

Modeling of food safety knowledge, attitude, and behavior characteristics

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Abstract

In 2016-2017, foodborne outbreaks in Indonesia were mostly due to foods from households and street food vendors, indicating that people do not understand and apply food safety practices properly. In 2015, the government of Indonesia initiated a community-based food safety empowerment program to increase food safety knowledge, attitude and behavior of selected communities. Knowledge, attitude, and behavior are variables which can appropriately be analyzed by multivariate analysis. This study aimed to determine the characteristics and relationships of food safety knowledge, attitude and behavior in the intervened communities using the Partial Least Square Structural Equation Modeling (PLS-SEM) method. The study used purposive method to establish the respondents and developed a questionnaire to collect the responses. A total of 254 respondents were obtained from 9 urban areas in DKI Jakarta Province. Analysis using PLS-SEM concluded one statement for knowledge, three statements for attitude, and six statements for behavior as the statement characteristics for food safety. Results of this study suggest that knowledge affects food safety attitude and behavior significantly, but attitude does not influence behavior significantly. These results indicated the need to improve food safety knowledge in order to improve food safety attitude and behavior of the communities. However, it is important to realize that the transformation of attitude into behavior requires other factors such as environmental support and ease of the application of the principle of food safety.

1. Introduction

Indonesia Food Law Number 18 of 2012 states that food safety is a major aspect that has to be fulfilled in foods consumed by the public. Consumption of unsafe foods can cause food poisoning. In 2016-2017, there were 167 news of food poisoning and 113 foodborne outbreaks reported in Indonesia (NADFC, 2016a; NADFC, 2017). Based on the news and reports, the foods implicated in the outbreaks were those from the households, street vendors, home industries, and caterings/food services. Outbreaks caused by household foods indicated that people did not understand and apply food safety practices appropriately (NADFC, 2017). To improve knowledge, attitude, and practices of food safety in selected communities, the government of Indonesia through The National Agency of Drug and Food Control (NADFC) initiated community

empowerment on food safety for both rural and urban communities. The program has been carried out since 2015 in 33 provinces. The general objectives of this program were to encourage communities to provide safe food and strengthen the communities' economy. Meanwhile, the specific objectives were to increase food safety knowledge, attitude, and behavior; enhance the food safety practices implementation amongst food businesses, and encourage the replication of similar food safety activities in the villages (NADFC, 2016b). The communities involved in the activities include food businesses, food merchants, school communities, nonformal organizations, and health centers.

The indicators for the above program were the number of intervened communities and trained food safety cadres (NADFC, 2015), which reached 40.608 community members and 4.266 food safety cadres

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(NADFC, 2018). However, these indicators do not reflect food safety knowledge, attitude, and behavior of the intervened communities. Thus, there was a need to conduct a study to see the relationships between food safety knowledge, attitude, and behavior after the intervention.

Gefen *et al.* (2011) stated that according to the neuroscience techniques, latent variables such as beliefs, intentions, and feelings are theoretical constructs that can not be measured directly; and can only be measured through the related characteristics. Several studies have measured knowledge, attitude, and behavior indirectly through their respective characteristics and showed that those three variables are latent variables. Generally, studies on the three variables are also conducted by the bivariate approach thus does not describe the relationships between the variables. A more appropriate method to analyze such variables is the multivariate approach, such as the Structural Equation Modeling (SEM). As the second generation multivariate analysis technique, SEM combines factor analysis and path analysis. SEM is also able to analyze the relationships of multiple latent independent and dependent variables, each of which with many indicators. SEM has been used in recent studies to determine the characteristics and relationships of food safety knowledge, attitude, and behavior of several communities.

The need for studying the relationship between food safety knowledge, attitude, and behavior in the communities intervened by the NADFC program then can be carried out by modeling food safety knowledge, attitude and behavior using SEM approach. This study aimed to describe the demographic characteristics of respondents, determine the correlations between respondents' demographic characteristics and food safety knowledge, attitude, and behavior; determine the indicators of knowledge, attitude, and behavior as the characteristics related to food safety; and obtain a model of the relationships between food safety knowledge, attitude, and behavior of the intervened communities.

2. Materials and methods

2.1 Respondents

Respondents were purposively chosen from the participants of the community empowerment program on food safety in DKI Jakarta province from 2015 to 2018. The respondents were categorized as housewives, street food vendors, home-industries, and food retailers communities. The criteria for the housewives are married women, divorcée or widows who do not work in the formal sector. Street food vendors are men or women who process ready-to-eat foods for sale, including foods

sold in food stalls. Home-industry communities are men or women who process low risk packaged food with a shelf-life of more than 7 days. The criteria for food retailers are men or women, owners or workers in food retailers.

