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Health consideration in food consumption: impacts of education level and custom rules adherence

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ABSTRACT

Individual attributes, such as educational background, may influence the degree of health consideration in food consumption. The local social norms may affect the same consideration in the collective level. Represented by education level and the custom rules adherence in food choosing behavior, this study aimed to examine how knowledge influences health consideration in food consumption and how the local social norms moderate this association in a multicultural enriched society. By utilizing the Bayesian Mindsponge Framework (BMF) as a conceptual framework, this study analyzed a dataset of 710 urban residents in Indonesia. There was a negative association between education level and health consideration in food consumption in which the custom rules adherence in food choosing behavior moderated against this negative association. For those with a low level of custom-based food consumption, their health consideration is lower as they have higher education level. However, the opposite trend which is a more intuitive positive association was found in those who consume more custom-based food. Socio-cultural factors have a complex impact on food choosing behavior among Indonesian urban residents. Therefore, governmental policies in the health promotion campaign of healthy-nutritious food should incorporate socio-cultural aspects with a deeper understanding of the human mind's information processing.

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1. INTRODUCTION

Health is an important aspect for people in choosing their daily foods. People usually take health as one of their motives in choosing foods, whether it will be functional/conventional or organic food choices. Factors influencing individual dietary practices are complex, but the social context of health is one of them [1]. The general knowledge levels, such as education level, and local social norms, such as custom-based food choices, may play a role in influencing people to take health as a crucial aspect in choosing their foods, in terms of organic and functional foods. Individuals' different understandings of healthy diet may influence their food choices [2].

There are challenges in healthy food choices. Sometimes, more nutritious food relates to higher price tags. Low socio-economic status households do not have enough money to spend on healthful food products because they cost more in the supermarket and take more time to prepare, so low-income

households are potentially priced out of purchasing these food products [3]. Therefore, health and price competitively challenge people to choose functional or organic food daily. Functional food consumption is an adjustment to lifestyle, while healthy lifestyle influences food consumption, especially the organic one [2]. The health consideration boosts people to choose organic food, but lower price tags encourage people to compromise with healthy food choice. People who eat organic food are mostly have a healthier lifestyle, and they can reduce the risk of allergy, overweight, and obesity, while consumers of conventional food tend to be exposed to higher amounts of pesticides, which may negatively influence cognitive development at some levels of exposures [4]. Due to its adverse health effects, taxing unhealthy foods or subsidizing healthy foods need to be considered.

Indonesia is a multicultural country. Located in South East Asia, Indonesia is the biggest archipelago country in the world with its enormous geographic and cultural diversity across the archipelagos [5]. Indonesia is experiencing a fast nutrition transition currently—a shift in food consumption related to globalization, modernization, urbanization, and economic development, with potentially adverse impacts on diets, health, and the environment [6]. In a country experiencing a rapid nutrition transition like Indonesia, then culture, food environment, and food choosing behavior are crucial for ensuring dietary shifts successfulness, together with context, socioeconomic status, attitudes, beliefs, and perceptions [7]. Education level may influence food choices, especially in Indonesian urban residents [8], describing the dynamics of combination between rationality in economic values and the cultural values [9]. This study concentrates on the knowledge levels represented by education level and the local social norms represented by the adherence to custom rules in food choosing behavior. These two variables have a potency to influence the degree of health consideration in food consumption. A low education level correlates with a certain diet pattern, such as high carbohydrates, sweets, and red meats, but low fiber; while a high education level correlates with more consumption of fruits, vegetables, and fish [10]. Education level which is opposed to income levels or supermarket access determines food preferences. A study in the United States of 100,000 households in 2006-2011 showed that the higher the education level of a household, the healthier the foods its members buy [3]. Regarding local social norms, they are situated among other sustainable food choice motives. Social norms are categorized into descriptive and injunctive norms. Perception of the descriptive norms correlates significantly with food choices, in terms of actual and the intended one. Perception of injunctive social norms has insignificant correlation with food choices. A study on 348 adults in Helsinki, Finland, found that the impact of descriptive norms' perception is weaker compared to habit, visual appeal, monetary value, and ability to satiate hunger. Taste is the one and only variable showing a more substantial impact on food choices compared to the descriptive norms' perception [11].

