Calorie Labeling Impact on Consumers Who Understand Their Calorie Needs: A Cross-Sectional Study

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Abstract

Introduction: Saudi Arabia has an obesity prevalence of 38.96%, ranking 15th globally. The increasing prevalence of obesity has motivated Saudi Arabian health policymakers to develop national strategies to prevent or reduce the anticipated increase in cases. Therefore, the Food and Drug Authority has recently enacted compulsory calorie labeling on the menus of all food industry providers who provide food and drinks to consumers outside their homes. This study aimed to determine whether calorie labeling on fast-food restaurant menus helps consumers make informed decisions about their food consumption. **Methods:** This cross-sectional study conducted in Saudi Arabia between April and October 2022 employed a self-reported online survey to investigate the influence of caloric labeling on residents' food-ordering decisions and to determine the effects of the independent variables on calorie requirement knowledge. Participants included Arabic- and English-speaking adults residing in different regions of Saudi Arabia. Data collection utilized a river sampling technique, employing social media platforms for survey distribution. The inclusion criteria encompassed adult Saudi residents exposed to calorie labels, while those who did not encounter such labels were excluded. **Results:** This study aimed to examine the factors influencing individuals' food choices and their knowledge of daily calorie requirements. A social media advertisement was used to recruit 935 participants, with 760 included in the final analysis. Descriptive statistics revealed that the mean age of participants was 37.5 years, with 61.1% being female. Moreover, 59.3% reported having a college degree, and the mean monthly income was SAR 7,725. Logistic regression analysis demonstrated that knowing the daily calorie requirements significantly influenced food choices, with individuals who knew their calorie needs being four times more likely to use calorie labels when selecting food. However, other independent variables were found to be statistically insignificant. Additionally, age and citizenship status were significantly associated with knowledge of calorie requirements, with the 18–29 age group and Saudi Arabian citizens showing higher knowledge levels. **Discussion:** The findings of this study may catalyze further research aimed at measuring and understanding other variables that may impact consumer choices, such as pictures and font sizes, and understanding consumer knowledge and awareness of daily calorie requirements.

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Introduction

Obesity and weight gain are major public health concerns affecting millions of people worldwide and contributing to various ailments [1]. Since 1975, the global obesity prevalence has tripled; there were more than 650 million individuals with obesity in 2016 [2]. The trend of obesity and excessive weight gain has also impacted Saudi Arabia. Obesity in Saudi adults increased from 22% to 36% between 1993 and 2005 [3–5]. According to a recent study, the prevalence of obesity and overweight is 38.96% and 29.30%, respectively, in Saudi Arabia [6].

Increased intake of calories and energy-dense foods and physical inactivity are the primary causes of obesity and excessive weight gain [4]. The Saudi Arabian population has experienced a notable increase in eating out, primarily influenced by changing lifestyles and increased convenience, leading to a shift in food consumption patterns toward consuming meals away from home [7–9]. According to AlFaris et al. [7], fast-food consumption is common among adolescents and young adults, with 95.4% of adolescents and 79.1% of young adults consuming fast-food at least once a week. The consumption of food away from home is associated with increased caloric intake and a decline in nutritional quality [10], which is associated with an increased body mass index [11].

The increasing prevalence of obesity in Saudi Arabia has prompted health policymakers to develop national strategies to mitigate the expected increase in cases. The Ministry of Health, Ministry of Municipal and Rural Affairs, and Saudi Food and Drug Authority have made efforts to impose and amend policies to promote consumer health and safety. These efforts include levying a tax on energy and soft drink businesses, restricting specific foods and drinks from being served in school cafeterias, limiting partially hydrogenated oils, and implementing several interventions like the "Walk 30" intervention. In 2019, the Saudi Food and Drug Authority mandated caloric labeling on the menus of all food providers [12].

Various studies worldwide have assessed the effect of calorie labeling policies on consumer decisions across a range of settings, including restaurants, cafeterias, and cafes; the findings of these studies range from supporting to opposing the effectiveness of the policy [13–15]. Furthermore, many studies focused on college-aged students, adolescents, low-income neighborhoods/communities, and racial and ethnic minorities. Because studies focus on a specific group, meal, and time of day, various elements, such as the level of hunger or accessibility, may impact the findings, and the generalizability of their results is limited.

