

RESEARCH ARTICLE

An In-Store Experiment on the Effect of Accessibility on Sales of Wholegrain and White Bread in Supermarkets

René A. de Wijk^{1*}, Anna J. Maaskant¹, Ilse A. Polet¹, Nancy T. E. Holthuysen¹, Ellen van Kleef², Monique H. Vingerhoeds¹

1 Wageningen UR-Food & Biobased Research, Wageningen, The Netherlands, **2** Wageningen University, Marketing and Consumer Behaviour Group, Wageningen, the Netherlands

* Rene.deWijk@wur.nl



 OPEN ACCESS

Citation: de Wijk RA, Maaskant AJ, Polet IA, Holthuysen NTE, van Kleef E, Vingerhoeds MH (2016) An In-Store Experiment on the Effect of Accessibility on Sales of Wholegrain and White Bread in Supermarkets. PLoS ONE 11(3): e0151915. doi:10.1371/journal.pone.0151915

Editor: Jean Adams, University of Cambridge, UNITED KINGDOM

Received: November 26, 2015

Accepted: March 7, 2016

Published: March 24, 2016

Copyright: © 2016 de Wijk et al. This is an open access article distributed under the terms of the [Creative Commons Attribution License](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Data Availability Statement: The data is publicly available at the following link: <https://figshare.com/s/d51f36c5b0740f6cbfb7>.

Funding: This project received financial support from the Dutch Bakery Centre and the Ministry of Economic Affairs (grant number AF12104; <http://www.tki-agrifood.nl/projectengalerij/2012/pps-2012-gezondheid—basisvoedingsmiddelen-en-gedragsinterventies.jpg>). Neither organization had any role in the design, analysis, or writing of this article.

Abstract

Even though whole grain foods have various health benefits, consumers have been found not to eat enough of them. Nudging interventions are built on the premise that food purchases and consumption are strongly influenced by the environment in which decisions are made. Little research has been conducted to examine the influence of a small and inexpensive nudging intervention on bread choices in a real-life supermarket context. An in-store experiment was conducted in two six-week periods in two supermarkets to investigate the effects of accessibility on consumers' purchase of healthier whole grain and other types of bread. In the high accessibility condition, healthier bread was placed in a more convenient location for the shopper on the left side of the shelves where it was encountered first. In the low accessibility condition, it was placed on the right side. There were consistent significant differences in sales between supermarkets, types of bread, day of the week, but not between low and high accessibility. Additional research is needed to better understand the effects of convenience and accessibility on bread choices.

Introduction

The health benefits of whole grain foods are well documented [1–4]. Nevertheless, in many countries whole grain consumption is low compared to international recommendations [5–6]. Whole grain consumption has been promoted in various ways, such as by emphasizing or improving its affordability, healthiness, availability, taste and appearance [7–10]. In the last decade, there has been a considerable increase in interest in using insights from behavioural economics and psychology to change behaviour in a healthier direction, because a lot of behaviour is driven by habits and automatic routines. Every day, people are faced with numerous instances where they have to make food-related decisions such as whether they want to eat, what they want to eat, what the rest of the family want to eat, whether the food is healthy and safe, and whether the food is in line with their health goals (Wansink and Sobal [11] mention up to 200 food-related decisions that the average person has to take per day). Giving each of these

Competing Interests: The authors declare that they have no competing interests.

questions sufficient thought is mentally exhausting, and there is a great temptation to fall back on automated and less healthy behaviours [12]. Moreover, most supermarket purchases are unplanned, i.e., they are based on in-store decisions. Estimates of unplanned purchases vary between studies. For example, Inman et al. estimate that 60.9% of purchases are unplanned [13].

Increasingly, interventions focus on arranging the decision-making contexts in such a way that they engage with consumers' automatic and impulse-driven decision-making system. These so-called nudging interventions adapt the environment in which people make choices to help them make better choices, without appealing to people's reason or forcing certain choices upon them [14–16]. The evidence base for nudging as a means to improve the healthiness of food choices is growing. Depending on the specific studies, increases or decreases in sales as a result of nudging may be as large as 28% [17]. So far, nudging studies have targeted especially homes, schools, grocery stores, and restaurants. The essence of the nudging approach is to change environments in such a way that the healthy choice becomes a more convenient, attractive, or normal choice [18]. This paper focuses especially on the convenience component of a nudge approach by adapting the shelf location of healthier and less healthy breads. Locating healthy foods at a prominent or eye-level place and the unhealthy options further away is one of the most frequently mentioned examples when nudges are defined and illustrated (see for example [14, 19–20]).