The theory of health literacy is the major theory used to explain the connection between health and food. Nutbeam's tripartite model of health literacy may be used to explore the competencies that are likely to facilitate health and food relationships [1]. Education level and customs which are influenced by tradition or culture have the potency to influence individuals in choosing their foods. Currently, the theory of health literacy is not sufficient to explain the mechanism of how general knowledge levels and local social norms influence the degree of health consideration in food consumption. The human mind's information-processing theory can help complement this gap. By utilizing the mindsponge theory (MT) as the theoretical foundation of this study, we aimed at: i) examining how education level influences health consideration degree in food consumption, and ii) examining how the degree of adherence to custom rules in food-choosing behavior moderates the above possible association.

2. METHOD

2.1. Theoretical foundation

This study utilized MT, an information-processing theory of the human mind, as the theoretical basis [12]. MT helps explain and adress the complex psychological phenomena and behavioral problems, especially due to their temporal dimension related to the information process influencing the natural updates of human thinking and society [13]. For instance, MT was used to distinguish the domestic from international students in how they perceive the difficulties of adjusting to new foods [14]. According to MT, the human mind tries to optimize the perceived value of new information regardless of its objective values. Perceptions of food health values are crucial for determining an individual's dietary choices and adaptation [14]. Health perception or beliefs on food health values, and food choice factors e.g. motives and eating behavior, can predict healthy diet consumption [15]. There are many inputs available in the infosphere or environment, so that there are many potential factors which may influence the health consideration in food consumption. We hypothesize that education level is associated with health consideration in food consumption and the adherence to custom rules moderates this association.

Indonesian sets culture as the basic foundation in not only food consumption among households, but also health and monetary value considerations [8]. Religious rules and customary traditions recommend food choices in the Indonesian majority. Religion specifies eating habits through a variety of laws, symbols, and meanings which may further subject individuals to dietary restrictions based on their age, sex, or social standing, and there is substantial intra-cultural variation in these restrictions [16]. In the other hand, education level emphasizes the importance of individual cognition in food choice, together with social and contextual factors [17]. The education level influences food choices, further emphasizing economic rationality dynamics and cultural values of individuals [8], [9]. Thus, education may associate closer with custom or cultural values than food choosing behavior. The adherence to custom rules in food choosing behavior has a potency to moderate the association between education level and the adherence to custom rules in food choosing behavior.

2.2. Study framework

Bayesian Mindsponge Framework (BMF) was used as an analytical framework. MT is highly compatible with Bayesian statistical analysis, which is helpful in conducting BMF analytics. This analytical framework combines the inferential advantages of Bayesian analysis and the conceptual formulation power of the mindsponge mechanism from MT [13]. Bayesian inference treats all the known and unknown properties probabilistically [18], enabling reliable prediction of parsimonious models. Thus, constructing a parsimonious model is the first and key step in performing BMF analytics. Bayesian analysis still deals effectively with various intricate models, such as the nonlinear or multilevel regression frameworks, even under the utilization of the Markov chain Monte Carlo (MCMC) technique. In comparison to the frequentist approach which solely relying on the p-values in results' interpretation, Bayesian inference has more advantages because it is able to utilize the credible intervals in interpreting the results [19], [20]. In the previous study, BMF analytics were used to examine how international students process and adapt to new food experiences in a different cultural environment [14]. In this study, BMF and its analytics were employed to achieve two study objectives as mentioned in the end of introduction section.

2.3. Material

This secondary study utilized a dataset on food consumption of 710 respondents in five major Indonesian cities [8]. The five cities were Jakarta (n=174) representing Betawi ethnic, Bandung (n=150) representing Sunda ethnic, Surabaya (n=118) representing Java ethnic, Makassar (n=120) representing Bugis ethnic, and Denpasar (n=148) representing Bali ethnic. Samples were enrolled by mean of stratified random sampling based on social class. Demography characteristics of study respondents are as: i) average age was 41.3 years old, ii) 57.9% were females, iii) 60.1% were Moslems, and iv) 40.7% were Javanese. As for education level, the majority was high school graduates (25.5%) and the rest had diploma, bachelor, and post-graduate degree.

