Consumption of Bakery Products in Correlation with Selected Demographic Characteristics

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Abstract
The presented paper analyzes the consumption of consumers of bakery products based on a questionnaire survey. For these data, the chi-square test of independence was used to examine the relationship strength between qualitative variables, specifically whether there's any dependence between sex and the existence of dietary restriction. Also, the relationship between the frequency of consuming bakery products and the age of respondents. For both case scenarios, a relationship between the specified attributes was discovered. Subsequently, we examined, relative abundances of answers according to segmentation of consumers, while we found out the difference between classic consumer and consumer with alternative type of eating as vegan, paleo low carb, gluten free or diagnosed allergy, intolerance or other health problems related to consuming bakery products. The research is supported by the VEGA project: Challenges for food security in 21st century Europe - key factors, socio-economic and environmental contexts, no. VEGA 1/0755/21.

Keywords: bakery products, consumer behaviour, correspondence analysis, food market,

JEL Classification: C02, C12, C14

1. Introduction
According to Ashley, J.M. (2016) hunger, undernutrition, and food insecurity keep destitute people around the world from breaking the cycle of poverty in its broadest sense because they limit their ability to study, work, and care for themselves and their families. Progression of the poorest countries will continue to stay an unattainable goal if hunger and undernutrition persist, because they place a direct strain on these countries' economic and human potential, often from generation to generation. Development invariably entails improving the situation in terms of food security, which is critical in combating poverty.

Bread is only food known throughout the world, from the most developed towards the most primitive cultures, and it is on everyone's table in some form, said Elena P et al (2021).

Since bakery products are usually considered essential, research is focused on them and specifically on the consumption of bakery products by Slovak consumers.

According to Lopúchová, T. (2020), only half of the capacity of bakeries is used in Slovakia, and the use of this capacity depends mainly on the Slovak consumer. As the consumption of fresh bread in Slovakia is declining and its durability is rising, it is necessary to examine the reason for such consumer behavior.

Despite a lot of research dealing with consumer segmentation, such as research by Vigneau, E and Qannari E.M. (2002), or potato consumer research by Sharma, C. et al. (2020), it is necessary to address this issue in our territory, as with the correct segmentation of consumers of the products
and the subsequent targeting of marketing activities could contribute to the support of the Slovak market with the mentioned products.

Another fact is that the number of consumers with health restrictions in their diet is rising. It is for this reason that it is also necessary to analyze this reality and the product market itself for these consumers. These are special dietetic foods, respectively gluten-free or lactose-free/non-dairy bakery and cereal products. As Gómez M. (2021) said, gluten-free products are in high demand around the world because certain groups of people, that have now grown in recent decades, really must completely remove gluten from their diet. Gluten-free products are becoming increasingly popular among consumers who believe they are healthier. Even Hansen C et al (2022) stated that gluten-free diet may help prevent the development of type 1 diabetes, according to experimental and clinical evidence. According to Richardson et al (2022), the increased dietary restriction and request for testing are being driven by latest press attention to gluten and potential health advantages derived from removing it from the diet. According to Brites L, Schmiele M and Steel C (2018) Celiac disease is a genuine condition in today's society, with celiac patients taking account for about 1% of the population. The one and only treatment for those kind of people is to avoid gluten in their diet and lifestyle. As a result, bakery scientists have been busy creating and developing gluten-free options and a variety of bakery and pasta goods. Rajput M, Chauhan A, Makharia G (2022) said that because of the following factors, a shift in epidemiology and improved recognition of celiac disease has been possible. While diagnosing celiac disease used to be a time-consuming process, the availability of reliable serological tests has greatly simplified the criteria for a diagnosis. It was assumed that celiac disease only affected children, but it is now known that it affects people of all ages, including the elderly.

Padma Ishwarya S, Prabhasankar P (2014), in their research, addressed a probiotic approach to achieving a favorable environment in the human body by stimulating beneficial bacteria. Several food products act as substrates for the application of prebiotics and one of them is bakery products. The trend of increasing consumption of bakery products justifies the choice of their use as carriers for the supply of prebiotic compounds. In addition to health benefits, prebiotic compounds also have nutritional and technological effects in the food matrix. In addition to increasing fiber content, candidate prebiotics also affect the rheology and final quality of bakery products. Prebiotic compounds are selected to provide the final product with the desired properties. The health benefits of prebiotics, the technological benefits in bakery products such as bread and biscuits, and extruded products such as pasta are thoroughly discussed. Lluis Serra-Majem et al. (2007) in their study looked at the evaluation of eating habits in Spanish children and adolescents based on the Mediterranean Food Quality Index tool, which considers certain principles that support and call into question traditional healthy Mediterranean eating habits. Christoph Silow, Claudia Axel, Emanuele Zannini, Elke K. Arendt (2016) focused on salt reduction in bakery products. Bread and other cereal products contribute about 30% to the daily sodium intake of Westerners. Although it may sound simple, the reduction of salt in food is not so clear-cut, as salt affects the processability and quality properties of the final bakery products. Long-term strategies and revisions are needed to achieve the ultimate reduction targets. Several different techniques have been proposed for the reduction of sodium chloride. Other approaches include salt substitutions or enhancers. One promising strategy to reduce salt was to add sourdough to the pastry. The yeast can counteract some of the negative effects of salt reduction on bread, thus improving the overall quality. Fernando Rodriguez-Artalejo et al. (2007) tested the hypothesis that higher consumption of bakery products, sweetened soft drinks and yoghurts is associated with higher energy intake, saturated fats, sugars, and an overall poorer diet in Spanish children. This is a cross-sectional study involving 1112 children aged 6.0-7.0 years in four Spanish cities. Nutrition and food intake were obtained through a food frequency
questionnaire. The overall quality of the diet was calculated using the Healthy Eating Index (HEI).

