International Journal of Gastronomy and Food Science 27 (2022) 100456

Contents lists available at ScienceDirect

International Journal of Gastronomy and Food Science

journal homepage: www.elsevier.com/locate/ijgfs

Nutritional content of the street food purchased in Chișinău, Moldova: Opportunity for policy action

Sofia Sousa [a,b,c], Gabriela Albuquerque [a,b], Marcello Gelormini [d], Susana Casal [a,b,e], Olívia Pinho [c,e], Albertino Damasceno [a,b,f,g], Pedro Moreira [a,b,c,h], João Breda [i], Nuno Lunet [a,b,g], Patrícia Padrão [a,b,c,*]

[a] EPIUnit - Instituto de Saúde Pública, Universidade do Porto, Portugal
[b] Laboratório para a Investigação Integrativa e Translacional em Saúde Populacional (ITR), Porto, Portugal
[c] Faculdade de Ciências da Nutrição e Alimentação da Universidade do Porto, Portugal
[d] Nutrition, Physical Activity and Obesity Programme, Division of Noncommunicable Diseases and Life-Course, World Health Organization (WHO) Regional Office for Europe, Denmark
[e] LAQV/REQUIMTE, Laboratório de Bromatologia e Hidrologia, Faculdade de Farmácia, Universidade do Porto, Portugal
[f] Faculdade de Medicina, Universidade Eduardo Mondlane, Mozambique
[g] Departamento de Ciências da Saúde Pública e Forenses e Educação Médica, Faculdade de Medicina da Universidade do Porto, Portugal
[h] Centro de Investigação em Atividade Física, Saúde e Lazer, Universidade do Porto, Portugal
[i] Special adviser, WHO Regional Office for Europe, Denmark

ARTICLE INFO

Keywords:
Eastern Europe
Ready-to-eat foods
Nutritional value
Sodium
Trans fatty acids
Non-communicable diseases

ABSTRACT

This study aimed to describe the street food purchased and its nutritional value in Chișinău, Moldova. A cross-sectional study was conducted in 68 street food vending sites. Data on the food items purchased were collected through direct observation. Nutritional composition was estimated through chemical analyses, food composition tables or nutrition labels. From the 151 customers observed, two-thirds purchased industrial food items, most commonly buns/cakes/cookies (15.2%), soft drinks/industrial juices (15.2%) and confectionery (10.6%). The purchases were energy dense (median: 362 kcal/100g), rich in saturated fat (5.6 g), trans fat (0.43 g) and sodium (585 mg) and poor in potassium (212 mg).

1. Introduction

Street food is daily consumed by millions of people worldwide, having a strong gastronomic importance in low- and middle-income countries (LMIC) and reflecting traditional and regional cultures and culinary practices (Fellows and Hilmi. 2012). In Eastern Europe, recent socioeconomic development and urbanization led to eating habits modifications, namely the increasing consumption of energy-dense foods, such as sugar-sweetened beverages and packaged processed food products rich in sugar and salt (Ulijaszek and Koziel. 2007). Furthermore, physical inactivity, limited time to prepare homemade meals and increased consumption of foods away from home have also become common features of these populations. Simultaneously, a shift to high non-communicable disease (NCD) prevalence and mortality is rapidly occurring, which can be partly attributed to these dietary and lifestyle changes. In the Republic of Moldova, overweight and obesity is reported to affect, respectively, 50% and 21% of the adult population (20 years or older) (World Health Organization. 2018); also, approximately one-third is estimated to present raised blood pressure (World Health Organization. 2013).

Despite street food's importance for the foodscape of urban areas in many transitional societies (Fellows and Hilmi. 2012), research has been focusing mainly on hygiene and food safety issues related to street food consumption, whereas there is a current gap of knowledge concerning the nutritional composition of this type of food source (Abrahale et al., 2018). Here, we report on the foods and beverages purchased by street food customers in the main urban centre of Moldova, and the nutrition composition of their purchases.

2. Methods

This study was set in the context of the FEEDCities project, which is

* Corresponding author. Faculdade de Ciências da Nutrição e Alimentação da Universidade do Porto, Rua do Campo Alegre, 823, 4150-180, Porto, Portugal.
E-mail address: patriciapadrao@fcna.up.pt (P. Padrão).

https://doi.org/10.1016/j.ijgfs.2021.100456
Received 14 April 2021; Received in revised form 11 August 2021; Accepted 5 December 2021
Available online 8 December 2021

based on a stepwise standardized characterization of the food environment in cities from Eastern Europe and Central Asia, and whose protocol is published elsewhere (Lunet et al., 2019). For the purpose of this work, a cross-sectional evaluation of street food customers was conducted in Chișinău, capital city of Moldova, between June and August 2016.