Convenience is the result of the ease, time, and comfort involved in obtaining a food and can be achieved in many ways. Small convenience changes in the environment, such as changing the distance to healthy or unhealthy foods, placing specific foods near the checkout, or changing the order of food in buffet lines, are typically not consciously noticed by consumers but have demonstrated effects on food choices and can assist in making the healthy choice the convenient choice [17, 21–22]. Research on the way shelves are stocked in grocery stores shows that a product's absolute and relative shelf position strongly influences the choices that consumers make [23]. The more shelf space a type of product occupies or the more prominent the shelf location (e.g. at eye level or end of aisle display), the more items are sold [24].

The present study examines the convenience nudge principle in supermarkets to select healthier whole grain bread. The habit strength of bread purchases is typically high, as people have a repeated pattern of purchase [25]. Although nudging studies in canteen settings have shown effects of more prominent location of healthier foods [26–27], to our knowledge, no study has specifically attempted to nudge consumers' bread purchases in a real-world supermarket setting. The current research extends prior research by exploring consumer purchase responses to a convenience nudge to encourage whole grain bread purchases in two supermarkets over an extended period of time. Healthier bread choices were made more convenient by altering the horizontal shelf position and therefore the accessibility (healthier bread is encountered either first or last during visits to the bread section). We hypothesize that the purchase of a certain category of bread is higher when it is encountered first, as it is more visible and prominent than when it is encountered last.

Methods

Setting

Data were based on sales of every type of fresh bread sold in two supermarkets ("supermarket A" and "supermarket B") in the same chain located in Veenendaal, the Netherlands. Both supermarkets shared a similar store layout. The fresh bread department of both stores was located next to the entrance, and all customers passed this department before they entered the rest of the store. Five clusters of fresh breads were identified, labelled for this study as whole grain (9 types), dark wheat (4), wheat (6), light wheat (4), and white (8) because, in Dutch supermarkets, bread is identified by colour rather than by degree of refinement of the wheat.



Fig 1. Fresh bread department located near the entrance of the test supermarkets. Shoppers enter the bread aisle from the left and exit from the right to other departments.

doi:10.1371/journal.pone.0151915.g001

These bread clusters were organized on shelves on the left side of one aisle that customers entered from the left and exited from the right (see Fig 1). An additional cluster of banquet/bake-off breads (84 types) was situated on the far left and a cluster of specialty bread (26 types) on the far right of the aisle. Shelf height ranged from approximately 30 cm to 150 cm, shelf width was eight and nine metres in supermarket A and B, respectively.

Experimental design and procedures

In the “healthier bread first” condition, whole grain bread was placed at the entrance of the aisle (next to the banquet/bake-offs), followed by dark wheat bread, wheat bread, light wheat bread, and white bread. In the “healthier bread last” condition, the order was reversed, with whole grain bread placed at the exit of the aisle, just before the specialty bread (Fig 2).

The effect of horizontal shelf location was investigated over two periods. During period 1 (week 43–49, 2013), bread was presented in the “healthier bread first” condition in one supermarket (location B) and in the “healthier bread last” condition in the other supermarket (location A). During period 2 (week 5–9, 2014), this order was reversed. Ideally, the second period should have been as long as the first period, but the second period was shortened due to the fact that the original shelf placement needed to be restored in view of upcoming holiday sales. The supermarket staff refilled shelves during the day. Researchers visited both supermarkets daily to verify the bread placements over the shelves.

Measurement and statistical analysis

The dependent variable was the total number of units of bread sold per day from each of the five bread categories. Since breads were sold as wholes and halves, all sales were recalculated to

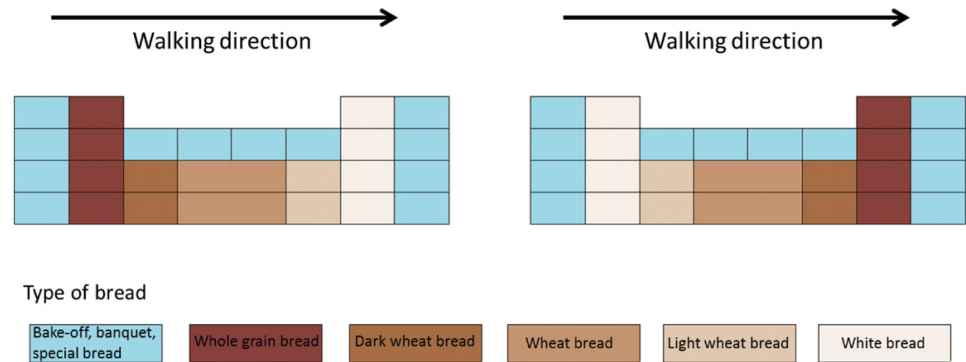


Fig 2. Diagram of bread placement in supermarket.

