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Effects of abnormal food shape on willingness to buy the product: a meta-analytic study

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Resumo

The study applied meta-analysis approach to understand the effect of abnormal food shape on willingness to buy the product. In this research, 16 empirical articles were examined, with a total of 54 effect sizes that tested 4.855 participants. This paper also tests some potential moderators that could influence the main direct effects. The results showed and consistent negative effects between abnormal shape on consumers willing to buy this kind of food. We also find that significant moderation effects that potentialized the main direct relationships (methodological; cultural; economic; and contextual).

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Abstract

The study applied meta-analysis approach to understand the effect of abnormal food shape on willingness to buy the product. In this research, 16 empirical articles were examined, with a total of 54 effect sizes that tested 4.855 participants. This paper also tests some potential moderators that could influence the main direct effects. The results showed and consistent negative effects between abnormal shape on consumers willing to buy this kind of food. We also find that significant moderation effects that potentialized the main direct relationships (methodological; cultural; economic; and contextual).

Keywords: Meta-analysis; Food waste; Abnormality food; Purchase intention; Sustainability.

1. Introduction

Food waste has become an issue of social concern and debate (Aschemann-Witzel, 2018), and has being progressively recognized as an urgent matter among governments, companies, NGOs, academics, and general audiences (Schanes et al., 2018). Even though food waste has increased over the past few decades, the awareness of this problem has only been related in recent years (Hartmann et al., 2021). Several efforts have been made by retail, academics, and policy makers, aimed at mitigating food waste (Cooremans and Geuens, 2019; Coderoni and Perito, 2020; Legendre et al., 2020; Tsalis, 2020).

In the context of food waste, fruits, vegetables, roots, and tubers (FaVs) are the most wasted food items in the world. In fact, 45% of FaVs produced by the world are lost and wasted (FAO, 2011). In fact, most of these foods do not reach the supermarkets or consumers' kitchens, as they are not arriving to an aesthetic standard imposed by retailers (e.g., if they are misshapen, stained, or asymmetrical foods, they are called imperfect or abnormal. (Xu et al., 2020). According to Helmert et al. (2017), the rejection of imperfect-looking foods plays an important role in the context of food waste. Aesthetic characteristics can have a significant impact on consumers' food disposal decisions (Huang et al. 2019). Small deviations from the so-called perfect aesthetic standards can activate negative perceptions (Buzby et al., 2014; Legendre et al., 2020), leading to the acceptance or rejection of a product (Loebnitz et al., 2015). Foods that have visual imperfections, but are fully suitable for consumption, can be discarded due to deviations in aesthetic standards (Koo et al., 2019).

Aligned with the relevance of food waste in practice, research proposing to investigate the influence of abnormal food shape (AFS) on consumer preference has increased in recent years. Much research has been done on different continents (e.g., America; Europe; Asian) and different contexts (e.g., fruits; vegetables). These primary studies provide input for a better understanding of the food waste phenomenon. However, it is natural that they also produce fragmentated findings. For example, while most studies found a negative effect of AFS on consumers' willingness to buy (e.g., Berardinetti, 2018; Boges, 2019), some studies found opposite effects (e.g., Cooremans and Geuens, 2019; Lombart et al., 2019). This contradiction found on primary studies on AFS could be explain by methodological practices (Hedges and Olkin, 2014) or contextual influences (e.g., Hofstede, 2010; Pelau et al., 2020).

Thereby, the meta-analysis research is a good methodological strategy to integrate the fragmentations of primary studies and pacify some conflicting results (Hunter and Schmidt, 2004). The meta-analysis is also able to investigate the possible influences of methodological and contextual effects on direct relationships (Viechtbauer, 2010). Based on this powerful tool, we propose a meta-analytic study to investigate the possible influence of abnormal food waste on consumer willingness to buy. Our research also investigates some possible moderators that could potentiate the direct effects. Thus, with this study we hope to contribute with academic field in consolidating the knowledge about the effects of abnormal food waste on consumer

responses and also about some possible moderators (e.g., methodological; contextual). The findings will serve as an guide of food waste topic, since this method promotes a state of the art on what we know and how the effects operate in these relationships (Borenstein et al., 2009).