The definition of street food proposed by the Food and Agriculture Organization (FAO) and World Health Organization (WHO), as "ready-to-eat foods and beverages prepared and/or sold by vendors or hawkers especially in the streets and other similar places" (Food and Agriculture Organization. 1989; World Health Organization. 1996) was adopted in order to select eligible street food vending sites. These included both stationary and mobile vending units selling food products ready to be consumed immediately without needing further preparation. Vending sites selling exclusively non-prepared fruits and vegetables or other not ready-to-eat raw foods (e.g. meat, fish) were excluded from the study. Customers approaching eligible street food vending sites to buy ready-to-eat foods and/or beverages were eligible for the study.

To define the study area, a 1-km diameter buffer was built around the centroid of the central market, that way covering both the market and its surroundings. Field researchers, operating in pairs, canvassed all publicly accessible streets within the study area, identifying all eligible street food vending sites. Finally, a systematic selection of the vending sites was performed, in which one out of every four vending sites were included in the study.

In all selected vending sites, data on the foods and/or beverages purchased (hereafter referred to as food items) and their quantities were collected through direct observation by trained local field researchers. In each vending site, up to four customers were observed, over a maximum period of 10 min, whichever occurred first (Fig. 1A). If no customer was observed during this period, field researchers would move on to the next selected vending site. Observations were performed both on week days and weekends and covering all businesses' working hours (from 8:00 to 16:00). The food items purchased were classified into homemade (foods and beverages that were prepared and/or cooked at home or in the street, even if using industrial ingredients) or industrial (foods and beverages that were produced by the food industry and sold as such, with no further preparation) and grouped into 8 sub-categories of foods and 6 sub-categories of beverages, according to similarities in nature and composition (World Health Organization. 2015a).

To estimate the nutritional composition of the street food purchases, a total of 52 samples of the most commonly available street-vended food items (identified during a previous step of the project (Albuquerque et al., 2020)) were collected for chemical analysis (Fig. 1B and C) in different randomly selected vending sites. All analyses (i.e. protein, total fat, fatty-acids, sodium and potassium) were conducted according to standard methods, as recommended by the Association of Official Analytical Chemists (AOAC International. 2016). Total carbohydrates plus fibre were estimated by difference. After proximate analysis, energy values were calculated using the Atwater general factors (4 kcal/g for protein and carbohydrates; 9 kcal/g for fat). For the less common food items, which were not sampled for chemical analysis, nutritional composition (i.e. energy, protein, carbohydrates, total fat and, when available, saturated fatty-acids and sodium) was estimated using the Slovak Food Composition Database (Ministry of Agriculture and Rural Development of the Slovak Republic, 2019) or food composition labels. A street food purchase was defined as an acquisition consisting of at least one food. As such, for the purpose of describing the nutritional content, customers buying only beverages were excluded.

3. Results

A total of 68 street food vending sites were observed, of which 55 (80.9%) had customers observed. A total of 151 customers were identified, of which 60.9% were female. A total of 169 food items were purchased, with an average of 1.1 food items per customer and 3.7 food items per 10 min of observation. Approximately two-thirds of the observed customers (n=101, 66.9%) purchased at least one industrial food item. The most commonly purchased foods were buns/cakes/cookies (n=23 customers, 15.2%), confectionery (n=16, 10.6%), savoury snacks (n=14, 9.3%) and savoury pastries (n=13, 8.6%). The most frequently bought beverages were soft drinks/industrial juices (n=23 customers, 15.2%), water (n=21, 13.9%) and alcoholic beverages (n=18, 11.9%). Purchase of fruit was not observed (Fig. 2).

