.145	-0.193	-0.199	-0.039	-0.016	-0.152	0.040	-0.108	-0.077
	p-value	0.363	0.041	0.195	0.265	0.136	0.124	0.765	0.901	0.241	0.762	0.407	0.553
TFA / ***TT***	ρ	0.145	-0.089	0.158	0.262	0.151	-0.062	0.315	0.022	0.119	-0.133	-0.053	-0.043
	p-value	0.103	0.320	0.074	0.003	0.089	0.486	0.000	0.802	0.180	0.135	0.551	0.627

[35] 0.1 < | ρ | < 0.3 – weak correlation / *vāja sakarība*;
0.3 < | ρ | < 0.5 – moderate correlation / *vidēji cieša sakarība*;
| ρ | ≥ 0.5 – strong correlation / *cieša sakarība* (Laerd Statistics, 2017).
[36] Evaluated only based on the results from the second study period (n=70) / *Izvērtēts ņemot vērā datus tikai no otrā pētījuma posma (n=70).*

Partial non-parametric correlation between maternal habitual food intake and essential element content in human milk / *Daļēja neparametriska korelācija starp uzņemto pārtikas produktu lietošanas biežumu un esenciālo elementu saturu mātes pienā* (n=65)[37]

Essential elements / *Esenciālie elementi*	**Food & drink groups / *Pārtikas produktu un dzērienu grupas***	**Cereals, cereal products & potatoes / *Graudaugi, graudaugu produkti & kartupeļi***	**Eggs, meat & meat products / *Olas, gaļa, gaļas izstrādājumi***	**Fish & seafood / *Zivis & jūras veltes***	**Milk & dairy products / *Piens & piena produkti***	**Pulses / *Pākšaugi***	**Vegetables / *Dārzeņi***	**Fruits & berries / *Augļi & ogas***	**Plant-based fats / *Augu izcelsmes taukvielas***	**Condiments / *Piedevas ēdienam***	**Sweets & baked goods / *Saldumi & konditorejas izstrādājumi***	**Salty snacks & fast food / *Sāļās uzkodas & ātrās" uzkodas***	**Soft drinks / *Limonādes***	**Caffeine containing drinks / *Kofeīnu saturošie dzērieni***	**Herbal teas / *Zāļu tējas***	**Alcohol / *Alkohols***
Calcium / *Kalcijs*	ρ[38]	0.058	0.404	0.234	0.100	-0.259	-0.206	0.136	-0.279	0.045	0.057	-0.113	0.065	0.231	0.092	0.199
	p-value	0.666	0.002	0.080	0.459	0.052	0.125	0.313	0.036	0.738	0.675	0.403	0.629	0.084	0.495	0.137
Magnesium / *Magnijs*	ρ	0.000	0.146	0.298	0.056	-0.217	-0.076	0.141	-0.057	-0.015	0.104	0.220	0.108	0.073	-0.140	0.112
	p-value	1.000	0.280	0.024	0.677	0.105	0.577	0.295	0.675	0.914	0.441	0.100	0.426	0.589	0.300	0.408
Sodium / *Nātrijs*	ρ	0.139	-0.081	0.097	-0.120	-0.219	0.011	0.144	-0.134	0.009	-0.023	0.048	-0.051	-0.079	0.024	0.152
	p-value	0.304	0.547	0.474	0.374	0.102	0.936	0.286	0.319	0.947	0.868	0.721	0.708	0.559	0.857	0.258
Potassium / *Kālijs*	ρ	-0.183	0.053	0.017	0.170	-0.299	0.027	-0.065	-0.162	-0.173	-0.047	-0.316	0.069	-0.093	-0.007	0.149
	p-value	0.173	0.697	0.899	0.205	0.024	0.844	0.633	0.230	0.199	0.737	0.017	0.612	0.491	0.958	0.270
Zinc / *Cinks*	ρ	-0.109	-0.157	-0.265	-0.171	0.038	-0.109	-0.101	0.030	-0.009	-0.058	-0.021	0.098	0.020	-0.191	-0.043
	p-value	0.421	0.245	0.046	0.203	0.777	0.421	0.456	0.824	0.945	0.667	0.875	0.468	0.884	0.156	0.748