Data collection of urban society food consumption included field surveys by face to face interview assisted by local enumerators with prior informed consent. The instrument was developed based on indicators of cultural aspects of food consumption at the household level [21]. The questionnaire consisted of 28 items which was divided into five parts, namely: A) general information, B) demographic information, C) income and expenditure information, D) control questions (health or price priority consideration in food choosing behavior), and E) cultural aspect of food consumption. Part D and E were assessed by a 5-point Likert scale ranging from strongly disagree (score 1) to strongly agree (score 5) to differentiate individual responses. We chose three variables among 28 available variables based on the number of items in the questionnaire, namely: *Health* as the dependent variable of health consideration in food consumption (part D: item 16), *Education* as the independent variable of education level (part B: item 7), and *CustomRules* as the moderating variable of custom rules adherence in food choosing behavior (part E: item 18). Table 1 explains about the three selected variables to be analyzed in this study.

2.4. Model construction

The model construction based on the mindsponge-based study conceptualization is the key step of implementing the BMF method, making this method unique and innovative [13]. It is advantageous in BMF analytics, both conceptually and technically, to construct a parsimonious model that gives MCMC algorithms-aided Bayesian analysis higher predictive accuracy [22]. Based on MT reasoning, we constructed the analytical model as:

$$\begin{gathered} Health \sim normal(\mu, \sigma) \\ \mu_i = \beta_0 + \beta_{Education} * Education_i + \beta_{CustomRules*Education} * CustomRules_i * Education_i \\ \beta \sim normal(M, S) \end{gathered} \quad (1)$$

The probability around μ is determined by the form of normal distribution, with the standard deviation σ. The degree of health consideration in food consumption of respondent i's family is indicated by μ_i. $Education_i$ is the highest education level of respondent i and $CustomRules_i$ is respondent i's degree of custom-based food consumption. The model has an intercept β_0 and coefficients $\beta_{Education}$ and $\beta_{CustomRules*Education}$. The probability around β is also in the form of normal distribution. The logical network of the analytical model is displayed in Figure 1.

2.5. Data analysis

Following BMF analytics and Bayesian analysis protocols, we conducted Bayesian analysis aided with MCMC algorithms which may increase the predicting power and accuracy of Bayesian inference by iteratively generating large samples of serially correlated parameters [13], [23]. Bayesian inference treats all properties probabilistically, including unknown parameters, which helps increase the predicting power when constructing a parsimonious model [18]. For Bayesian analysis, examining parameters' credible range with the highest occurrence probability helps increase the result interpretation accuracy without compromising statistical integrity. Uninformative prior is used to reduce subjective influences in the estimation due to the exploratory nature of the study. The MCMC setup is as: 5,000 iterations with 2,000 warm-up iterations and 4 chains.

To check whether simulated data fit the real data, the goodness-of-fit of the analytical model is validated using Pareto-smoothed importance sampling leave-one-out (PSIS-LOO) diagnostics [24], [25]. LOO is computed as follows:

$$LOO = -2LPPD_{loo} = -2\sum_{i=1}^{n} \log \int (y_i|\theta)_{post(-i)}(\theta)d\theta \quad (2)$$

$p_{po(-i)}(\theta)$ refers to the posterior distribution based on the data minus data point i. In computing the LOO cross-validation, the k-Pareto values are employed in the PSIS method to help identifying the observations with a high degree of influence on the PSIS estimate. When the k values are below 0.5 then a model is considered fit commonly. To accurately estimate the LOO cross-validation, the k values are recommended to be no more than 0.7. The greater value is often considered as influential and problematic for estimation.

To check whether the iterative samples in a Markov chain are independent, we use the Gelman-Rubin shrink factor (*Rhat* value) and the effective sample size (*n_eff* value) as indicators. The *Rhat* value shows the convergence of iterative simulations and should equal 1, while the *n_eff* value indicates the number of non-autocorrelated iterative samples during the stochastic simulation process and should be above 1000 for reliable inference [26]. The Bayesian analysis was conducted on R using the bayesvl open-access package, which provides good visualization capabilities [27]. To support the data tranparency enabling public evaluation and reuse, and also lower the cost of data reproduction, we deposited all data and code snippets of this study onto an Open Science Framework (OSF) server: https://osf.io/ydknb/.