The paper is organized as follows: Section 2 presents the literature review and hypothesis development; Section 3 describes the research methodology; Section 4 presents the results of the research; and finally, we discuss the meta-analytical findings and the factors that influence the intention to purchase imperfect products, and how this understanding can contribute to reducing food waste at the consumer level.

2. Theoretical foundations

2.1. Abnormal food waste and consumer preference

The rejection of products with imperfect physical appearance occupies an important role in food waste (Helmert et al., 2017). Such products fall into what is called suboptimal food (SF), that is, those foods that deviate from normal or optimal products, without deviations in intrinsic quality or safety (Halloran et al., 2014). Aesthetic has many implications for the consumer behavior (Loebnitz et al., 2015; Symmank et al., 2017; Shao et al., 2020). The aesthetic standard of a product is of great relevance in determining consumer preferences (de Hooge et al., 2016; Koo et al., 2019). That is, the aesthetic characteristics of a product (weight, shape, color, or size) strongly influence the consumers' judgment, attitudes, and decisions (Baker et al., 2016; Legendre et al., 2020). According to Porter *et al.* (2018), visual appearance is the primary determinant in fruit and vegetable choice, leading consumers to frequently reject aesthetically imperfect foods (Loebnitz et al.2015).

Preliminary studies have examined the effect of AFS on purchase willingness, and have shown that the appearance of these products plays a significant role in consumers' purchase intention (Loebnitz and Grunert, 2015; Symmank et al., 2018; Lombart et al., 2019). For example, Loebnitz et al. (2015) pointed out that consumers' purchase intention was lower for extremely abnormally shaped food way, compared to normally shaped foods. Accordingly, Symmank et al. (2018) pointed out that consumer purchase intention was significantly lower for bananas visually below the aesthetic standard considered ideal. Thus, the following hypothesis was proposed:

H_1 - The effect of AFS on willingness to buy is negative.

2.2. Possible moderators affecting the relationship between abnormal food shape on willingness to buy

We propose some possible moderators that could enhance or attenuate the direct relationship. As above-mentioned, we investigated the methodological and contextual factors that could explain the fragmentation of previous studies. On the contextual factors, we analyzed the possible influence of cultures and economies of the countries where the primary studies were produced. We also investigated the effects of countries by sustainable and food polices. On the methodological effects, we analyzed the possible influence of the sample size used on primary studies. Below, we detailed each investigated moderator.

2.2.1. Cultural effects

The concept of culture has been widely studied in various fields and for different purposes, including to understand consumer behavior (De Mooij and Hofstede, 2002). Additionally, culture is considered one of the main factors that influence consumer behavior and, consequently, the purchasing behavior of individuals (Purbey and Sadarangani, 2018). Hofstede's cultural dimensions model is recognized as a useful framework for investigating cross-cultural differences (Purbey and Sadarangani, 2018; Moon and Tikoo, 2008). Moon et al. (2018) suggest that Hofstede' cultural dimensions explain the cross-cultural differences in consumer purchase intentions. Some authors argue that food waste is related to national culture (Hanssen et al. 2016; Flokorwsli et al., 2018). The study by Zhang et al. (2018), for example,

points out the importance of cultural influences on the amount of food wasted. In the present study, we used the six culture dimensions (power distance; individualism; masculinity; uncertainty avoidance; long term orientation; indulgence) proposed by Hofstede (2010). So, we considered the Hofstede's parameters trough the country origin of each study and adopt the median of the cultural dimensions as the cut-off point (low or high level).

