ANALYSIS OF FACTORS AFFECTING ZERO-WASTE FOOD CONSUMPTION IN SCHOOLS

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Abstract
The research aims to identify the factors affecting food waste and waste generation in schools and, consequently, barriers to zero-waste food consumption based on a systematic review of literature for the period 2015-2022. The research employed qualitative methods: systematic literature review, analysis and synthesis, as well as the monographic method. The literature review examined 1702 research papers and the abstracts. Using a PRISMA 2020 flow diagram, 54 papers were selected from the ScienceDirect, Scopus and Google Scholar databases for an in-depth analysis. Based on the literature review, 8 groups of factors that affected the generation of food waste in schools in the consumption process were identified: demographical, political, school food policy, environmental, socio-economic, personal/human, physical/human and geographical. The factors identified and aggregated might provide a basis for further discussions on zero-waste food consumption and food waste reduction in schools, as well as specific actions to optimize school food consumption and promote effective food and food waste management.

Key words: zero-waste, food consumption, factors, food waste.

Introduction
Every year, one third of the food produced for human consumption worldwide is lost or wasted at some stage in the food supply chain, totalling approximately 1.3 billion tonnes of food, which causes significant economic, social and environmental damage (Massari et al., 2021). To protect the planet and contribute to prosperity, in 2015 the UN developed the Sustainable Development Goals for 2030. Goal 12 involves ensuring responsible consumption and production patterns – it is necessary to halve global food waste per capita at the level of retailers and consumers, as well as reduce food losses in production and supply chains, which could help to ensure food security and shift to a more resource-efficient economy (UNDP, 2022).

In developed countries, raising awareness of food waste and loss is particularly important at the stage of consumption, which is the main source of food waste. In this respect, public school canteens create a unique environment that shows eating habits and the way the available resources are managed (García-Herrero et al., 2019). School canteens, where sustainable food consumption habits need to be passed on to future generations, produce a lot of food waste. There is a need to find a solution to the conflict between education on best practices and schoolchildren behaviour through incorporating school catering into a sustainability strategy (García-Herrero et al., 2021).

To date, the factors affecting food waste in schools in the consumption process have not been extensively researched in Latvia; therefore, the research aims to identify the factors affecting food waste and waste generation in schools and, consequently, barriers to zero-waste food consumption based on a systematic review of literature for the period 2015-2022. To achieve the aim, the following specific research tasks were set: to make a systematic literature review to identify the factors that hinder zero-waste food consumption in schools; to summarize the results and draw conclusions.

The zero-waste approach has been introduced not only in several industries of the economy but also in educational institutions (Mungúa et al., 2018). Food consumption and food waste reduction is a social responsibility of every educational institution; therefore, food waste management requires a holistic approach to sustainable resource use and waste management (Hamid et al., 2020). Food waste relates to the final consumption stage and is a consequence of consumer behaviour (Principato et al., 2018); therefore, it is important to identify the factors that affect food waste and food waste generation in schools in order to optimize food consumption and promote effective food and food waste management.

Materials and Methods
The research employed qualitative methods: systematic literature review, analysis and synthesis, as well as the monographic method. The literature review examined 1702 research papers and the abstracts. Using a PRISMA 2020 flow diagram, 54 papers were selected from the ScienceDirect, Scopus and Google Scholar databases for an in-depth analysis.

Results and Discussion
Systematic literature reviews could be defined as a kind of research synthesis that is conducted to identify and obtain international evidence or practices and answer a specific question (Munn et al., 2018).

The research question is as follows: what factors affect food waste and food waste generation in schools and are therefore a barrier to zero-waste food consumption?

The process of selecting and synthesising the relevant literature is shown in Figure 1, i.e. a PRISMA
To select the most relevant literature, it is important to choose the right keywords (Linnenluecke, Marrone, & Singh, 2020; Tseng et al., 2019). Since food consumption closely relates to food waste, the authors chose the keywords ‘food consumption in schools’, ‘food waste in schools’, ‘plate waste in schools’ for the selection of research papers. Using the keywords and selecting the period of 2015 to 2022, several thousand papers were initially found, of which 1702 were selected using the advanced search technique (ScienceDirect – 624, Scopus – 879, Google Scholar – 199). Of the total, 269 overlapped and 1070 were excluded because of their titles. At the next step, 363 papers were left for screening, which were evaluated by the abstract, and 214 were left for reading. After analysing the papers, another 99 papers were excluded because they did not answer the research question. Finally, 54 out of the 115 most relevant papers were selected for further analysis.

Based on the literature review, 8 groups of factors that affected food waste in schools in the consumption process were identified.