Table 1. Variable description

Variable	Definition	Data type	Value
Health	Whether the principle of health is a major consideration in the family's consumption patterns	Numerical	1: strongly disagree 2: disagree 3: neither agree nor disagree 4: agree 5: strongly agree
Education	The respondent's highest education level	Numerical	1: Primary school or below 2: Junior high school 3: Senior high school 4: Diploma (college) 5: Bachelor's degree 6: Master's or Doctoral degree
CustomRules	Whether the principle of tradition/customs becomes the main consideration in choosing the type of food for family's consumption	Numerical	1: strongly disagree 2: disagree 3: neither agree nor disagree 4: agree 5: strongly agree

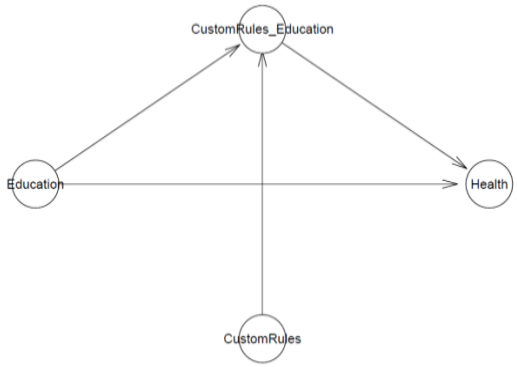

Figure 1. The analytical model's logical network

3. RESULTS AND DISCUSSION

The latest model fitting run was on June 28, 2023, R version 4.2.1, Windows 11. The total elapsed time was 85.4 seconds. PSIS-LOO diagnostics as shown in Figure 2 shows that all *k* values are below the threshold of 0.5, indicating that the simulated data fit well with the real data. Table 2 shows the estimated posteriors of the analytical model's parameters. All *n_eff* values are above 1000 and all *Rhat* values equal to 1 which shows that the model is convergent.

Table 2 shows a linear relationship. *Education* is negatively associated with *Health* ($M_{Education} = -0.49$ and $SD_{Education} = 0.04$). However, we need to consider the interaction between *Education* and *CustomRules*. *CustomRules_Education* was found to have a positive association with *Health* ($M_{CustomRules\_Education} = 0.15$ and $SD_{CustomRules\_Education} = 0.01$). This means *CustomRules* moderates against the negative association between *Education* and *Health*. To elaborate, for those with a low level of custom-based food consumption, their health consideration is lower as they have higher education level. However, a more intuitive positive association between *Education* and *Health* (the opposite trend) is found in those who consume more custom-based foods. Figure 3 shows the posterior distribution with Highest Posterior Density Intervals (HPDIs) at 90%. The found effects are clear, which suggests that the results are reliable. The convergence of the Markov chains is also validated through the trace plots as shown in Figure 4, which show that the chains fluctuate around central equilibriums after the warm-up period. The Gelman-Rubin-Brooks plots as presented in Figure 5 show that *Rhat* values drop to 1 during the warm-up period. The autocorrelation plots as shown in Figure 6 show that autocorrelation is eliminated after a finite number of lags.

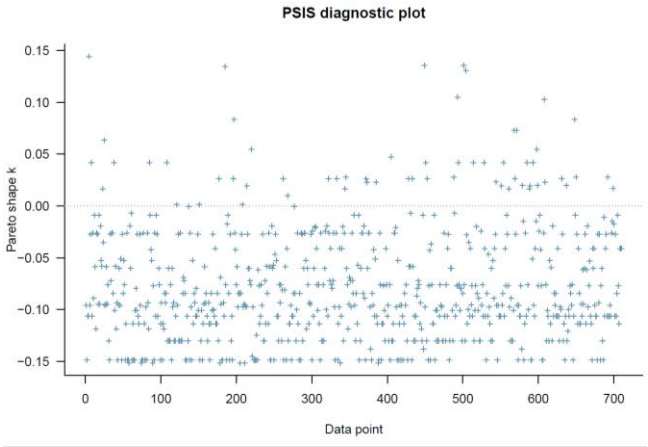

Figure 2. PSIS-LOO diagnostic plot for the model

Table 2. Estimated posteriors

Parameters	Mean	SD	n_eff	Rhat
Constant	3.26	0.11	6,441	1
Education	-0.49	0.04	5,273	1
CustomRules_Education	0.15	0.01	6,220	1