Power distance: Cultures that are characterized by low levels of power distance demonstrate a drive for more democratic decision making (Pelau et al., 2020). In contrast, the cultures that are characterized by high levels of distance may exhibit a greater social inequality (Hofstede, 2010) and therefore a greater economic asymmetry. Countries with high levels of power distance have large income differences between social strata (Hofstede, 2010). Based on the evidence that social inequality impacts financial income, we assume that consumers with low purchasing power will prioritize the economics, without considering the careful selection of food. The literature indicates that price-oriented consumers waste less food (Aschemann-Witzel et al., 2017; Pelau et al., 2020). That is, consumers who are opposed to the idea of wasting money are motivated to avoid wasting food (Aschemann-Witzel, 2018). In summary, it is possible to assume that in cultures with high levels of power distance, due to low financial income, consumers seek savings and, consequently are less demanding about aesthetic standards of food. Then, we suggest that:
H_{2a} - The relationship between AFS and willingness to buy is stronger (weaker) among countries with high (low) levels of power distance.

Individualism: Cultures characterized by high levels of individualism are made up of people who tend to pursue their own individual goals (Yin et al., 2019). In contrast, cultures characterized by low levels of individualism demonstrate a more harmonious relationship between the view of individual and collective (Pelau et al., 2020). Collectivist cultures are made up of more altruistic citizens (Evanschitzky et al., 2014) and more inclined toward sustainability practices (Bedard and Tolmie, 2018). Previous studies have shown a positive association between environmental sustainability and collectivism (Sreen et al., 2018). Therefore, we assume that collectivism may affect the consumers' intention, leading them to consider group and environmental effects related to purchasing an abnormal food. Then, we suggest that:
H_{2b} - The relationship between AFS and willingness to buy is stronger (weaker) among countries with low (high) levels of individualism.

Masculinity*:* Cultures characterized by low levels of masculinity are driven by cooperation, care for others, and quality of life (Pelau et al., 2020). Furthermore, countries with low levels of masculinity are guided by sustainable values and show greater care and concern for the environment (Husted, 2005). Therefore, it can be assumed that less masculine cultures are more willing to buy sustainable products. Organic food consumers, for example, are primarily characterized by attitudes and behaviors towards sustainability (Bryla, 2016). Loebnitz et al. (2015) demonstrated that abnormal food is associated to organic farming, as consumers perceive aesthetic irregularities because of more natural production methods. These findings are corroborated by the research of Asioli et al. (2014), who pointed to a higher acceptance of irregular-looking fruits and vegetables by organic food consumers. These relationships lead us to believe that individuals guided by sustainable values have higher intentions to buy abnormally shaped foods. Hence, we believe that:
H_{2c} - The relationship between AFS and willingness to buy is stronger (weaker) among countries with low (high) levels of masculinity.

Uncertainty Avoidance*:* Cultures characterized by high levels of uncertainty avoidance are driven by reduced unpredictability and risks, as well as the need for security and control (Hofstede, 2010; Pelau et al., 2020). In contrast, cultures characterized by low levels of

uncertainty aversion are driven by a greater acceptance of change (Pelau et al., 2020). According to Houghton et al. (2006), in terms of food, the levels of risk acceptable to the consumers are strongly influenced by culture. Previous studies have shown that risk perceptions significantly impact food purchase intentions (Yin et al., 2018). Loebnitz and Grunert (2018) has pointed out that consumers perceive a higher risk in abnormal fruits and vegetables. Thus, we suggest that the uncertainty aversion may influence the consumers' purchase intention, as foods that deviate from aesthetic standards may elicit a higher risk perception. We then suggest that:

H_{2d} - The relationship between AFS and willingness to buy is stronger (weaker) among countries with low (high) levels of uncertainty avoidance.

Long Term Orientation: Cultures characterized by high levels of long-term orientation are more pragmatic and future-focused (Pelau et al., 2020). According to Sreen et al. (2018), long-term subordinates should have as a priority benefits for future generations. Previous studies have suggested that in countries with high levels of long-term orientation, citizens are more likely to protect the environment, seeking a prosperous and sustainable future for themselves and their families. (Leonidou et al. 2010). Therefore, in the context of food waste, we assume that in long-term cultures, consumers are more willing to buy abnormal food, as they consider future environmental benefits. Therefore, we suggest that:

H_{2e} -The relationship between AFS and willingness to buy is stronger (weaker) among countries with high (low) levels of long-term orientation.