Demographical factors. The amount of food waste in schools is significantly affected by the age of schoolchildren (Derqui & Fernandez, 2017; Park, Choi, & Kim, 2015). However, no unambiguous conclusions could be drawn based on the available research studies due to conflicting research findings that younger schoolchildren waste more than older ones (Niaki et al., 2017) and that the amount of food waste in educational institutions increases with age (Steen et al., 2018), and adolescents have a negative attitude towards school food (Tuorila et al., 2015). Based on the findings, children at the age of 6-7 years begin to form their food waste behaviour; therefore, environmentally friendly interventions aimed at reducing food waste should begin at this age (Sorokowska et al., 2020). Food consumption is also affected by gender (Park, Choi, & Kim, 2015; Qian et al., 2022a). It has been observed that boys tend to eat more food and are even willing to eat someone else’s uneaten portion, thus producing less food waste than girls do (Moreno-Black & Stockard, 2018; Painter, Thondhlana, & Kua, 2016), whereas girls prefer fruits and vegetables, thus wasting less food of this category (Cerrah & Yigitoglu, 2022; Moreno-Black & Stockard, 2018). It is emphasized that the level of education also shapes food consumption behaviour (Chen & Chen, 2018; Qian et al., 2021; Qian et al., 2022a), i.e. the lower the level of education, the more food is wasted (Wu et al., 2019).

Political factors. School catering is governed by laws, regulations and policies at several levels, which must comply with a number of standards: hygiene, health, etc., as well as international standards and various regulations regarding procurement, waste management, etc. (Derqui, Fernandez, & Fayos, 2018; Priefer, Jörissen, & Bräutigam, 2016), not focusing on nutrition or taste issues (Göbel et al., 2015). In addition, the rigidity and inflexibility of procurement specifications in adjusting various foods (Falasconi et al., 2015) and issues related to catering policies and school catering management plays some role (Boschini et al., 2020). It has been found that changing school dietary guidelines reduced the amount of food waste of plant origin by up to 28%, and it is suggested that a healthy diet could be part of strategies to reduce food waste (Reynolds et al., 2019). Schoolchildren comments and feedback from
the school kitchen are equally important, which helps to develop appropriate food waste reduction measures (Malefors, Eriksson, & Oosowski, 2017). Often the main barrier to reducing food waste is inappropriate and unsupportive school policies, e.g. food is not allowed to be shared or taken away (Panizza et al., 2017; Zhao et al., 2019), which could relate to the old and common but ineffective habits (Persson Oosowski et al., 2022). Schoolchildren’s eating habits vary from school to school, yet the habits are strongly linked to school management priorities and positions regarding waste management and nutrition education for schoolchildren (Derqui & Fernandez, 2017; Torres-Pereda et al., 2020). Education, training, additional activities and awareness about nutrition, as well as the negative impacts of wasteful behaviour and food waste have been identified as key success factors in reducing food waste in schools (Chen & Chen, 2018; Schanes, Dobernings, & Gőzö, 2018).

School food policy. Catering providers could have different strategies for planning and managing the catering process (Boschini et al., 2020; Pirani & Arafat, 2016). A lot of food waste is generated after cooking or serving the food, as well as because the food is not consumed before the expiry date (Ishangulyev, Kim, & Lee, 2019). Canteen employee professional skills (Heikkilä et al., 2016) to cook well or reuse leftovers are also important (Pires et al., 2022). The menu and designing it are also considered to be important factors, as the reduction of food waste requires a change in practices, in particular improved planning and management based on past experience (Silvennoinen, Nisonen, & Pietiläinen, 2019), as the cause of additional food waste from school meals is associated with the composition of the menu, e.g. non-standard food (Prescott et al., 2019), the presence of alternative foods (Falasconi et al., 2015) or special diets in schools (Eriksson et al., 2017). Food leftovers could be reduced by providing enough time to eat (Kodors et al., 2022; Painter, Thondhlanu, & Kua, 2016), as the amount of food waste is affected by the duration of lunch, a sense of urgency and a lack of time to eat (Burton et al., 2022; Painter, Thondhlanu, & Kua, 2016; Qian et al., 2021; Silvennoinen, Nisonen, & Pietiläinen, 2019). Several research studies emphasized the role of a lunch supervisor as crucial, as a lack of control over food leftovers made by schoolchildren is a major source of food waste (Derqui & Fernandez, 2017; Martins et al., 2020). Teachers should be encouraged to have lunch with their schoolchildren, as they play an important role in shaping long-term eating habits (Martins et al., 2016). The different and unequal availability of resources in schools, e.g. kitchen facilities and human resources, can affect the amount of food waste generated (Derqui & Fernandez, 2017; Derqui, Fernandez, & Fayos, 2018). Too large portions are also one of the most important factors in food waste (Betz et al., 2015; Boschini et al., 2020; Pires et al., 2022; Shanks, Banna, & Serrano, 2017; Steen et al., 2018; Talwar et al., 2021), and reducing food waste could be achieved by simply reducing portions (Visschers, Gundlach, & Beretta, 2020) or by offering portions of different sizes (Vizzoto, Testa, & Iraldo, 2021). The size and shape of the plate also significantly affects the food waste generated (Betz et al., 2015; Priefer, Jörissens, & Bräutigam, 2016; Richardson, Prescott, & Ellison, 2021), with larger plate sizes generating more food waste per schoolchildren per meal (Qian et al., 2022a), which could be prevented by introducing smaller oval plates in catering establishments (Gwozd et al., 2020), or by changing the size of the plates from large to small (Ravandi & Jovanovic, 2019). The design of food (Falasconi et al., 2015; Gwozd et al., 2020) and the serving dishes are not less important (Talwar et al., 2021).