A total of 78 street food purchases (as defined above) were observed, whose nutritional composition, both per purchase and per 100 g, is displayed in Table 1. The purchases presented high energy density (median: 362 kcal/100 g), with the highest contribution to total energy value coming from carbohydrates (52.6%), followed by total fat (37.2%) and protein (7.7%). The highest contribution to total fat came from saturated fatty-acids, whose median content in a single purchase accounted for around one-quarter (25.1%) of its maximum daily intake recommendation, considering an average adult with a reference intake of 2000 kcal/day (World Health Organization. 2003). *Trans*-fat contributed to 2.7% of the total fat content, with the majority of the purchases (n=42, 60.9%) surpassing the limit of 2 g/100 g of total fat, recently legislated in some countries in the WHO European Region (World Health Organization. 2015b). These street food purchases also supplied a median of 585 mg of sodium (29.3% of the maximum daily intake recommendation for this nutrient (World Health Organization. 2003)) and 212 mg of potassium (only contributing to 6.0% of its minimum daily intake recommendation (World Health Organization. 2012)). Median molar sodium-to-potassium ratio was far above the

Fig. 1. Example of a customer purchasing at a street food vending site (**A**) and examples of two foods collected at street food vending sites for laboratorial analysis: homemade *pateuri*[a] (**B**) and industrial cookies (**C**).[a]*Pateuri* is a fried savoury pastry made with leavened dough filled with cheese, vegetables or meat.

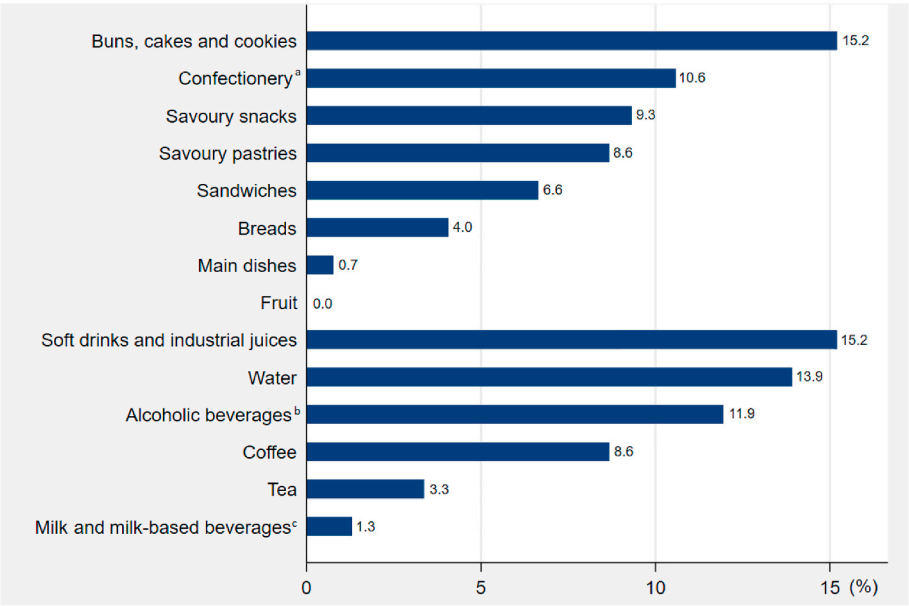

Fig. 2. Ready-to-eat foods and beverages purchased by customers of street food vending sites in Chișinău, Moldova (n=151).
[a]Includes ice-cream, candies and chocolate.
[b]Includes beer and *kvass* (a fermented beverage with low alcohol content made from rye bread).
[c]Includes milk and *kefir* (fermented milk drink prepared by inoculating cow, goat or sheep milk with kefir grains).

Table 1
Estimated nutritional composition of the purchases made by the street food customers observed in Chișinău, Moldova (n=78[a]).

	N	Per purchase	Per 100g
		Median (P25–P75)	Median (P25–P75)
Energy (kcal)	78	353 (243–666)	362 (268–688)
Macronutrients (g)			
Protein	78	8.2 (4.3–13.6)	9.8 (4.9–15.1)
CHO	78	53.1 (29.5–87.5)	50.4 (32.8–108.3)
Total fat	78	16.8 (7.5–31.4)	14.3 (9.4–28.2)
SFA	73[b]	5.6 (3.2–11.1)	6.0 (2.9–9.1)
MUFA	69[b]	4.8 (1.7–10.7)	4.2 (2.8–8.5)
PUFA	69[b]	3.8 (1.9–8.1)	3.9 (1.6–13.7)
n-6	69[b]	3.8 (1.9–8.0)	3.8 (1.6–13.5)
n-3	69[b]	0.1 (0.0–0.1)	0.1 (0.0–0.1)
TFA	69[b]	0.43 (0.12–1.00)	0.77 (0.09–1.88)
Micronutrients (mg)			
Na	73[b]	585 (227–1029)	616 (389–814)
K	69[b]	212 (114–263)	197 (144–337)
Na/K ratio	69[b]	5.5 (1.8–6.8)	

P25, percentile 25. P75, percentile 75. CHO, carbohydrates. SFA, saturated fatty acids. MUFA, monounsaturated fatty acids. PUFA, polyunsaturated fatty acids. TFA, *trans* fatty acids. Na, sodium. K, potassium.
[a] Number of customers who bought at least one food (customers buying only beverages were excluded).
[b] In these variables, the number of cases differ from the total due to missing values.

recommended value of one (World Health Organization. 2003).