***Indulgence*:** Cultures characterized by high levels of indulgence tend to give in to human impulses and desires that give rise to pleasure and fun (Minelgaitė and Liobikienė, 2019). The literature points out that in indulgent societies, individuals tend to experience greater happiness and, consequently, higher levels of positive emotions (Guo et al., 2018). According to Booth (1994), the choice of food is impacted by variables that go beyond the nutritional value and the physiological needs of individuals. For Evers et al. (2018), emotions provide motivational impulses that can direct human behavior. Russell et al. (2017) highlight that positive emotions can be important in determining environmentally responsible behaviors. Based on these findings, we consider that emotionally positive individuals are more prone to environmentally sustainable practices, therefore waste less food. Then, the following hypothesis was proposed:

H_{2f} - The relationship between AFS and willingness to buy is stronger (weaker) among countries with high (low) levels of indulgence.

2.2.2. Economic effects

To analyzed the possible economic effects, we followed the *Human Development Index (HDI)* to classify countries on two groups: (1) low HDI index; (2) high HDI index. We applied the same procedure used on cultural moderators to identify the groups. The HDI, annually published by the United Nations, is a socioeconomic indicator that reflects three major dimensions of human development: longevity, knowledge and standard of living (Human development Reports, 2020). Moreover, the HDI indicator is used in many research papers as a proxy for sustainable development (Hoinaru et al., 2019). As previously mentioned, consumers from countries with low economic development tend to be more economy-driven and are therefore less demanding of aesthetic standards (Aschemann-Witzel, 2018). For this reason, we hypothesized that:

H_3 - The effect of AFS on willingness to buy is stronger (weaker) and negative on countries with low (high) HDI.

2.2.3. Food Sustainability Index (FSCI)

The Food Sustainability Index (FSI) is a global study on sustainability of food systems in 67 countries, in three categories: Food Loss and Waste (FLW), Sustainable Agriculture (SA)

and Nutritional Challenges (NC). The study was developed based on social, economic, and environmental dimensions, referring to the main challenges related to food sustainability, namely: access to food, promotion of healthy and sustainable diets and responsible food distribution (FSI, 2018). The Food Sustainability Index was created from the collaboration between the Economist Intelligence Unit and the Barilla Center for Food and Nutrition (BCFN) to highlight the best practices related to the main United Nations' (UN) Sustainable Development Goal. In this paper, we focus our analysis on the "food loss and waste" category. We followed the same procedures used in the cultural and economic moderators to identify our groups to perform the moderation analysis. **Food loss and waste:** According to the Food and Agriculture Organization (FAO, 2020), food loss concerns the production chain as a whole, while food waste focuses only on distribution and consumption. The available data suggest that worst performing countries are highly vulnerable to access nutrition and adequate food for the general population, showing the urgent need for sustainable improvements in the food system. On the other hand, countries with high scores across the FSI's shows policies and measures based on best practices, advancing in the fight against food waste. Previous studies have investigated, in several countries, the relationship between sustainable consumption attitudes and consumers' purchase intention in the context of food waste. Su et al. (2020), for example, demonstrated that environmental self-identity drove abnormal food purchase intention . Consistent with these findings the research by Xu et al. (2020) indicated that environmental self-identity stimulated imperfect foods consumption. The results of these studies suggest that purchasing abnormally shaped food may encourage the reduction of food waste, contributing to the improvement of the environment and the food system as an single concern. Therefore, the current study proposed the following hypotheses:

H_{4a} - The effect of AFS on willingness to buy is stronger (weaker) and negative on countries with low (high) level of food loss and waste.