[37] Number of participants who submitted both FFQ and questionnaire about maternal & child characteristics, as well donated human milk for essential element analysis. Partial non-parametric correlation analysis was controlled for following variables – maternal age, maternal BMI, child's age, child's birth weight & birth length, child's sex, parity, feeding pattern, milk expression manner / *Dalībnieču skaits, kuras iesniedza gan pārtikas produktu lietošanas biežuma anketu, gananketu par mātes & bērna parametriem, kā arī ziedoja mātes pienu esenciālo elementu analīzēm. Daļēja neparametriska korelācija veikta kontrolējot pēc sekojošiem mainīgajiem – mātes vecums, mātes ĶMI, bērna vecums, bērna dzimšanas svars & garums, bērna dzimums, kopējais bērnu skaits mātei, ēdināšanas veids bērnam, piena noslaukšanai izvēlētā metode.*

[38] 0.1 < | ρ | < 0.3 – weak correlation / *vāja sakarība*;
0.3 < | ρ | < 0.5 – moderate correlation / *vidēji cieša sakarība*;
| ρ | ≥ 0.5 – strong correlation / *cieša sakarība* (Laerd Statistics, 2017).

Partial* non-parametric correlation between maternal energy & nutrient intake and essential element content in human milk / *Daļēja neparametriska korelācija starp uzņemto enerģijas & uzturvielu daudzumu un esenciālo elementu saturu mātes pienā* (n=65)[39]

Essential elements / *Esenciālie elementi*	**Energy and nutrients / *Enerģija un uzturvielas***	**Energy / *Enerģija***	**Fat/ *Tauki***	**Protein / *Olbaltumvielas***	**Carbohydrates / *Ogļhidrāti***	**Sugars, total / *Cukuri, kopā***	**Fructose / *Fruktoze***	**Galactose / *Galaktoze***	**Glucose / *Glikoze***	**Lactose / *Lactose***	**Maltose / *Maltoze***	**Sucrose / *Sukroze***	**Starch / *Ciete***	**Fibre, total / *Šķiedrvielas, kopējās***	**Alcohol / *Alkohols***
Calcium / *Kalcijs*	ρ[40]	-0.178	0.076	-0.018	-0.202	-0.257	-0.288	0.253	-0.193	0.161	0.093	-0.210	-0.092	-0.294	-0.080
	p-value	0.185	0.572	0.897	0.132	0.053	0.030	0.058	0.150	0.232	0.492	0.116	0.495	0.026	0.556
Magnesium / *Magnijs*	ρ	0.025	0.059	0.203	-0.058	-0.044	0.006	0.030	0.052	0.065	0.225	-0.194	0.062	-0.007	0.084
	p-value	0.852	0.665	0.130	0.670	0.743	0.964	0.823	0.701	0.633	0.092	0.114	0.647	0.959	0.535
Sodium / *Nātrijs*	ρ	-0.068	-0.025	-0.037	-0.061	-0.245	-0.017	-0.058	0.002	-0.072	0.137	-0.381	0.137	0.085	0.104
	p-value	0.615	0.852	0.787	0.652	0.066	0.900	0.667	0.987	0.595	0.309	0.003	0.310	0.530	0.443
Potassium / *Kālijs*	ρ	-0.212	-0.090	-0.162	-0.223	-0.150	-0.109	0.141	-0.059	0.158	-0.059	-0.286	-0.101	-0.220	0.117
	p-value	0.113	0.503	0.229	0.095	0.265	0.420	0.297	0.661	0.240	0.662	0.031	0.454	0.100	0.385
Zinc / *Cinks*	ρ	0.149	0.061	-0.028	0.224	0.081	0.042	-0.078	-0.024	-0.065	0.110	0.154	0.178	0.139	-0.020
	p-value	0.268	0.653	0.836	0.095	0.551	0.755	0.563	0.857	0.629	0.414	0.251	0.186	0.304	0.885