2. Data and Methods

This paper presents calculations and results from pre-research. Given pre-research is part of dissertation research which is in progress. A questionnaire was used to collect data from quantitative research which was divided into 8 sections. First section was focused on respondent’s lifestyle, if they have any healthy dietary restriction. If respondent did not have any diagnoses, they continued into second section. Second section was about alternative type of eating like low carb, gluten free, paleo or vegan and we asked if their lifestyle and alternative type of eating affects their selection of bakery products. Then if they eat alternatively, they continued to third section, where we question focused on their consumer behavior for example frequency and quantity of specific bakery product. Fourth and fifth section was for respondents which have dietary restriction. We asked similar questions as respondents without dietary restrictions except for two questions. Sixth and seventh section was for respondents without diagnoses and also without alternative type of eating and we asked similar questions as others. Last section was focused on identification questions while obtaining anonymity.

Characteristics of survey respondents

The questionnaire survey had 57 respondents, with 26 men and 31 women. 8.77 percent of respondents were under the age of 18, 22.81 percent were between the ages of 18 and 24, 35.09 percent were between the ages of 25 and 49, 24.56 percent were between the ages of 50 and 64, and 8.77 percent were over the age of 65. The Nitra region received the most responses, while the Banská Bystrica and Bratislava regions received the fewest. Women aged 25-49 from the Nitra region were the most numerous group of respondents.

Chi-square test of independence

When testing associations, we determine whether there is a dependence between the given attributes, i.e., whether a given occurrence of a certain attribute X is likely to assume the occurrence of another attribute Y. When examining the dependence between the attributes we verify the following hypotheses:

Null hypothesis: Attributes are independent.

Alternative hypothesis: Attributes are dependent.

The test criterion is expressed by formula:

$$\chi^2 = \sum_{i=1}^{m} \sum_{j=1}^{r} \frac{(E-T)^2}{T}$$ (1)

where: m – number of rows, r – number of columns, n – total number of respondents, E - empirical frequency, T – theoretical frequency, $\chi^2$ – symbolizes the calculated test criterion.
We measured the intensity of the dependence using:

**Pearson’s coefficient**

\[ C = \sqrt{\frac{\chi^2}{n + \chi^2}} \]  
(2)

Where:

\( \chi^2 \) – symbolizes the calculated test criterion,

\( n \) – symbolizes total number of respondents.

The correlation coefficient can have a value between -1 and 1. If the correlation coefficient is equal to zero, it indicates there's no linear relationship between the variables under consideration.

For our case (2x2 table) the maximum of coefficient is 0.7, what means that values near 0 are weak dependence, values near 0.353 are medium strong and from 0.4 to 0.7 can be consider as there is a strong dependence.

**Cramer V coefficient**

\[ V = \sqrt{\frac{\chi^2}{n \min ((m, r) - 1)} } \]  
(3)

where: \( m \) – number of rows, \( r \) – number of columns, \( n \) – total number of respondents, \( \chi^2 \) – symbolizes the calculated test criterion.

The values of coefficient is <0;1>. That means values from 0 to 0.5 are weak, values around 0.5 are medium strong and values near one are consider for strong dependence.

**Correspondence analysis**

Correspondence analysis, also known as reciprocal averaging, is an effective data science visualization tool to determine and presenting the connection between categories. In presented paper was correspondence analysis used for presentation of relationship between frequency of consumption of bakery products and age of respondents.

For calculations were used software SAS and Microsoft Excel.

### 3. Results and Discussion

In the first section of the paper, we focused on determining the dependence, or independence, between the presence of dietary restriction and the gender of the consumers. **Table 1** presents the data input from the survey that was conducted in 2022, specifically the chi square estimation.