H_{4b} - The effect of AFS on willingness to buy is stronger (weaker) and negative on countries with low (high) level of food loss.

H_{4c} - The effect of AFS on willingness to buy is stronger (weaker) and negative on countries with low (high) level of users' waste.

2.2.4. Methodological Moderators

2.2.4.1 Sample Size: Sample size was classified by two groups: small and large. We accessed the methodological section of each study and adopt the median of the sample sizes as the cut-off point. Small samples are more homogeneous (Fern & Monroe, 1996) and therefore tend to overestimate the effect sizes of the relationships (Rosenthal & Rubin, 1982). Therefore, we propose that:

H_5 - The effect of AFS on willingness to buy is stronger (weaker) and negative on studies with small (large) sample.

3. Methods

We followed the PRISMA Protocol to conduct the systematic review that drove this meta-analytic research (Moeher et al., 2009). In this case, we performed four steps: (1) literature search; (2) inclusion criteria; (3) coding process and (4) analysis procedures. In the literature search, we aim to select all published research on marketing or food management fields. In this case, we performed manual search in representative databases as ABI/Inform Global, Web of Science, Emerald, ScienceDirect, Taylor and Francis and EBSCO. We also searched on the main Conferences Proceedings and Journals of food management field (American Marketing Association Publications; American Consumer Research Conference; Journal of Consumer Behaviour). The main keywords searched were "food waste"; "suboptimal food"; "consumer"; "intention". These terms were searched in the titles, abstracts, and keywords of papers published through 2021. This initial search identified 980 primary studies.

In the second step, we examined the adequacy of each identified study to be part of this meta-analysis. For that, we classified the papers in terms of reporting (1) experiments that included information necessary to carry out the meta-analytical procedures (i.e., F-test, t-test, means, standard deviations) or (2) studies that did not include such information (i.e., literature reviews, qualitative or correlational studies). We excluded the latter category. The final data set consisted of 54 effect sizes, retrieved from 16 experiments that tested 4.855 participants. This procedure is the same applied by other meta-analysis (e.g., Chernev et al., 2015).

In the third step - coding process, we followed an established practice (Rust and Cooil, 1994). In this case, two researchers coded the experiments according to outcome (purchase intention; behavioral intention; willingness to buy moderator (e.g., Hofstede cultural Index; HDI index; type of food); and meta-analytic statistics (mean and standard deviation of willingness to buy and control conditions; sample size of each experiment). The judges reached a high agreement level (97%) and resolved disagreements through discussion (Santini et al., 2020).

The last step performed was the analysis. Effect-sizes were calculated using Cohen's d (Cohen, 1998). This statistic represents the difference between two means (i.e., experimental condition vs. control condition) divided by the combined standard deviation and is frequently used in meta-analyses (Scheibehenne et al., 2010; Chernev et al., 2015). Thus, we transformed the difference in the dependent variable between the normal and the AFS from each experiment into a Cohen's *d* effect size measure that expresses the difference between the food shape, scaled by its pooled standard deviation (Cohen 1977). Effects were calculated using the random effect method, as suggested by Hunter and Scmidt (2004). The random effect model control was chosen because this method promotes more generalizable results for studies with heterogeneous sample sizes (Rosenthal and DiMatteo, 2001). We also evaluated the heterogeneity level of each relationships by Crochan's Q and I^2. In the Cocharn's Q, the heterogeneity is proved by the significance level (Lau et al., 1998). The I^2 shows heterogeneity in a range from 0 to 100%. The moderation analysis was performed by meta-regression analysis. In this case, we used raw effect sizes from primary studies as a dependent variable in weighted regression analysis. The coded moderators were used as independent variables (Combs et al., 2019). The analyses for the traditional meta-analytic approach were conduct by packages of R (version 4.0.2) – Meta, Metafor, Metareg (Viechtbauer, 2010).