4. Discussion and conclusions

Street food seemed to be frequently consumed in this urban area, as shown by a high number of foods and beverages acquired within a limited observation period. The frequent purchase of ultra-processed food products may reflect the westernization of food habits and a deviation from traditional gastronomy in these street food customers. A high availability of industrial food items such as confectionery, sweet pastries, savoury snacks and soft drinks was identified in this setting (Albuquerque et al., 2020), which may influence consumers' choices. Ready-to-eat fruit was not purchased by the customers observed, which may be in part explained by the fact that the availability of ready-to-eat fruit was very low (sold at only 2.5% of the observed vending sites) (World Health Organization. 2017, Albuquerque et al., 2020). This is in line with the low consumption of fruit that has been described for the Eastern European region (Willett et al., 2019). Nevertheless, it should be noted that vending sites selling exclusively unprepared fruits and vegetables were excluded from this study, since purchases made in these venues are usually directed towards household food consumption, which contradicts the definition of 'street food' as 'ready-to-eat'.

The street food purchases observed were found to be energy-dense and showed concerning levels of saturated fat, *trans*-fat and sodium, and low contents of potassium, which in the long term can have a negative impact on health. This nutritional profile may reflect the ingredients used during their preparation, as described for other settings (Gupta et al., 2016; Sousa et al., 2018). Frequent purchase of sugary foods and beverages, such as buns/cakes/cookies, confectionery and soft drinks/juices also suggests high levels of sugars intake by these customers. Our results are in line with findings from other LMIC, which showed that this nutritional profile is frequently found in many popular items made available by street food vendors (Steyn et al., 2014).

These results should be considered when designing public health strategies aiming to improve the urban food environment in this setting, while preserving and promoting gastronomic identity and cultural value. Multisectoral-based policies should be targeted to: (1) restrict the availability of ultra-processed food products rich in saturated fat, trans-fatty acids, sugar and salt, while improving the availability and affordability of nutrient-dense foods, such as ready-to-eat fruits and vegetable-based homemade dishes; (2) improve the nutritional value of the foods and beverages offered, especially its lipid profile and salt content, either through recipe improvement by the vendors and small manufacturers, or food product reformulation and labelling improvement at the food industry level; and (3) raise awareness and literacy of both vendors and consumers regarding street food's nutritional composition and its impact on health. Examples of some of these political efforts have been successfully implemented in other settings where street food sale is also frequent (Eurasian Economic Commission. 2011, Tester et al., 2012; Hawkes et al., 2013). Further guidance to governments and local authorities on the implementation of public health measures towards healthier food markets was recently published, containing examples of possible short, medium and long term interventions relevant for decision-makers (World Health Organization 2021). Regardless of the measures applied, continuous monitoring would be a vital step towards

the achievement and maintenance of a healthier street food environment (Gelormini et al., 2017).

A generalised lack of information regarding dietary intake has been recently identified for many countries within the WHO-Europe, including for Moldova, where no national nutrition surveys have been conducted yet (Rippin et al., 2018). As such, we consider that the FEEDCities research project has been contributing to reduce this nutrition-related research gap, by increasing knowledge regarding street food availability, purchasing habits and nutritional value. The development of a robust, stepwise and standardized methodology has resulted in comprehensive and comparable data among countries. However, due to local cultural specificities, generalisability of the results has been limited. Dissemination of these ground-breaking results should contribute for the evolution of health and food policy, ultimately leading to the improvement of these populations' health.

Funding

This work was supported by the World Health Organization Europe [grant numbers 2015/591370-0; 2017/698514] and by the Ministry of Health of the Russian Federation. The EPIUnit – Instituto de Saúde Pública, Universidade do Porto and the Investigation Unit LAQV/REQUIMTE was financed by national funds through FCT – Fundação para a Ciência e a Tecnologia, I.P., under the projects UIDB/04750/2020 and UID/QUI/50006/2020, respectively. Individual grants attributed to SS [SFRH/BD/130650/2017] and GA [SFRH/BD/118630/2016] are funded by FCT and the Human Capital Operational Programme of the European Social Fund (POCH/FSE).