[39] Number of participants who submitted both 72-hour diary and questionnaire about maternal & child characteristics, as well donated human milk for essential element analysis. Partial non-parametric correlation analysis was controlled for following variables – maternal age, maternal BMI, child's age, child's birth weight & birth length, child's sex, parity, feeding pattern, milk expression manner / *Dalībnieču skaits, kuras iesniedza gan 72-stundu uztura dienasgrāmatu, gan anketu par mātes & bērna parametriem, kā arī ziedoja mātes pienu esenciālo elementu analīzēm. Daļēja neparametriska korelācija veikta kontrolējot pēc sekojošiem mainīgajiem – mātes vecums, mātes ĶMI, bērna vecums, bērna dzimšanas svars & garums, bērna dzimums, kopējais bērnu skaits mātei, ēdināšanas veids bērnam, piena noslaukšanai izvēlētā metode.*

[40] $0.1 < |\rho| < 0.3$ – weak correlation / *vāja sakarība*;
$0.3 < |\rho| < 0.5$ – moderate correlation / *vidēji cieša sakarība*;
$|\rho| \geq 0.5$ – strong correlation / *cieša sakarība* (Laerd Statistics, 2017).

Annex XIX continued / *XIX pielikuma turpinājums*

Essential elements / *Esenciālie elementi*	**Energy and nutrients / *Enerģija un uzturvielas***	**SFA / *PT***	**MUFA / *MNT***	**PUFA / *PNT***	**n-6 PUFA / *n-6 PNT***	**n-3 PUFA / *n-3 PNT***	**n-6 / n-3 PUFA ratio / *n-6 / n-3 PNT attiecība***	**LA / *LS***	**ALA / *ALS***	**LA / ALA ratio / *LS / ALS attiecība***	**EPA / *EPS***	**DHA / *DHS***	**TFA / *TT***	**Cholesterol / *Holesterīns***
Calcium / *Kalcijs*	ρ[41]	0.241	0.035	-0.197	-0.162	-0.197	-0.072	-0.168	-0.117	-0.030	0.017	-0.117	0.185	0.044
	p-value	0.071	0.795	0.142	0.230	0.142	0.596	0.212	0.385	0.827	0.889	0.384	0.169	0.746
Magnesium / *Magnijs*	ρ	0.100	0.049	-0.141	-0.100	-0.141	-0.033	-0.089	-0.054	-0.022	0.102	-0.099	0.129	0.144
	p-value	0.461	0.719	0.297	0.458	0.297	0.809	0.512	0.688	0.869	0.452	0.466	0.338	0.399
Sodium / *Nātrijs*	ρ	0.074	0.041	-0.179	-0.184	-0.179	0.005	-0.187	-0.041	-0.030	0.030	0.022	-0.042	0.060
	p-value	0.586	0.765	0.183	0.171	0.183	0.971	0.163	0.764	0.825	0.824	0.874	0.754	0.656
Potassium / *Kālijs*	ρ	0.120	-0.146	-0.105	-0.071	-0.105	-0.030	-0.064	-0.051	-0.013	-0.054	-0.187	0.060	-0.028
	p-value	0.374	0.277	0.435	0.602	0.435	0.824	0.639	0.705	0.921	0.690	0.164	0.659	0.836
Zinc / *Cinks*	ρ	-0.034	-0.016	0.277	0.305	0.277	0.025	0.311	0.186	-0.059	-0.036	-0.143	0.083	-0.257
	p-value	0.803	0.906	0.037	0.021	0.037	0.856	0.018	0.165	0.663	0.790	0.288	0.540	0.053

[41] 0.1 < | ρ | < 0.3 – weak correlation / *vāja sakarība*;
0.3 < | ρ | < 0.5 – moderate correlation / *vidēji cieša sakarība*;
| ρ | ≥ 0.5 – strong correlation / *cieša sakarība* (Laerd Statistics, 2017).