To aid result interpretation, Figure 7 illustrates the estimated outcomes across situations based on posterior coefficients (using Mean values for computation due to the highest probability of occurrence). The *y*-axis represents the health consideration degree in food consumption, the *x*-axis represents the education level, and the line color represents the degree of consuming custom-based food products.

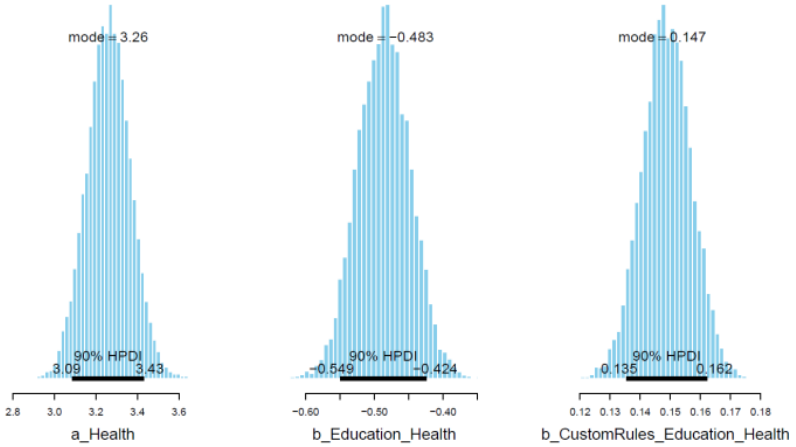

Figure 3. Posterior coefficients distributions

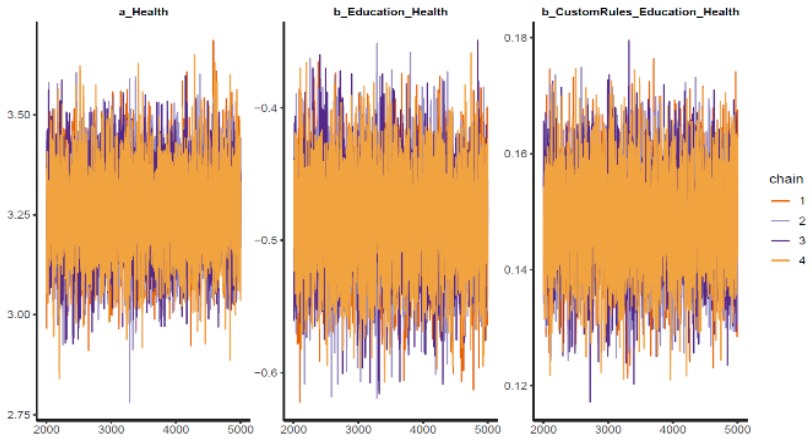

Figure 4. Trace plots for the model (x-axis = iterations; y-axis = posterior means)