Authorship

MG, AD, PM, JB, NL and PP designed the study. MG supervised the study implementation and data collection. SC and OP were responsible for the chemical analysis of the food samples collected. SS, NL and PP performed the analysis and interpretation of the results. SS drafted the manuscript. All authors critically revised and gave final approval of the manuscript submitted for publication.

Ethical standards

This study was conducted in accordance with the Declaration of Helsinki, and all procedures involving human subjects were approved by the Ethics Committee of the Institute of Public Health of the University of Porto (CE16058). Verbal informed consent was obtained from all vendors.

Implications for gastronomy

In Eastern European countries, street food is part of the cultural heritage and gastronomy, reflecting the availability of local food products, culinary practices and consumers' preferences. Furthermore, with the recent rise of gastronomic tourism, street foods are also becoming a great attraction to foreigners seeking to experience the unique and authentic flavours of the local cuisine.

Our study found a very frequent purchase of westernized food options, such as soft drinks and confectionery, which may suggest a separation from local gastronomy, in line with the nutrition transition process that is currently occurring in this setting. Our findings also showed that street food purchases are rich in energy, saturated and trans fats, as well as sodium, and poor in potassium. The improvement of the availability and affordability of nutrient-dense foods such as fruits, vegetables, legumes and nuts, as well as the promotion of the use of healthier ingredients and culinary practices while preserving gastronomic identity, would contribute to enhance the nutritional profile of Moldovan street foods. Promoting the consumption of homemade traditional dishes would also contribute to preserve traditional gastronomy. These strategies would contribute to increase food security in this setting, while counteracting the effects of nutrition transition.

The involvement of street food customers and vendors, as well as the food industry, is essential to guarantee this change in food availability and dietary habits, leading to a healthier street food environment, while not only maintaining but also promoting local food culture.

Declaration of competing interest

The authors declare that they have no conflict of interest. João Breda is a staff member of the World Health Organization Regional Office for Europe. The author is responsible for the views expressed in this publication, and they do not necessarily represent the decisions or stated policy of WHO.

Acknowledgements

The authors would like to acknowledge the local organizations that collaborated in the implementation of the study, namely the WHO Country Office in the Republic of Moldova, the Ministry of Health of the Republic of Moldova, the National Centre of Public Health and the State University of Medicine and Pharmacy Nicolae Testemitanu. Further support regarding study and field methodology were provided by Danielle Agnello, Inês Morais and Jo Jewell. Special thanks go to the team of field researchers, whose work was essential to the accomplishment of this study. The authors also express their sincere gratitude to all the staff of LAQV/REQUIMTE who were involved in the laboratory analyses performed for this study.

References

Abrahale, K., Sousa, S., Albuquerque, G., Padrão, P., Lunet, N., 2018. Street food research worldwide: a scoping review. J. Hum. Nutr. Diet. 32 (2), 152–174. https://doi.org/10.1111/jhn.12604.

Albuquerque, G., Gelormini, M., Morais, I.L., Sousa, S., Casal, S., Pinho, O., Moreira, P., Breda, J., Lunet, N., Padrão, P., 2020. Street food in Eastern Europe: a perspective from an urban environment in Moldova. Br. J. Nutr. 124 (10), 1093–1101. https://doi.org/10.1017/S0007114520002020.

Aoac International, 2016. Official Methods of Analysis of AOAC International, twentieth ed. (Gaithersburg, Maryland, USA).

Eurasian Economic Commission, 2011. Technical Regulation on Butter and Fat Products - TP TC 024/2011 (in Russian). Moscow, Russia.

Fellows, P., Hilmi, M., 2012. Selling street and snack foods. In: Rural Infrastructure and Agro-Industries Division of the Food and Agriculture Organization of the United Nations (Rome, Italy).

Food and Agriculture Organization, 1989. Food and Nutrition Paper No. 46. Street Foods: Report of an FAO Expert Consultation, Jogjakarta, Indonesia, 5–9 December 1988.

Gelormini, M., Padrão, P., Lunet, N., Jewell, J., Lanca de Morais, I., Breda, J.J., 2017. Monitoring and surveillance of street food vendors to prevent noncommunicable diseases: the FEEDCities project. Publ. Health Panorama 3 (4), 742–746.

Gupta, V., Downs, S.M., Ghosh-Jerath, S., Lock, K., Singh, A., 2016. Unhealthy fat in street and snack foods in low-socioeconomic settings in India: a case study of the food environments of rural villages and an urban slum. J. Nutr. Educ. Behav. 48 (4), 269–279. https://doi.org/10.1016/j.jneb.2015.11.006 e261.

