

## 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 (Munguía *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

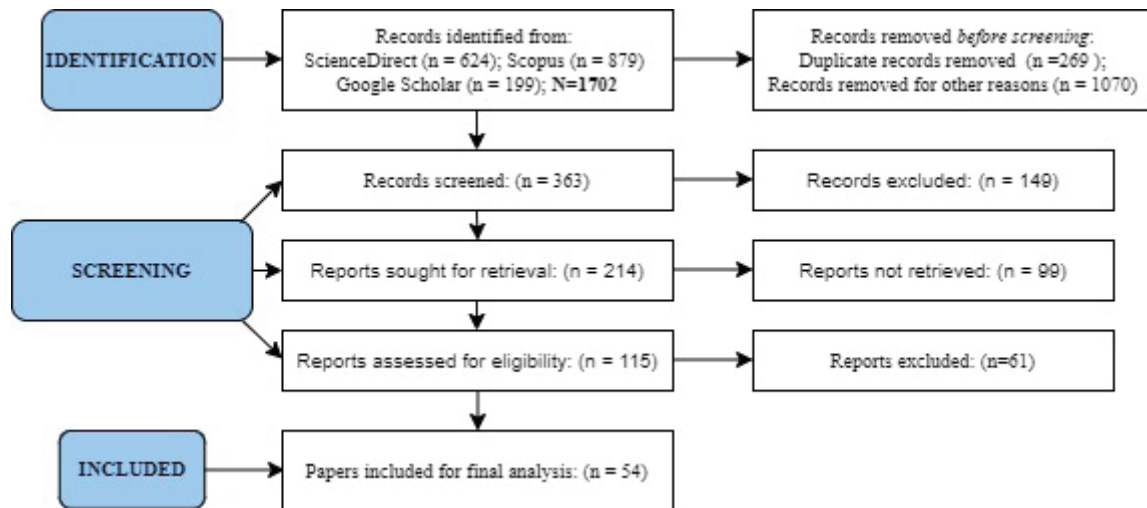


Figure 1. PRISMA 2020 flow diagram for new systematic literature reviews.

Source: authors' construction based on (Page *et al.*, 2021).

2020 flow diagram, which was developed to help the researchers to clearly represent the process of literature selection (Page *et al.*, 2021).

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, & Osowski, 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 Osowski *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, Dobernig, & Gözet, 2018).

*School food policy.* Catering providers could have different strategies for planning and managing the catering process (Boschini *et al.*, 2020; Pirani & Ararat, 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 (Ishangulyyev, 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, Thondhlana, & 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, Thondhlana, & 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 (Vischers, 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, Jörissen, & 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 (Gwozdz *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; Gwozdz *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, Jörissen, & 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, Santanera, &

Falavigna, 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, and various tests showed that the slimmest participants tended to waste more food (Qian *et al.*, 2022b).

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*Geographical factors.* Attitudes to food waste vary from culture to culture (Qian *et al.*, 2022a). The development of a menu and the wishes of schoolchildren are also associated with the region where the school is located; therefore, food waste differs for each kind of menu (Bustamente, Afonso, & De los Ríos, 2018).

The results show that a very wide range of factors affect food waste in schools in the consumption process, what should be taken into account developing effective strategies to reduce food waste in schools.

## 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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