Saudi Arabia, known as the heart of the Arab and Islamic world, is currently undergoing massive reforms that have been implemented at different levels, including the health sector, and many countries are observing the success of these reforms in hopes of replication. However, few research studies have been conducted to verify the usefulness of calorie labeling on menus in reducing caloric consumption among Saudi residents. These investigations have also been limited to certain regions [16–18] or specific groups [19]. Therefore, the present study aimed to provide a better understanding of the influence of restaurant menu caloric labeling on residents' food consumption in Saudi Arabia through a self-reported online survey.

Materials and Methods

Study Design

This cross-sectional study was conducted in Saudi Arabia between April 2022 and October 2022. A self-reported online survey was conducted to understand the influence of restaurant and coffee shop menu caloric labeling on residents' food-ordering decisions in Saudi Arabia.

Study Site and Population

This study targeted residents from different regions of Saudi Arabia. The non-citizen population in Saudi Arabia comes from different cultures and backgrounds with different languages; therefore, data collection was limited to participants who speak Arabic, English, or both.

River sampling was performed to obtain a comprehensive sample of residents from different regions of Saudi Arabia. This method relied on collecting data from the population available for participation in the study through social media. The questionnaire was distributed online through social media (WhatsApp, Twitter, Facebook, Snapchat, Instagram, LinkedIn, and email).

Inclusion Criteria

Adult Saudi residents in different regions of Saudi Arabia who saw calorie labels on restaurant and coffee shop menus were included in this study.

Exclusion Criteria

Participants who did not see the calorie labels were excluded from this study.

Instruments

This study's aim was addressed using a self-reporting questionnaire (see Appendix) that included questions adapted from the National Health and Nutrition Examination Survey section/portion on menu label usage behaviors from the Eating and Activity in Adolescents and Young Adults Survey [20] and from a study that investigated the public's understanding of daily caloric recommendations and their perceptions of calorie posting in chain

restaurants [13]. Questions such as "What is your height in centimeters?", "What is your weight in kilogram?", "Do you know your calorie needs per day?", and "How did you use the calorie information in a restaurant when deciding what to order?" were used to measure and understand the usage of calorie labels among participants.

We translated the questions into Arabic to obtain a version that can be applied to citizens and non-citizens who speak Arabic. The survey was conducted using Qualtrics software for online participation and data collection. The survey was tested after modification and translation using a small pilot study to ensure the questions were understood and to assess the time it took to complete. This pilot survey was completed by 20 participants and took approximately 10 min to complete. Only one question required modification, whereas the remaining questions were straightforward.

At the end of April 2022, the survey link was distributed through social media available to the primary researcher (WhatsApp, Twitter, Facebook, Snapchat, Instagram, LinkedIn, and email). Advertisements were made on Twitter, Facebook, and Instagram to increase the number of participants.

Human Subjects and Ethical Considerations

A consent form was created following the requirements of the Institutional Review Board, and approval of the Institutional Review Board was obtained through the Jeddah Research Health Affairs for science and technology before the data were collected. Written informed consent was obtained from all participants. The survey contained no identifiable information and was only labeled with a serial number. The online survey was conducted securely without collecting respondents' IP addresses.

Variables

Demographics

Data on participants' general demographics were collected, including educational level, annual income, citizenship status, employment status, region of residence, and body mass index.

Knowledge of Calorie Needs

In the present study, the investigation of participants' knowledge of calories was a key focus. This knowledge was examined, measured, and analyzed based on the hypothesis that individuals with limited or no knowledge of calories would exhibit a decreased likelihood of perceiving, comprehending, and utilizing calorie labels, consequently having no impact on their food choices. To assess participants' knowledge of calorie needs per day, a self-report measure was employed. Specifically, participants were asked the question, "Do you know your calorie needs per day?". This inquiry served as a means to gauge their level of familiarity and understanding regarding the recommended daily caloric intake tailored to their individual physiological requirements. The answer to this question was collected using a dichotomous response format, where participants were presented with the options of "yes" and "no."

Calorie Label Usage

The aim of assessing the variable of calorie label usage was to determine participants' ability to utilize calorie label information when selecting food items. A direct question was asked: "Did you use the calorie information in deciding which foods to buy?". This inquiry aimed to ascertain whether participants relied on calorie information as a factor when making food choices. Participants provided dichotomous responses to the question with options of "yes" and "no."

Data Management and Analysis

The data were downloaded from Qualtrics as an Excel spreadsheet, and incomplete surveys were excluded. Data were analyzed using the IBM SPSS Statistics software 26 (IBM Corp., Armonk, NY, USA). Descriptive statistical analyses were performed after all variables were coded.

Logistic regression analyses were performed to examine the effectiveness of calorie labeling in restaurants and coffee shop menus in reducing high-calorie food consumption among Saudi residents. Statistical significance was set at $p < 0.05$.