Hawkes, C., Jewell, J., Allen, K., 2013. A food policy package for healthy diets and the prevention of obesity and diet-related non-communicable diseases: the NOURISHING framework. Obes. Rev. 14 (Suppl. 2), 159–168. https://doi.org/10.1111/obr.12098.

Lunet, N., Gelormini, M., Jewell, J., Morais, I., Albuquerque, G., Sousa, S., Damasceno, A., Casal, S., Pinho, O., Moreira, P., Breda, J., Padrão, P., 2019. FEEDcities Project - A Comprehensive Characterization of the Street Food Environment in Cities. World Health Organization, Copenhagen, Denmark.

Ministry of Agriculture and Rural Development of the Slovak Republic, 2019. Slovak food composition. Database Online. http://www.pbd-online.sk/en. (Accessed 30 January 2020).

Rippin, H.L., JHutchinson, J., Evans, C.E.L., Jewell, J., Breda, J.J., Cade, J.E., 2018. National nutrition surveys in Europe: a review on the current status in the 53 countries of the WHO European region. Food Nutr. Res. 62 https://doi.org/10.29219/fnr.v62.1362.

Sousa, S., Damasceno, A., Gelormini, M., Jessen, N., Lunet, N., Padrão, P., 2018. Powdered chicken stock may be an important source of dietary sodium intake in Maputo, Mozambique. J. Public Health 40 (3), 659–660. https://doi.org/10.1093/pubmed/fdx113.

Steyn, N.P., McHiza, Z., Hill, J., Davids, Y.D., Venter, I., Hinrichsen, E., Opperman, M., Rumbelow, J., Jacobs, P., 2014. Nutritional contribution of street foods to the diet of people in developing countries: a systematic review. Publ. Health Nutr. 17 (6), 1363–1374. https://doi.org/10.1017/S1368980013001158.

Tester, J.M., Yen, I.H., Laraia, B., 2012. Using mobile fruit vendors to increase access to fresh fruit and vegetables for schoolchildren. Prev. Chronic Dis. 9, E102. https://doi.org/10.5888/pcd9.110222.

Ulijaszek, S.J., Koziel, S., 2007. Nutrition transition and dietary energy availability in Eastern Europe after the collapse of communism. Econ. Hum. Biol. 5 (3), 359–369. https://doi.org/10.1016/j.ehb.2007.08.007.

Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T., Tilman, D., DeClerck, F., Wood, A., Jonell, M., Clark, M., Gordon, L.J., Fanzo, J., Hawkes, C., Zurayk, R., Rivera, J.A., De Vries, W., Majele Sibanda, L., Afshin, A., Chaudhary, A., Herrero, M., Agustina, R., Branca, F., Lartey, A., Fan, S., Crona, B., Fox, E., Bignet, V., Troell, M., Lindahl, T., Singh, S., Cornell, S.E., Srinath Reddy, K., Narain, S., Nishtar, S., Murray, C.J.L., 2019. Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems. Lancet 393 (10170), 447–492. https://doi.org/10.1016/S0140-6736(18)31788-4.

World Health Organization, 1996. Essential Safety Requirements for Street-Vended Foods. Food Safety Unit, Division of Food and Nutrition, World Health Organization, Geneva, Switzerland.

World Health Organization, 2003. WHO Technical Report Series 916. Diet, Nutrition and the Prevention of Chronic Diseases: Report of a Joint WHO/FAO Expert Consultation (Geneva, Switzerland).

World Health Organization, 2012. Guideline: Potassium Intake for Adults and Children (Geneva, Switzerland).

World Health Organization, 2013. Nutrition, Physical Activity and Obesity. Republic of Moldova. WHO Regional Office for Europe, Copenhagen, Denmark.

World Health Organization, 2015a. WHO Regional Office for Europe Nutrient Profile Model. WHO Regional Office for Europe, Copenhagen, Denmark.

World Health Organization, 2015b. Eliminating Trans Fats in Europe. A Policy Brief. WHO Regional Office for Europe, Copenhagen, Denmark.

World Health Organization, 2017. FEEDcities Project: the Food Environment Description in Cities in Eastern Europe and Central Asia - Republic of Moldova. WHO Regional Office for Europe, Copenhagen, Denmark.

World Health Organization, 2018. Noncommunicable Diseases Country Profiles (Geneva, Switzerland).

World Health Organization, 2021. Safe and Healthy Food in Traditional Food Markets in the WHO European Region. WHO Regional Office for Europe, Copenhagen, Denmark.