4. Results

Our first hypothesis predicted a negative effect of AFS on willingness to buy the product. We evaluated 54 effects from 16 different studies. The average effect of AFS on willingness to buy the product is D = - 1.09, $p < .01$ (CI_{95} = -1.44; -.73). So, this result confirms the arguments used to support the hypothesis H_1. Importantly, this main result showed higher level of heterogeneity since the Crochan's Q was significant (3093.47; $p < .001$) and I^2 was 98%. This heterogeneity could be explained by moderators, as presented in the next sections.

4.1. Cultural moderation analysis

The first possible moderator analyzed was cultural Hofstede's dimensions: (1) power distance; (2) individualism; (3) masculinity; (4) uncertainty avoidance; (5) long term orientation; (6) indulgence.

We found that four of the six cultural dimensions presented moderating influence on the relationship between AFS and willingness to buy the product. Countries with high level of power distance showed stronger effects than countries with low level ($D_{\_high}$ = -4.622; $D_{\_low}$ = -.808; $p < .01$). Another significant moderator was cultural masculinity orientation. In this case, the stronger effects between food shape and willingness to buy the product was stronger on countries with low level of masculinity than high level ($D_{\_high}$ = -1.542; $D_{\_low}$ = -5.446; $p < .001$). Accordingly, countries with low level of uncertainty avoidance produced stronger effects

on the relationship between AFS and willingness to buy the product than countries with high level of it ($D_{\_high}$ = .386; $D_{\_low}$ = -5.853; p < .001; respectively). The last significant cultural moderator was indulgence. The stronger effect was found in countries with high level of indulgence than whit low level ($D_{\_high}$ = -6.500; $D_{\_low}$ = -.799; p < .001; respectively). Thus, our results confirmed hypothesis H_{2a}, H_{2c}, H_{2d} and H_{2e}.

4.2. Economic moderation analysis

We also investigated the possible moderation effect of economies context in the country on the relationship between AFS and willingness to buy. The countries in the studies were coded by HDI index. By the median of the mentioned index, we identified studies from countries with low and high HDI. The analysis presented significant moderation effects (β = 4.507; p < .001). The negative effect between AFS and willingness to buy was stronger on countries with low than high HDI ($D_{\_low}$ = -.8081; $D_{\_high}$ = -5.332 p < .001; respectively), confirming hypothesis H3.

4.3. FSI moderation analysis

We also investigated the possible influence of Food Sustainability Index (FSI) by four dimensions: (1) food loss and waste; (2) food loss and (3) end user waste. About FSI moderators, our analysis identified that food loss and waste, and food loss presented a significant effect on the relationship between AFS and willingness to buy. On both cases, the stronger negative effect was found in countries with low (compare to high) ranking of FSI indicator (*food loss and waste*: $D_{\_high}$ = -.827; $D_{\_low}$ = -2.438 p < .05; *food loss*: $D_{\_high}$ = -.188; $D_{\_low}$ = -3.648; p < .001). So, our results confirmed hypothesis H_{4a} and H_{4b}.

4.4 Methodological moderation analysis

On the methodological moderation analysis, we investigated the possible influence of sample size (small *vs* large). We detected significant moderator effect for sample size (H_5). The negative effect between AFS and willingness to buy was stronger on studies with large samples than small samples ($D_{\_large}$ = -1.101; $D_{\_small}$ = -.405 p < .05; respectively).

5. Discussion and conclusions

This paper proposed a meta-analytic study to analyzed and consolidate the influence of effects of AFS on willingness to buy the product and possible moderators that could enhance or mitigate the direct relationship. In line with previous studies (Loebnitz et al., 2015; Grewal et al., 2018; Symmank et al., 2018), our findings demonstrated that consumers are less willing to by abnormally shaped food. In addition, our findings demonstrate that purchase intent for imperfect foods is influenced by other factors. That is, shape abnormality is only one criterion in food choice (de Hooge et al., 2016). The results from data analysis reveal that cultural (e.g., Hofstede's dimensions), environmental food system (e.g., FSI), methodological (sample type), and economic (e.g., HDI) variables have a significant impact on the relationship between AFS and consumer willingness to buy products with imperfect physical appearance.