Environmental factors. There are many reasons for consuming and wasting food, including the environment in which schoolchildren eat (Shanks, Banna, & Serrano, 2017). The amount of food waste increases with the capacity of the dining hall, which is associated with increased levels of stress and noise (Steen et al., 2018). The availability of food at the school snack bar also increases food waste, which encourages schoolchildren to eat more than they can (Priefer, Jörissens, & Bräutigam, 2016). Schoolchildren waste less food if there is a positive atmosphere in the dining hall (Elnakib et al., 2021).

Socio-economic factors. Several researchers have pointed out that food waste is affected by the family’s socio-economic status and income level (Park, Choi, & Kim, 2015; Qian et al., 2021; Qian et al., 2022a; Wu et al., 2019). The family’s socio-economic status also affects schoolchildren’s attitude to food, as it has been found that primary school children from families with lower socio-economic status associate healthy food with something tasty rather than tasteless, thus wasting less healthy food (van der Heijden et al., 2020).

Personal/human factors. The amount of food waste generated by school canteens is also affected by schoolchildren’s eating habits (Shanks, Banna, & Serrano, 2017) and dietary choices (Moreno-Black & Stockard, 2018; Wu et al., 2019). It has been observed that food brought from home and breakfasts in the classroom generate less food waste in the school canteen (Farris et al., 2019); however, the schoolchildren who ate snacks high in saturated fat or calories in the morning, which cause loss of appetite at noon, were more likely to waste lunch food (Falasconi et al., 2015; Martins et al., 2020). School lunch food is adequate for schoolchildren’s daily diet and is generally more nutritious than other foods, including those taken from home (Pagliarino, Santana, &
Falavigna, S. (2021). Schoolchildren eating habits are extremely different, as it could be associated with the regularity of meals, the kind of breakfast, even the age at which schoolchildren start smoking (Park, Choi, & Kim, 2015), as well as their appetite (Martins et al., 2016; Wu et al., 2019), as food is wasted more when the schoolchildren are not hungry (Betz et al., 2015) or are not satisfied with the taste of the food served (Qian et al., 2021; Talwar et al., 2021) or other sensory properties of the food (Tuorila et al., 2015; Martins et al., 2020). It has been found that most of the schoolchildren discarded uneaten food from school lunch (60%), and much fewer did that at a restaurant (8%) (Mitchell & Prescott, 2020), which indicates that it is acceptable to discard unwanted food, but it is not acceptable to discard wanted food (Zhao et al., 2019). In addition, stress (Philippe et al., 2021), peers, pressure from others and the presence of other people during lunch (Qian et al., 2021; Qian et al., 2022a) can increase food waste. The behaviours of teachers and schoolchildren also affect food consumption (Blondin et al., 2018). In China, it is believed that the only child in the family is more likely to waste food than someone who has siblings (Qian et al., 2022a). People often blame other individuals for food waste and waste generation or mention other conditions that they cannot influence or control; therefore, knowledge and an in-depth understanding of food waste and personal attitudes could reduce the effects but not completely eliminate them (Malefors et al., 2022; Qian et al., 2021; Visschers, Gundlach, & Beretta, 2020).

Physical human factors. Food consumption is affected by body weight (Park, Choi, & Kim, 2015), metabolism (Shanks, Banna, & Serrano, 2017), as well as the body mass index (BMI); it was found that the lower the BMI, the higher the probability of food waste, as the body mass index (BMI); it was found that the metabolism (Shanks, Banna, & Serrano, 2017), as well as specific actions to optimize school food consumption and promote effective food and food waste management.

Geographical factors. Attitudes to food waste vary from culture to culture (Qian et al., 2022a).

Conclusions

Comprehensive research studies on the problem of food consumption and waste in schools is available in the scientific literature. Using a PRISMA 2020 flow diagram and applying the systematic literature review method, 54 most relevant research papers were selected to answer the research question. Based on the literature review, 8 groups of factors were identified: demographical, political, school food policy, environmental, socio-economic, personal/human, physical/human and geographical, which affected food waste and food waste generation in schools and were therefore a barrier to zero-waste food consumption. The factors identified and aggregated might provide a basis for further discussions on zero-waste food consumption and food waste reduction in schools, as well as specific actions to optimize school food consumption and promote effective food and food waste management.

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