**Table 5 Calculation of chi square**

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>have</td>
<td>2,915</td>
<td>2,445</td>
<td></td>
</tr>
<tr>
<td>don’t have</td>
<td>1,239</td>
<td>1,039</td>
<td></td>
</tr>
</tbody>
</table>

Source: author’s calculations

The test characteristic was 7.638, with a critical value of 3.841 (for alpha = 0.05). Based on the findings, we can conclude that the presence of health dietary restrictions is statistically significantly related to the gender of the consumers (alpha = 0.01, critical value = 6.635). We can
affirm a weak dependence reaching the medium - strong dependence based on the coefficients evaluating the intensity of the dependence (Pearson's coefficient = 0.344, whereas the values for medium strong dependence = 0.353, Cramer's V coefficient = 0.369). Table 2 shows the data from the questionnaire survey from January and February 2022. In this section, we examined the relationship between the frequency of consumption of bakery products and the age of consumers.

Table 6 Calculation of chi square

<table>
<thead>
<tr>
<th>Age/Consumption</th>
<th>Sometimes</th>
<th>Regularly</th>
<th>Never</th>
<th>Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-17</td>
<td>0.385</td>
<td>0.422</td>
<td>0.263</td>
<td></td>
</tr>
<tr>
<td>18-24</td>
<td>0.009</td>
<td>0.030</td>
<td>0.684</td>
<td></td>
</tr>
<tr>
<td>25-49</td>
<td>0.254</td>
<td>0.506</td>
<td>1.053</td>
<td></td>
</tr>
<tr>
<td>50-64</td>
<td>1.566</td>
<td>1.190</td>
<td>0.094</td>
<td></td>
</tr>
<tr>
<td>65 and more</td>
<td>0.385</td>
<td>0.277</td>
<td>11.463</td>
<td></td>
</tr>
</tbody>
</table>

18,581

Source: author’s calculations

The test characteristic was 18.581, with a critical value of 15.507. Based on the findings, we can conclude that the frequency with which bakery products are consumed is statistically dependent on age of the consumers. We can affirm a medium strong dependence relying on the coefficients measuring the intensity of the dependence (Pearson's coefficient = 0.496, Cramer's V coefficient = 0.581).

Figure 2 Relation of consumption of bakery products to the age of respondents

Source: author’s calculations

As can be seen in Figure 1, Slovak respondents, in age from child to middle adulthood, consume bakery products regularly. Respondents in late adulthood according to answers from questionnaire survey consume less bakery product than younger consumers. Older respondents specifically respondents older than 65 years are more likely prone to minimal or none consumption of bakery products.
As the last part of presented paper we examined the degree of agreement with the statement according to the segmentation of consumers into three categories, namely the consumer with a voluntary alternative diet, the consumer with a dietary restriction and the traditional consumer. Slovak respondents were asked, if they agree with statement: “My main reason for consuming bakery products is that I consider bakery products as essential.” In the following figures can be seen relative abundances of degree of agreement. Respondents have choice to partially agree or partially disagree even if it seems to be the same answers. Partially agree is for respondents which more agree than disagree and partially disagree are for respondents which more disagree than agree.

\begin{figure}
\centering
\includegraphics[width=0.5\textwidth]{alternative.png}
\caption{Answers from respondents on the alternative type of diet}
\end{figure}

From Figure 3 we can state, that 50% of respondents with alternative type of eating partly or totally disagree and 50% partially agree but none of respondents answered that they totally agree.

\begin{figure}
\centering
\includegraphics[width=0.5\textwidth]{dietary restriction.png}
\caption{Answers from respondents with dietary restriction}
\end{figure}

From Figure 4 we can say that 40% totally or partially agree and 60% partially or totally disagree with statement.
The last segment of consumers of bakery products were classic or traditional consumers. Relative abundance of answers can be seen in Figure 4. 77% of respondents stated that they fully agree, resp. they partially agree that they consider bakery products as essential. Less than a quarter of respondents disagreed with presented statement.

4. Conclusion

Our intention, based on a questionnaire survey, was to analyze the relationship between the presence of health dietary restriction and the gender of consumers, in the next part we analyzed the relationship between the age of consumers and the frequency of consumption bakery products. In the subsequent section, using SAS software, according to the results from Figure 1, we found out that from child age to middle adulthood age there was a frequency of regular eating of bakery products. The reason may be the fact that, as is well known, Slovak consumers, from kindergartens to workers, usually have bakery products for breakfast or even for a snack. Respondents aged 50-65, which is consider as a late adult, eat less bakery products than younger ones. We believe that the reason is age awareness and the effort to start eating healthier. Another reason is that diagnosed food allergies, which cause restrictions on certain types of food (for our research, these are bakery products), are more common than a few years ago. In the last part of our research, we find out the respondents' opinions as to whether they consider a bakery product to be essential or not. Respondents were divided into three categories, namely voluntary alternative diet consumer, dietary consumer and traditional consumer. Based on the results, we can state that there are differences between the traditional consumer and the other two categories. The average consumer considers bakery products to be more necessary or essential than the other two categories. Other dependencies will be explored in the following research, which is part of the dissertation, but also part of the VEGA project: Challenges for food security in Europe in the 21st century - key factors, socio-economic and environmental contexts.
Acknowledgements

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