doi:10.1371/journal.pone.0151915.g002

one whole unit, e.g. one half bread was recorded as 0.5 unit of bread. Day of the week and number were recorded per location, as well as bread promotions. Both supermarkets offered the same bread promotions at the same time, but promotions varied per week in both experimental periods.

The supermarkets differed in the absolute number of bread units sold. To compensate for these differences in absolute sales, and to correct for weekly bread promotions, ratios between the bread sales of both supermarkets were calculated based on average weekly sales during both periods. Thus, for each bread type, the ratio “Sales in Supermarket A” : “Sales in Supermarket B” was calculated for each week. An effect of accessibility on whole grain bread sales should result in relatively more whole grain sales in supermarket B during period 1, where it was more accessible, and relatively fewer sales during period 2 compared to supermarket A. As it was expected that a carry-over effect might occur that affected wheat bread sales, in the analysis wheat bread was divided into three categories based on colour.

Results

Bread sales: General

Absolute numbers of sold units of breads were used to verify statistical differences between bread type, day of the week, and supermarkets. Bread sales in supermarket B significantly exceeded bread sales in supermarket A on average by 68% during both periods. Despite differences in absolute number of bread sales, both supermarkets showed similar effects of day of the week and type of bread (Table 1). Bread sales differed systematically with day of the week, with lowest sales on Mondays and Tuesdays and highest sales on Fridays and Saturdays. Repeated measures ANOVA showed significant differences in sales per day of the week for both supermarket A ($F(2.52, 108) = 130, p < .000, \eta^2 = .75$) and supermarket B ($F(2.15, 92) = 112, p < .000, \eta^2 = .72$).

Bread sales: Effect of accessibility

To investigate an effect of accessibility of whole grain bread across both supermarkets, a 5x2 ANOVA with type of bread (whole grain, dark wheat, wheat, light wheat, white) and condition (“healthier bread first”, “healthier bread last”) as between-subject factors on average week sales ratio was performed. A main effect was found on the average sales ratio between supermarkets for bread type ($F(4, 55) = 13.0, p < .001, \eta^2 = .487$), but not for time period ($F(1, 55) = 1.90, p = .174, \eta^2 = .033$), nor for the interaction between type of bread and time period ($F(4, 55) =$

Table 1. Total number of bread units sold per day of the week, supermarket, and test period/condition.

	Period 1		Period 2	
	<i>Supermarket A Less healthy bread first</i>	<i>Supermarket B Healthier bread first</i>	<i>Supermarket A Healthier bread first</i>	<i>Supermarket B Less healthy bread first</i>
Monday	88	140	81	135
Tuesday	96	122	90	116
Wednesday	96	163	92	154
Thursday	102	188	89	167
Friday	116	239	109	206
Saturday	146	229	134	216
Average	107	180	99	166

Sales of whole grain bread were significantly higher (32.5% of total bread sales) than sales of dark wheat bread (17.9%), wheat bread (25.0%), light wheat bread (9.7%), and white bread (14.9%) (Table 2).

doi:10.1371/journal.pone.0151915.t001

1.95, $p = .115$, $\eta^2 = .124$). Thus, the sales of bread type differed in the two supermarkets. However, no effects of condition, or an interaction between condition and type of bread, were found. Hence, accessibility did not affect sales (Fig 3).

Discussion

The unplanned character of most in-store consumer decisions coupled with the automatic and habit-driven nature of many consumer decisions offer opportunities to gently direct—or nudge—consumers towards healthier foods. In the present study, the effect of a convenient shelf space location on the sales of whole grain and white bread was examined in two supermarkets by varying their accessibility. In the accessible, healthier bread first condition, whole grain bread was placed in a more convenient position on the left side of the shelves in the bread section (Fig 2). In this condition, customers encountered the healthier bread first. This order was reversed in the less accessible, healthier bread last condition.