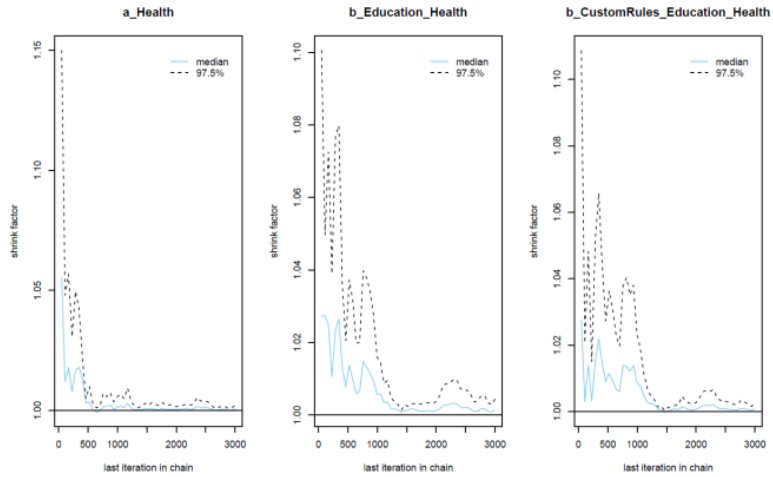

Figure 5. Gelman-Rubin-Brooks plots for the model

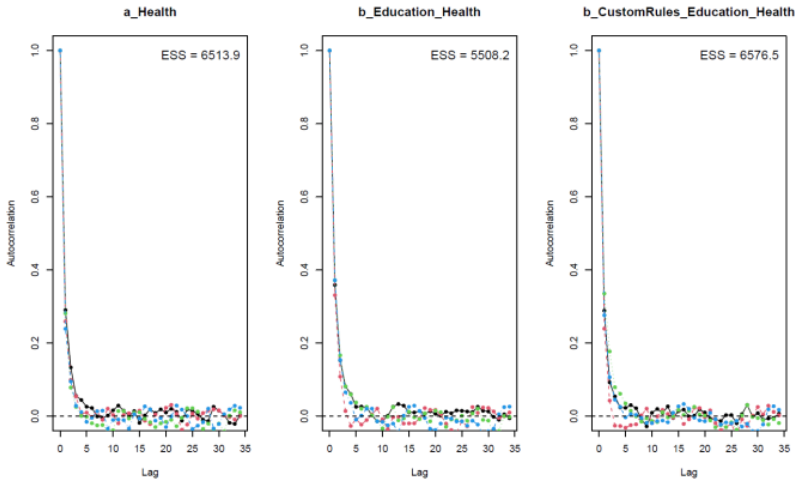

Figure 6. Autocorrelation plots for the model

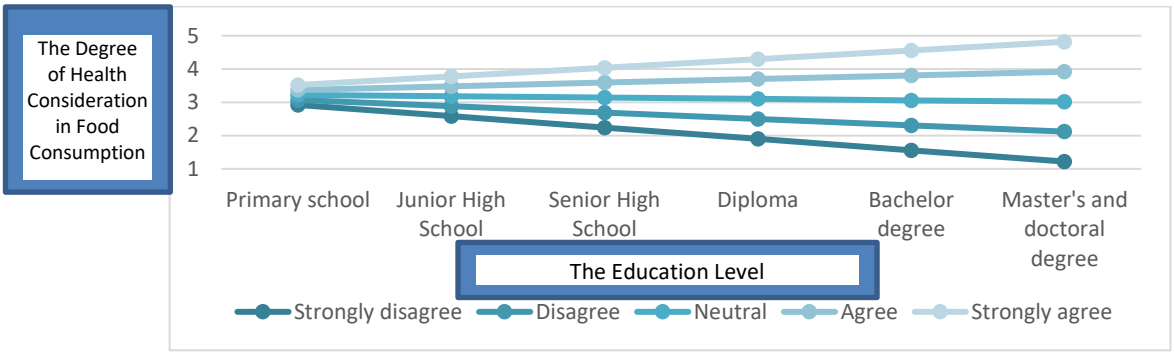

Figure 7. Estimated health consideration degree in food choosing behavior

The individual food consumption is more influenced by personal preferences compared to social influences, such as education level and the psychological processes of information processing, learning, attitude and behavior [28]. Food choice is defined as a decision-making process whereby individuals consider, acquire, prepare, distribute, and consume foods and beverages which is dynamic, distinct, and unique eating activities [29], [30]. It is also a complex set of drivers that vary among individuals and depend on culture, habit, taste, social and environmental factors [31]. Specifically in urban residents, empirical study has found that: i) family influence, ii) cultural perception i.e. beliefs related to health consideration in food choosing behavior, seasonality, and hometown food, iii) convenience i.e. decisions of food procurement, cooking time constraint, situational eating, and iv) habit i.e. subconscious decisions and food roots being the food choice drivers [32].