Results

Data analysis was conducted after identifying and eliminating outliers. The assumptions for logistic regression were evaluated, and no issues were detected. Furthermore, multicollinearity among the independent variables was assessed using variance inflation factors. Notably, no variance inflation factor values exceeding 10 were observed, indicating the absence of multicollinearity problems.

A social media advertisement was made between April and October 2022 to recruit participants. The survey link was distributed using social media outlets, and participants were encouraged to begin the survey through Qualtrics. After applying the selection criteria, 760 of the 935 respondents were included in the analysis.

Sample Demographics: Descriptive

Table 1 summarizes the descriptive statistics and participant characteristics. The final sample included 760 participants; their mean age was 37.5 years (standard [SD] ± 9.8), and 61.1% were female. Overall, 59.3% of the participants reported having a college degree. In addition, 14.8%, 22.4%, and 3.6% reported having a graduate degree, high school, or equivalent education, and less than a high school education, respectively. The mean monthly income of the study participants was SAR 7,725 (SD ± 10,142) per year. We divided the participants into two categories according to income: SAR 4,000 (51.6%) and ≤SAR 4,000 (49.4%). Notably, most participants (58.0%) reported being Saudi citizens. The proportion of employed individuals was 74.1%. In addition, 7.4% of the participants were students, 2.4% were retired, and 16.2% were unemployed. The participants were divided into four groups according to body mass index: underweight (3.7%), healthy weight (34.5%),
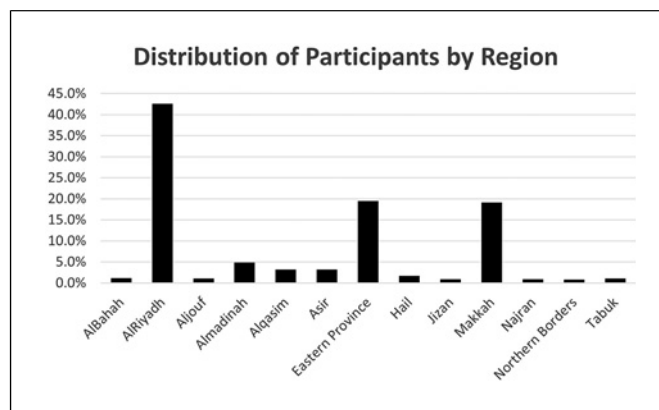
Table 1. Sociodemographic characteristics of study participants

Variable	Count	%
Sex		
Male	296	38.9
Female	464	61.1
Age		
18–29	158	20.8
30–39	310	40.8
40–49	188	24.7
50 and above	104	13.7
Citizenship status		
Non-Saudi	319	42.0
Saudi	441	58.0
Education status		
Less than high school	27	3.6
High school degree or equivalent	170	22.4
Undergraduate degree	450	59.3
Graduate degree	112	14.8
Employment status		
Unemployed	123	16.2
Employed	563	74.1
Student	56	7.4
Retired	18	2.4
Income level		
SAR 4,000 and less	392	51.6
Above 4,000	368	48.4
BMI group		
Underweight	28	3.7
Healthy weight	262	34.5
Overweight	269	35.4
Obesity	201	26.4
Knowledge of calorie needs		
No	362	47.6
Yes	398	52.4
Calorie label Usage		
No	322	42.4
Yes	438	57.6

Total number of participants included in the study ($n = 760$).

Fig. 1. The distribution of data samples across various regions in Saudi Arabia is illustrated.

as adjusted odds ratios with 95% confidence intervals, and statistical significance was set at a p value of 0.05. According to the model, 14.7% of the variance in reliance on calorie information occurred when the model could explain choosing foods, and 66.4% of the cases were classified correctly. The Hosmer-Lemeshow goodness-of-fit test indicated a non-significant p value of 0.38, indicating a good fit to the data.

In the final multivariate logistic regression analysis, the relationship between knowing the number of calories needed daily and choosing food was statistically significant ($p < 0.05$). However, other independent variables were statistically insignificant.

Results showed that people who knew how many calories they needed were approximately four times (adjusted odds ratios: 3.84, 95% confidence intervals: 2.77–5.32) more likely to use calorie labels when choosing food than those who did not know how many calories they needed. The remaining variables (Table 2) were insignificant.

Based on these results, we proposed another multivariate logistic regression analysis to determine the effects of the independent variables on calorie requirement knowledge, as shown in Table 3. The second model explained 15.5% (Nagelkerke R2) of the variance in correctly classifying 65.6% of the cases. The Hosmer-Lemeshow goodness-of-fit test indicated a non-significant p value of 0.25, suggesting that the model fits the data well.