Overall, the results showed no effects of our manipulation on sales of the different bread types. That is, sales of whole grain bread were not affected by placement in a more or less convenient location. A number of reasons might explain this lack of effect. First of all, it can always be argued that longer intervention periods and more test supermarkets could have produced different results. However, the intervals used and the low number of test supermarkets did show consistent and significant effects of variables such as the day of the week, specific weeks, and promotions on bread sales (not shown). In view of these significant effects, we believe that

Table 2. Percentage and number of bread units sold per type, supermarket, and test period.

	Less healthy bread first		Healthier bread first		Total sales
	<i>Supermarket A (period 1)</i>	<i>Supermarket B (period 2)</i>	<i>Supermarket A (period 2)</i>	<i>Supermarket B (period 1)</i>	
Whole grain	34% (178)	31% (251)	34% (166)	33% (289)	32.5% (884)
Dark wheat	17% (89)	18% (150)	17% (85)	18% (162)	17.9% (486)
Wheat	25% (132)	26% (216)	25% (122)	24% (209)	25.0% (679)
Light wheat	9% (47)	10% (85)	8% (38)	11% (93)	9.7% (263)
White	16% (83)	14% (117)	16% (75)	15% (128)	14.9% (403)
Total sales	100% (529)	100% (819)	100% (486)	100% (881)	100% (2715)

doi:10.1371/journal.pone.0151915.t002

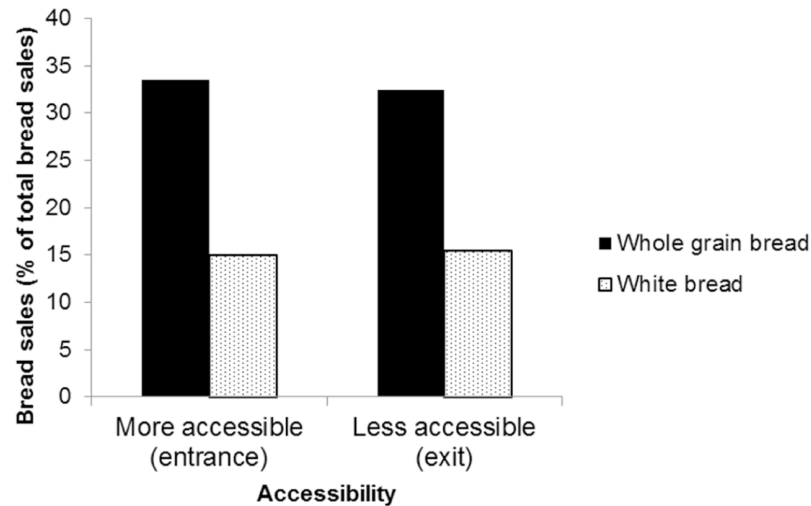


Fig 3. Effect on sales of bread placement.

doi:10.1371/journal.pone.0151915.g003

a lack of significant convenience effect demonstrates that it is either absent or very small and therefore irrelevant.

Second, consumer bread preferences and purchase habits are strong, and this may lead to a less 'nudgeable' product. Nudging requires the right amount of strength to influence decision-making processes. The fact that most consumers buy the same type of bread even when its location in the store changes suggests that consumers have strong bread preferences, at least with regard to white and whole grain bread; a typical consumer of white bread may not select whole grain bread instead just because whole grain bread is encountered first, and vice versa. This effect may be especially strong for white and whole grain bread, which may appeal to very different consumer segments [28–29]. Other types of bread such as whole grain and wheat bread may be more interchangeable for consumers [30]. Consumers often believe that the darker the bread, the healthier it is. In retrospect, varying the accessibility of whole grain and wheat bread could have produced more positive effects in this study.

Bread is also a product that is typically purchased on a regular basis, sometimes even daily. This, plus the fact that bread does not trigger purchasing behaviour like products such as beer or fatty food, means that the purchase of bread is most often habitual and planned [13]. The habitual and planned nature of bread purchases could refer to either the location of specific breads or the bread type itself. If bread purchases are driven by location, switching breads to different locations should lead to a shift in sales from one type of bread to another. The fact that this does not happen in this study suggests that habit refers to the type of bread that is purchased and that customers will look for that preferred bread in the event of relocation. The preferred bread category may be broader than one specific type of bread and may include for example whole grain as well as wheat bread; this could be the subject of further studies.