Our study supports the argument that decision-making needs sufficient information as inputs for evaluation at the individual and collective levels. Food consumption starts by a decision making process incorporated in food choosing behavior which is highly influenced by culture, custom, and environment [29], [31]. Aspects of food decision making include family preferences, habits, perceptions, convenience, and food safety-health [28]. Human behavior e.g. food choosing behavior is meaningful only when considering the sociocultural context of the individuals and how they have internalized a particular culture's qualities [33]. Individual values, personal preferences, and cultural values attached to someone determine his food choosing behavior [34]. Therefore, variations in food choosing behavior is influenced by sociocultural forces.

Culture is a kind of social heritage making us similar with a group of people and yet different from the majority of people in the world [35]. Food and feeding habits being one among the ten categories of culture characteristics [36]. Food has many symbolic meanings, making it becomes an important component of a society. In our society, food is a mean of establishing and expressing relationship between humans [37]. Culture influences food choice [17], and food practices enable the contruction and maintenance of cultural identities [38]. The eating process can be influenced by culture and society, as well as food custom [37].

Cultural behavior determines food habits and the social environment influences food choices [35]. Culture may influence food choices and individual food preferences via family influences [39]. In a household, we can see the food network system from the shared purchase places and choices among family members [40]. Primary socialization occurs mainly in the family, so that parents have control over culinary culture in the house determining the household food choices related to food familiarity [35]. Contextual cultural factors emphasizes familiarity as one important motive in choosing foods, added by health, taste, mood, sensory appeal, weight control, price, comfort, convenience, natural content/ingredients, and ethical concerns [34], [41].

The attitudes and interests in individual food consumption are also influenced by the cultural values [28]. Individual, a part of the society, is inseparable from the cultural influences due to his living in a certain cultural sphere. When an individual live in different places with different cultures then he will tend to consume different kinds of food. This may ilustrate that nutrition is more a cultural biological process than a biochemical or physiological process [37]. Cultural-based food consumption is primarily about all of our traditions and customs taking into consideration when choosing our foods [42]. Food itself is a form of cultural heritage [39]. Globally, cultural heritage is a key parameter in defining food security, while specifically, food choices and individual preferences are important parameters for ensuring sustainability achievement [39].

Geographically, Indonesia is the largest archipelago country in the world. Indonesia has 17,508 islands, but almost 6,000 islands only being inhabited, and there are more than 1,300 ethnic groups living across Indonesian archipelagos. Indonesia is divided into three regions with different time zones of western, central, and eastern Indonesia. Each region and archipelago has different cultures and habits, including in terms of food. The nature, history, and culture together shape the Indonesian food culture. Indonesian cuisine, a collection of various regional culinary traditions, is rich in variety and taste supported by the rich geographic and cultural diversity across the archipelagos. Therefore, when we visit different island in Indonesia, we will be exposed to a different variety and taste of the traditional food. Indonesian dietary custom is varied across the archipelagos and has many different influences. Middle Eastern and Indian influences can be found in western Indonesian cuisine e.g. in Sumatra island, Chinese influences can be found in central Indonesian cuisine e.g. in Java island, and Polynesian-Melanesian influences can be found in eastern Indonesian cuisine e.g. in Maluku island. We can find around 5,350 traditional recipes in Indonesian cuisine which is oftenly based on indigenous culture that formed in the archipelagos. Indonesian cuisine usually contain natural ingredients which often demonstrates a complex rich flavours, mostly often described as savory, hot and spicy. These unique Indonesian flavours acquired from certain ingredients and spices mixture. The traditional diet composition in Indonesia usually consists of (steamed) rice as the staple food, surrounded by vegetables or soup, and meat/fish-seafood/egg-poultry as the side dishes [5].

Based on religious beliefs, Moslem people as the majority of Indonesian tend to choose halal food and avoid non-halal food. Based on aspects of familiarity, for example in central Indonesia as the most congested communities area, the Javanese prefer sweet food if compared to the Madurese who prefer salty food more [43]. A study of 250 Javanese found that individuals with health consciousness and attentive lifestyles tend to choose local brand foods, while individuals with fashion consciousness, leadership, and extroversion lifestyles tend to choose foreign brand foods [44]. Indonesian consumers' motivation towards traditional ethnic food includes the desired values of financial security and happiness supporting the traditions and unique-spicy taste of Indonesian ethnic cuisines [45].