The association of age and citizenship status with knowledge of daily calorie requirements was statistically significant ($p < 0.05$). However, other independent variables were statistically insignificant. The age group of 18–29 years was almost twice as likely to know their calorie requirements as the age groups of 30–39 and

overweight (35.4%), and obese (26.4%). The percentage of respondents aware of their daily calorie requirements was 52.4%. According to the survey, 57.6% of the respondents relied on calorie information when making food choices. Figure 1 shows that approximately 82% of the sample came from three regions: the Riyadh region (42.6%), the Eastern Province (19.5%), and the Makkah region (19.1%).

Regression Result

Table 2 shows the results of the final multivariate logistic regression model used to ascertain the effects of the independent variables on the participants' choice of food. The logistic regression analysis presented the results

Table 2. Multivariate logistic regression model used to ascertain the effects of the independent variables on the participants' choice of food

Variable	p values	AOR	95% CI for EXP(B)	
			lower	upper
Sex				
Male				
Female	0.391	1.156	0.830	1.612
Age				
18–29				
30–39	0.156	1.387	0.883	2.177
40–49	0.757	1.083	0.652	1.799
50 and above	0.641	0.863	0.466	1.601
Citizenship status				
Non-Saudis				
Saudis	0.362	0.827	0.551	1.243
Education status				
Less than high school				
High school degree or equivalent	0.252	1.681	0.691	4.088
Undergraduate degree	0.171	1.829	0.770	4.344
Graduate degree	0.173	1.943	0.748	5.048
Employment status				
Unemployed				
Employed	0.658	0.897	0.554	1.452
Student	0.836	1.081	0.516	2.267
Retired	0.608	1.356	0.424	4.343
Income level				
SAR 4,000 and less				
Above SAR 4,000	0.983	1.004	0.674	1.496
BMI group				
Underweight				
Healthy weight	0.234	0.586	0.243	1.414
Overweight	0.423	0.696	0.286	1.690
Obesity	0.446	0.706	0.289	1.727
Knowledge of calorie needs				
No				
Yes	<0.001	3.836	2.767	5.319
Constant	0.385	0.562		

Total number of participants included in the study ($n = 760$). *Statistically significant at $p < 0.05$.

40–49 years. In addition, those aged 18–29 years were approximately five times more likely to know their calorie requirements than those aged ≥50 years. Saudi Arabian citizens know their daily calorie requirements almost twice as much as non-citizens.

Discussion

The present study assessed the influence of calorie labels on food menus on residents' food-ordering decisions in Saudi Arabia and the factors that could contribute to this decision. Therefore, the results of the present study offer insights into the effectiveness of Saudi Arabia's new calorie labeling policy, which was introduced on January 1, 2019. In addition, the present study can help inform healthcare policymakers about the barriers and factors that hinder people from choosing foods that are not calorie dense.

The average age of participants was 37.5 years, >60% were female, and approximately 60% had a college degree. Saudi participants accounted for 58% of the sample, and 74% were employed. Approximately 62% of the participants presented with either overweight or obesity, which matched the current prevalence of obesity in the country.

Table 3. Multivariate logistic regression analysis to determine the effects of the independent variables on knowledge of calorie needs

Variable	p values	AOR	95% CI for EXP(B)	
			lower	upper
Sex				
Male				
Female	0.784	0.955	0.686	1.329
Age				
18–29				
30–39	0.014	0.570	0.364	0.891
40–49	0.021	0.553	0.334	0.916
50 and above	<0.001	0.244	0.130	0.459
Citizenship status				
Non-Saudis				
Saudis	0.021	1.582	1.072	2.335
Education status				
Less than high school				
High school degree or equivalent	0.038	0.400	0.169	0.949
Undergrad degree	0.073	0.464	0.200	1.073
Graduate Degree	0.417	1.484	0.572	3.851
Employment status				
Unemployed				
Employed	0.718	0.917	0.575	1.463
Student	0.974	1.012	0.490	2.093
Retired	0.298	1.807	0.593	5.505
Income level				
SAR 4,000 and less				
Above SAR 4,000	0.129	1.351	0.916	1.992
BMI group				
Underweight				
Healthy weight	0.711	0.851	0.363	1.998
Overweight	0.619	1.243	0.526	2.939
Obesity	0.872	1.074	0.450	2.562
Constant	0.152	2.478		

Our survey results showed that 52.4% of the respondents knew their daily calorie requirements. According to the survey, 57.6% of the respondents made food decisions based on calorie information, which is consistent with the result of a study by Alassaf et al. in Saudi Arabia, showing that 50% of the participants knew their average daily caloric intake and changed their order according to the calorie count display [17].