Annex XIX continued / *XIX pielikuma turpinājums*

Essential elements / *Esenciālie elementi*	**Energy and nutrients / *Enerģija un uzturvielas***	**Calcium / *Kalcijs***	**Phosphorus / *Fosfors***	**Potassium / *Kālijs***	**Sodium / *Nātrijs***	**Salt / *Sāls***	**Magnesium / *Magnijs***	**Iron / *Dzelzs***	**Zinc / *Cinks***	**Selenium / *Selēns***	**Iodine / *Jods***
Calcium / *Kalcijs*	ρ[42]	-0.160	-0.234	-0.230	-0.016	-0.017	-0.227	-0.324	-0.079	-0.187	-0.005
	p-value	0.235	0.079	0.085	0.905	0.900	0.089	0.014	0.561	0.163	0.970
Magnesium / *Magnijs*	ρ	0.056	-0.013	0.099	0.106	0.109	-0.063	-0.098	0.091	-0.057	0.011
	p-value	0.678	0.924	0.463	0.434	0.420	0.642	0.467	0.502	0.673	0.934
Sodium / *Nātrijs*	ρ	-0.167	-0.043	0.055	0.263	0.265	-0.011	0.016	-0.051	-0.147	0.089
	p-value	0.214	0.749	0.682	0.048	0.046	0.937	0.907	0.708	0.275	0.511
Potassium / *Kālijs*	ρ	-0.120	-0.201	-0.067	-0.033	-0.031	-0.224	-0.211	-0.302	-0.258	-0.046
	p-value	0.375	0.134	0.622	0.809	0.817	0.095	0.115	0.023	0.053	0.732
Zinc / *Cinks*	ρ	-0.008	0.089	0.020	-0.086	-0.086	0.072	0.068	0.001	0.066	-0.114
	p-value	0.952	0.512	0.880	0.526	0.523	0.597	0.614	0.996	0.625	0.400

[42] 0.1 < | ρ | < 0.3 – weak correlation / *vāja sakarība*;
0.3 < | ρ | < 0.5 – moderate correlation / *vidēji cieša sakarība*;
| ρ | ≥ 0.5 – strong correlation / *cieša sakarība* (Laerd Statistics, 2017).

Annex XIX continued / *XIX pielikuma turpinājums*

Essential elements / *Esenciālie elementi*	**Energy and nutrients / *Enerģija un uzturvielas***	**Vitamin C / *Vitamīns C***	**Vitamin B_1 / *Vitamin B_1***	**Vitamin B_2 / *Vitamin B_2***	**Vitamin B_3 / *Vitamin B_3***	**Vitamin B_6 / *Vitamin B_6***	**Vitamin B_9 / *Vitamin B_9***	**Vitamin B_{12} / *Vitamin B_{12}***	**Vitamin A / *Vitamīns A***	**Vitamin D / *Vitamin D***	**Vitamin E / *Vitamīns E***	**Vitamin K / *Vitamīns K***	**Carotenoids, total / *Karotinoīdi, kopējie***
Calcium / *Kalcijs*	ρ[43]	-0.167	-0.117	-0.090	-0.062	-0.143	-0.258	0.091	-0.113	-0.076	-0.283	-0.219	-0.268
	p-value	0.215	0.387	0.505	0.648	0.290	0.053	0.500	0.404	0.572	0.033	0.101	0.044
Magnesium / *Magnijs*	ρ	0.094	0.040	0.106	0.173	0.111	-0.064	0.012	-0.162	-0.048	-0.039	0.091	-0.005
	p-value	0.486	0.768	0.434	0.198	0.413	0.637	0.927	0.230	0.725	0.774	0.501	0.968
Sodium / *Nātrijs*	ρ	-0.017	0.040	-0.022	-0.036	-0.007	-0.078	0.114	0.017	-0.036	-0.114	-0.019	0.055
	p-value	0.898	0.768	0.869	0.793	0.958	0.566	0.397	0.897	0.792	0.400	0.889	0.685
Potassium / *Kālijs*	ρ	-0.238	-0.186	-0.123	-0.245	-0.227	-0.227	0.089	-0.005	-0.064	-0.249	-0.154	-0.071
	p-value	0.074	0.166	0.361	0.066	0.090	0.090	0.511	0.968	0.638	0.062	0.252	0.599
Zinc / *Cinks*	ρ	0.083	0.085	-0.088	0.011	0.024	0.129	-0.039	0.020	0.012	0.070	0.225	0.008
	p-value	0.541	0.529	0.514	0.936	0.857	0.338	0.775	0.885	0.927	0.606	0.093	0.954

[43] $0.1 < |\rho| < 0.3$ – weak correlation / *vāja sakarība*;
$0.3 < |\rho| < 0.5$ – moderate correlation / *vidēji cieša sakarība*;
$|\rho| \geq 0.5$ – strong correlation / *cieša sakarība* (Laerd Statistics, 2017).