About culture moderators, the level of power distance had a significant effect in the relationship between AFS and willingness to buy the product. The result is consistent with assumption that, typically, low power distance cultures tends to be present in societies with greater social inequality and may result in a lower requirement for aesthetic standards and a greater intention to purchase food with abnormal shape.

We did not find a significant effect of culture level of individualism on the relationship between AFS on willingness to buy the product. On the other hand, the culture level of masculinity had a significant effect in the above-mentioned relationship. As predicted, individuals in less male cultures are more willing to buy abnormally shaped food. This finding suggests that people in such culture tend to value environmental protection (Tsai et al., 2019) and consequently waste less food.

Correspondingly, the level of uncertainty avoidance culture had a significant moderating effect on the relationship between AFS and willingness to buy the product. This finding is in accordance with Choi and Geistfeld (2004), once the authors found that high levels of aversion to uncertainty can affect the consumers' perceived risk and ultimately the purchase intent. Additionally, the results of the research by Pelau et al. (2020) indicated that high levels of uncertainty aversion imply high levels of food waste in both fruit and vegetable categories. On the other hand, individuals in cultures with low levels of uncertainty aversion feel comfortable and accept changes more easily (Pelau et al., 2020), which leads us to infer that in such cultures there is a greater willingness to purchase abnormally shaped food.

In case of the long-term culture orientation, we found no significant moderating effect on the relationship between AFS on willingness to buy the product. The last culture moderator tested, indulgence, presented a significant effect. The result revealed that high indulgence promoted a stronger effect than low indulgence. According to our initial prediction, this finding suggests that positive emotions (such as happiness) related to indulgent culture, influence the intention to buy abnormally shaped foods. In support of this finding, Kim et al. (2020) state that emotions play a critical role in the systematics of consumer behavior, while Russel et al. (2017) suggest that emotions are decisive in the context of food waste.

Regarding economic context, we investigated the possible moderation effect of country economic context on the relationship between AFS and willingness to buy. We identified studies from countries with low and high HDI. The findings lead us to believe that consumers in cultures with low levels of human development have a lower income and therefore seek budget savings. In line with our findings, Cattaneo et al. (2020) revealed that in low-income countries food waste is higher. Correspondently, Chaboud and Moustier (2020) showed that the acceptance of substandard food is relatively high in low-income countries.

Concerning to the FSI moderators, our analysis identified that food loss and waste, and food loss presented a significant effect on the relationship between AFS and willingness to buy. However, the end-user waste index moderating effect was not significant. These results partially confirm our hypothesis. Specifically, as predicted, countries with higher rates of loss and waste, and loss configure less availability for the purchase of abnormally shaped foods. Fabi et al. (2020) addressed economic aspects related to food loss and waste, showing that, given the inherent complexity of the food chain, losses are the main concern in low-income countries, while waste seems to be the predominant concern in high-income countries.

Finally, we detected that sample size moderated the directed relationship. In this case, the effects were opposite to those expected, since the negative influence of AFS was strong in large samples studies.

5.1. Study limitation and future avenues

Our study presented some limitations. First, based on the nature of meta-analytic studies, our research only considerer quantitative and experimental results. So, other methodological settings could be useful to promote better knowledge about abnormally shaped food consumption, including qualitative data. Since we consider only the consumer purchase intentions investigation. Thus, other variables related to the topic (e.g., quality perception; value perception) could be tested in future meta-analysis.

Our study presented some moderators (e.g., cultural; economic; FSI) that have not been tested by primary studies. So, new avenues could be conducted to test some of these moderators by primary studies on different samples and countries. We also noted that the majority studies were cross-sectional data. Future studies could apply longitudinal studies. Eye-tracking and Face Reader could be interesting tools to obtain greater understanding and spontaneous responses about abnormally shaped food consumption.

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