The present study found that people aware of their calorie needs were approximately four times more likely to use calorie labels while making food choices than those unaware. Although knowledge seemed to play a role in consumer's food choices and decisions, it is important to note that other factors, such as pricing, packaging and labels, salience, and internal factors, could also affect this relationship [21].

Participants aged 18–29 were almost twice as likely to know their calorie requirements as those aged 30–39 and 40–49 years. The younger-aged population also had a substantially higher chance of knowing their calorie requirements than those aged >50 years. This result could be explained by the fact that the younger generation is more educated and more exposed to social media, where most health education campaigns are conducted. Consequently, they may utilize web and mobile applications to calculate their caloric requirements.

Notably, Saudi Arabian citizens knew their daily calorie requirements almost twice as much as non-citizens; this may be due to some menus and calorie information being available in only one language and educational campaigns mainly targeting Saudi citizens rather than all Saudi residents.

Strengths
This study had some strengths. First is the large sample size and the inclusion of participants from various demographic backgrounds. Second, this study contributes to understanding how calorie labeling affects consumer behavior when ordering food.

Limitations

The study had some limitations. First is the sampling method, as river sampling through social media platforms was used. Therefore, it is difficult to generalize these results. In addition, the study introduces some bias because the sociodemographic data might not reflect the proportional structure of the entire population as people who do not use social media will not have the chance to access the survey. However, the sampling method provided valuable insights into the role of the calorie labeling policy in food choice when ordering from restaurants or coffee shops.

Third, while the knowledge theory of consumer behavior suggests that individuals make informed decisions based on their knowledge, it is important to recognize that other factors, such as personal preferences, social influences, and marketing strategies, can also significantly impact consumer choices. Therefore, the influence of calorie knowledge on actual behavior may be more complex than initially anticipated.

Fourth, although calorie labels aim to provide consumers with valuable information about the nutritional content of food products, they may have certain limitations. For instance, individuals may interpret calorie information differently based on their personal understanding or dietary goals. Additionally, some studies have suggested that individuals may underestimate or overestimate the calorie content of certain foods, leading to potential inaccuracies in their decision-making process.

Lastly, this study involved a self-reported survey; therefore, the reported parameters may not reflect the actual parameters as participants may overestimate or underestimate their weight and height, affecting their body mass index calculation. In addition, recall bias may be introduced because the survey questions ask participants to recall information from the past 3 months. This bias will be greater in participants who order food less frequently. Therefore, further studies are required to survey the participants immediately after ordering from restaurants or food applications.

Conclusion

This study evaluated the efficacy of the labeling policy in achieving its goals and provided an understanding of its effectiveness. This understanding will help policymakers decide what changes can be made to improve current policies. One of the most important takeaways from this research was the significance of being aware of calories and how they can affect one's eating choices. As a result, this study sheds light on how to enhance the efficiency of future programs by integrating educational initiatives with labeling-based approaches.

The present study might trigger further research to comprehensively measure and understand other variables that may impact consumer choices, such as pictures and font size, and to learn more about consumer knowledge and awareness of daily calorie needs. In the present study, 50% of the participants lacked knowledge of their daily caloric needs. Labeling foods with their calorie content is important, but we also need more comprehensive rules that take into account a more nuanced understanding of obesity. Policymakers have the option to augment calorie labels by including additional information, such as the recommended daily caloric intake. Establishing a direct association between the energy content of food and physical activity for consumers may potentially mitigate obesity. This approach empowers consumers to effectively situate their food choices within a broader context. All papers must contain the following statements after the main body of the text and before the reference list.

Statement of Ethics

This study protocol was reviewed and approved by the Jeddah Research Health Affairs for science and technology, approval number A01597. Informed consent to participate was not directly obtained but inferred by completion of the questionnaire.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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No source of funding was provided.

Author Contributions

Mutlaq Albugmi, Nouf Alsaheil, and Zahra Alahmed made substantial contributions to the development of the idea and study design, collected the data, performed the analysis and interpretation, and worked equally in drafting and revising the manuscript for final approval.

Data Availability Statement

The data that support the findings of this study are not publicly available due to their containing information that could compromise the privacy of research participants but are available from the corresponding author M.A. albugmi.m@gmail.com upon reasonable request.

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