Finally, the effectiveness of nudges may be very context-specific. A question that arises is whether the convenience and the prominence of the bread were really varied. In other studies, the convenience of product selection is varied for example by placing the products closer to or further away from the shopper [17], or by placing them at the beginning or at the end of a line buffet [22]. In the former case, it takes more effort to select the product that is further away. In the latter case, the assumption is that it is more convenient to select the product at the beginning of the line rather than risk the possibility of encountering no more attractive

alternatives in the rest of the line and having to go back (often against the traffic). We had speculated that our supermarket intervention would resemble the line buffet intervention. However, there are some critical differences. Going against the traffic may be much more problematic with a line buffet than in our supermarket situation because of the amount of traffic and the available space to manoeuvre. As [Fig 1](#) clearly illustrates, neither factor is typically really relevant in the test supermarket. Consequently, (perceived) accessibility may have been similar for the breads placed at the entrance and at the exit of the bread department.

In summary, the results of the study demonstrate no effect on sales of placement of bread near the entrance or near the exit of the bread department of supermarkets. Future studies may include other product categories and other types of product placements in supermarkets to explore whether the lack of effect in this study is related to the bread product category and/or to the good accessibility of the products within this category.

Acknowledgments

We are grateful to the participating supermarkets for their collaboration in this project. We thank Erica van Herpen and Adriaan Kole for their contribution in setting up the study.

Author Contributions

Conceived and designed the experiments: RdW AM IP NH EvK MV. Performed the experiments: AM IP NH. Analyzed the data: RdW. Wrote the paper: RdW. Read and approved the final manuscript: RdW AM IP NH EvK MV.

References

1. Slavin J. Why whole grains are protective: biological mechanisms. *Proc Nutr Soc.* 2003; 62(1): 129–134. PMID: [12740067](#)
2. Steffen LM, Jacobs DR, Murtaugh MA, Moran A, Steinberger J, Hong C, et al. Whole grain intake is associated with lower body mass and greater insulin sensitivity among adolescents. *Am J Epidemiol.* 2003; 158(3): 243–250. PMID: [12882946](#)
3. Jonnalagadda SS, Harnack L, Liu RH, McKeown N, Seal C, Liu S, et al. Putting the whole grain puzzle together: health benefits associated with whole grains—summary of American Society for Nutrition 2010 Satellite Symposium. *J Nutr.* 2011; 141(5): 1011S–1022S.
4. Aune D, Norat T, Romundstad P, Vatten LJ. Whole grain and refined grain consumption and the risk of type 2 diabetes: a systematic review and dose-response meta analysis of cohort studies. *Eur J Epidemiol.* 2013; 28(11): 845–858. doi: [10.1007/s10654-013-9852-5](#) PMID: [24158434](#)
5. Thane CW, Jones AR, Stephen AM, Seal CJ, Jebb SA. Whole-grain intake of British young people aged 4–18 years. *Brit J Nutr.* 2005; 94(5): 825–831. PMID: [16277788](#)
6. Devlin NF, McNulty BA, Gibney MJ, Thielecke F, Smith H, Nugent AP. Whole grain intakes in the diets of Irish children and teenagers. *Brit J Nutr.* 2012; 110(2): 1–9.
7. Mattei J, Malik V, Wedick NM, Hu FB, Spiegelman D, Willett WC, et al. Reducing the global burden of type 2 diabetes by improving the quality of staple foods: the Global Nutrition and Epidemiologic Transition Initiative. *Global Health.* 2015; 11(1), 1, doi: [10.1186/s12992-015-0109-9](#)
8. McMackin E, Dean M, Woodside JV, McKinley MC. Whole grains and health: attitudes to whole grains against a prevailing background of increased marketing and promotion. *Publ Health Nutr.* 2013; 16(04), 743–751.
9. Van Kleef E, Vrijhof M, Polet IA, Vingerhoeds MH, De Wijk RA. Nudging children towards whole wheat bread: a field experiment on the influence of fun bread roll shape on breakfast consumption. *BMC Publ Health.* 2014; 14(1): 906, doi: [10.1186/1471-2458-14-906](#)
10. Drewnowski A. The Nutrient Rich Foods Index helps to identify healthy, affordable foods. *Am J Clin Nutr.* 2010; 91(4), 1095S–1101S. doi: [10.3945/ajcn.2010.28450D](#) PMID: [20181811](#)
11. Wansink B, Sobal J. Mindless eating: the 200 daily food decisions we overlook. *Environ Behav.* 2007; 39, 106–123.