People have motives to choose the food they consume. Motives to choose the food is one example of the conscious reflection of food choice. In order to ensure a right decision toward foods entering human body system before choosing foods, a sufficient information of health and price are required the most by Indonesian these days [8]. The food choice motives were related to health [46], and together with environment, it is being the strongest determinant of food choices [47]. Perceptions of food health values are crucial for determining an individual's dietary choices and adaptation [14]. Consuming healthy food products has a clear role in the healthy functioning of an individual [48]. The concept of health affects the daily food practices can be shown by the perception on some traditional foods to have medicinal effect so that they are consumed regularly [38]. Healthy dietary changes at any age give substantial health benefits and increase life expectancy [49]. Therefore, it is important to take health into consideration in choosing our food because individual food choices will affect human physical functioning which may influence other important aspects of human life, such as wellbeing, life satisfaction, and quality of life.

Low education level is one of the socio-economic statuses considered to be a consistent risk factor for the consumption of an unhealthy diet [50]. Empirical studies have shown that education might provide the means to acquire and understand details on diet and how it affects health, more educated individuals adopt innovations more quickly than less educated individuals including food innovations, and education influences time management, and consequently, how much time is available for acquiring or purchasing and preparing

food [10]. People with low education level and low economic status are less concerned about the nutritious or health aspects of food, but are more concerned about affordability and satiety [6], [51]. According to MT, the human mind tries to optimize the perceived value of new information by using not only knowledge and social norms, but also emotions, instincts, and beliefs [12]. Education level supporting the individual knowledge level is really important for evaluating the health values of a certain food product by using the subjective cost-benefit judgments. The new food-related information will be accepted and become a mindset or core value only if the cost-benefit judgments' results are positive. This new food-trusted information may be used as a reference in subsequent information filtering processes toward other new food-related information available in the environment.

Results have shown that initially education level has a significant negative association with health consideration in food consumption among Indonesian urban residents, especially before the adherence to Indonesian custom rules in food choosing behavior strongly moderated against this negative association. This may happen because education provide information of food trends or innovations which is not all taking health values into consideration in developing the food products. The strong influence of social media these days, especially in the young generation or generation Z, as a promotion media of food products or eating destination has a power to drive consumer's food choice. This study results emphasize the important role of the Indonesian government to promote the original food customary tradition to the citizen which is healthy and rich in variety-taste due to its natural ingredients, especially toward the urban residents. The food-related information filtered in the collective level (society) may contain positive values that support health considerations in food consumption. As the information filtering process in human mind can be energy- and time-consuming, individuals may employ trust to the local custom or social norms as the gatekeeper of prioritized information channels to catalyze new information reception and interpretation [52]. In this study, the individual trust and adherence to Indonesian custom rules in food choosing behavior was proved to be significantly moderated against the negative association between education level and health consideration in food consumption. Meaning, the customary tradition or Indonesian culture has a great impact on food choosing behavior because it facilitates the health consideration in food consumption, especially among Indonesian urban residents. Despite the variation in education levels, Indonesian may rely on the original dietary custom for a healthy diet.

This study has some limitations. The data only include Indonesian urban residents, which may not represent distinct psychological traits in rural residents who have different infosphere, cultural sphere, and living conditions. However, by using the BMF, future studies can update the patterns found in this study. Study findings provide more insights for Indonesian government to incorporate the cultural aspects in the health promotion of nutritious food or healthy diet which may improve health consideration in food consumption among Indonesian across all education levels.

4. CONCLUSION

This study found a negative association between education level and health consideration in food consumption in which the custom-rules adherence in food choosing behavior moderate against this negative association. For those with a low level of custom-based food consumption, their health consideration are lower as they have higher education level. However, the opposite trend which is a more intuitive positive association was found in those who consume more custom-based food. Socio-cultural factors have a complex impact on food choosing behavior among Indonesian urban residents. Therefore, governmental policies in the health promotion campaign of nutritious food or healthy diet should incorporate socio-cultural aspects with a deeper understanding of the human mind's information processing.

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