12. Wansink B. Slim by design—Mindless eating solutions for everyday life. New York: William-Morrow; 2014.
13. Inman JJ, Winer RS, Ferraro R. The interplay among category characteristics, customer characteristics, and customer activities on in-store decision-making. *J Mark.* 2009; 73(5): 19–29.
14. Thaler RH, Sunstein CR. *Nudge: improving decisions about health, wealth and happiness.* New Haven, CT: Yale University Press; 2008.
15. Hollands GJ, Shemilt I, Marteau TM, Jebb SA, Kelly MP, Nakamura R, et al. Altering micro-environments to change population health behaviour: towards an evidence base for choice architecture interventions. *BMC Publ Health.* 2013; 13:1218, doi: [10.1186/1471-2458-13-1218](https://doi.org/10.1186/1471-2458-13-1218)
16. Quigley M. Nudging for health: on public policy and designing choice architecture. *Med Law Rev.* 2013; 21(4): 588–621. doi: [10.1093/medlaw/fwt022](https://doi.org/10.1093/medlaw/fwt022) PMID: [24081425](https://pubmed.ncbi.nlm.nih.gov/24081425/)
17. van Kleef E, Otten K, van Trijp HCM. Healthy snacks at the checkout counter: a lab and field study on the impact of shelf arrangement and assortment structure on consumer choices. *BMC Publ Health.* 2012 12: 1072, doi: [10.1186/1471-2458-12-1072](https://doi.org/10.1186/1471-2458-12-1072)
18. Wansink B. Change their choice! Changing behavior using the CAN approach and activism research. *Psych Mark.* 2015 32(5): 486–500.
19. Guldborg Hansen P. Making healthy choices easier: regulation versus nudging. *Annu Rev Public Health.* 2016; 37(1).
20. Moss M. Nudged to the produce aisle by a look in the mirror. *The New York Times*; August 27, 2013.
21. Hanks AS, Just DR, Smith LE, Wansink B. Healthy convenience: nudging students toward healthier choices in the lunchroom. *J Public Health.* 2012; doi: [10.1093/pubmed/dfs003](https://doi.org/10.1093/pubmed/dfs003)
22. Wansink B, Hanks AS. Slim by design: serving healthy foods first in buffet lines improves overall meal selection. *PLoS One.* 2013; 8(10), e77055. doi: [10.1371/journal.pone.0077055](https://doi.org/10.1371/journal.pone.0077055) PMID: [24194859](https://pubmed.ncbi.nlm.nih.gov/24194859/)
23. Breugelmans E, Campo K, Gijsbrechts E. Shelf sequence and proximity effects on online grocery choices. *Mark Lett.* 2007; 18(1–2), 117–133.
24. Desmet P, Renaudin V. Estimation of product category sales responsiveness to allocated shelf space. *Int J Res Mark.* 1998; 15(5), 443–457.
25. Ji MF, Wood W. Purchase and consumption habits: not necessarily what you intend. *J Consum Psychol.* 2007; 17(4), 261–276.
26. Thorndike AN, Sonnenberg L, Riis J, Barraclough S, Levy DE. A 2-phase labeling and choice architecture intervention to improve healthy food and beverage choices. *Am J Public Health.* 2012; 102(3), 527–533. doi: [10.2105/AJPH.2011.300391](https://doi.org/10.2105/AJPH.2011.300391) PMID: [22390518](https://pubmed.ncbi.nlm.nih.gov/22390518/)
27. Driessen CE, Cameron AJ, Thornton LE, Lai SK, Barnett LM. Effect of changes to the school food environment on eating behaviours and/or body weight in children: a systematic review. *Obesity Rev.* 2014; 15(12), 968–982.
28. Worsley A. The behavioural and demographic contexts of white bread consumption. *Br Food J.* 2003; 105(10), 695–699.
29. Sandvik P, Kihlberg L, Lindroos AK, Marklinder I, Nydahl M. Bread consumption patterns in a Swedish national dietary survey focusing particularly on whole-grain and rye bread. *Food Nutr Res.* 2014; 5(58). doi: [10.3402/fnr.v58.24024](https://doi.org/10.3402/fnr.v58.24024)
30. Arvola A, Lähteenmäki L, Dean M, Vassallo M, Winkelmann M, Claupein E, et al. Consumers' beliefs about whole and refined grain products in the UK, Italy and Finland. *J Cereal Science.* 2007; 46 (3): 197–206.