2.2 Questionnaire

The questionnaire consisted of four parts, i.e. (1) demographic characteristics, (2) food safety knowledge aspects, (3) food safety attitude aspects, and (4) food safety behaviour aspects. Part 1 was used to collect respondents' name, address, age, sex, education, and net monthly income. Part 2 consisted of 15 right or wrong statements about food safety definition and regulation (2 statements), raw material and water (4 statements), personal hygiene (3 statements), food storage (4 statements), food-borne disease (1 statement), and kitchenware hygiene and sanitation (1 statement). Each correct answer was given 1 point and incorrect answers were given 0. Part 3 consisted of 8 statements with 5 points Likert-scale answers, from strongly agree (0 point) to strongly disagree (5 points) that covered raw material and water (3 statements), personal hygiene (2 statements), food storage (2 statements), and kitchenware hygiene and sanitation (1 statement). Part 4 consisted of 6 statements with 5 points Likert-scale answers, from practiced every day (0 point) to never practiced (5 points), about raw material and water (1 statement), personal hygiene (2 statements), food storage (2 statements), and kitchenware hygiene and sanitation (1 statement). The questionnaire was tried to 37 respondents living in Cibubur, East Jakarta and revised when not easily understood by the respondents. The revised questionnaire consisted of 29 statements. The questionnaire was written in the Indonesian language.

2.3 Data collection

Each respondent answered the questionnaire independently and took about 15-20 minutes to complete the questionnaire. The data collection relied fully on the self-assessment of the respondents.

2.4 Data analysis

2.4.1 Analysis of demographic profiles

Descriptive analysis was used to compose respondents' demographic profiles, consisted of percentages per age group, gender, education level, and net income.

2.4.2 Validity and reliability tests of the questionnaire statements

The validity test for questionnaire statements regarding food safety knowledge (part 2) was conducted

by the biserial correlation test (MS Excel 97-2003). The validity test for questionnaire on attitude and behavior statements (part 3 and 4) were performed by corrected item-total correlation method at 95% confidence level ($\alpha = 0.05$) by PASW Statistics 18. The reliability tests in each part were based on Cronbach's Alpha. The statements were reliable when the Cronbach's Alpha is > 0.5 . Based on the validity and reliability tests, all the statements were valid and reliable (Cronbach's Alpha of knowledge, attitude, and behavior were 0.54; 0.58; and 0.74 respectively).

2.4.3 Correlation analysis between demographic characteristics and food safety knowledge, attitude, and behavior

The correlation analysis was conducted based on the respective scores of knowledge, attitude, and behavior by Pearson correlation (PASW Statistics 18), at 95% confidence level (significant if the p-value < 0.05).

2.4.4 Modeling to determine knowledge, attitude, and behavior characteristics and relationships

The modeling was done by Smartpls application version 3.2.8 and the results were evaluated based on the outer and inner models. The outer model describes the relationships between variables (knowledge, attitude, and behavior) and their valid statements. A statement will be a characteristic when its outer loading is > 0.5 . The inner model describes the relationships between the three variables. The description of the inner model will also test the hypothesis (Figure 1). The modeling steps, i.e. draw a model hypothesis, place valid statements of the variables, calculate the "Consistent PLS algorithm", remove statements with outer loading < 0.5 ; recalculate "Consistent PLS algorithm", and finally run "Consistent Bootstrapping PLS". A relationship is significant if the p-value is < 0.05 .

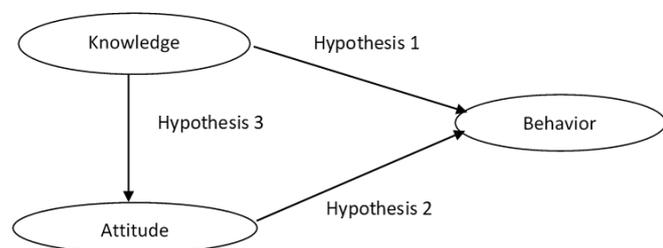


Figure 1. Hypothesis model (Schwartz, 1975)

3. Results and discussion

3.1 Demographic profile of respondents

Of the 254 respondents, 69 were housewives (27.16%), 67 were street food vendors (26.38%), 54 were home-industries workers (21.26%), and 64 were food retailers (25.20%). The female respondents

accounted for 77.17% of the total respondents due to a large number of housewives communities participating in this study. The largest age group of female respondents was 41-50 years old (45.41%), followed by 51-60 years old (22.45%) and 31-40 years old (19.90%), while for male respondents was 41-50 years old (36.21%), followed by 31-40 years old (32.76%), and 51-60 years old (13.79%). Although there were differences in the proportions in each age group, the 41-50 years old respondents were dominant both in women and men.

Women and men respondents having a net income of below Rp. 2 million/month were 52,04% and 46,55% respectively. Based on The National Social Economic Survey September 2017 (DKI-Jakarta, 2018), this amount is close to The Provincial Minimum Wage in DKI Jakarta Province, which is Rp 3.940.973,096 per month. Around one-third of respondents had net income of Rp 2-4 million per month thus more than 80% of respondents had an income of 1-2 times minimum wage in DKI Jakarta. Women had higher education but similar income as compared to men, possibly since female respondents tended to work for an additional income, not as the primary source of income in a family (Muyanja *et al.*, 2011). The demographic profile of the respondents is illustrated in Figure 2.

In general, the level of education of female respondents in this study was higher than male, similar to the female primary education profile of DKI Jakarta but different from the male's education profile (CBS-RI, 2018). This suggests an increase in the number of literate women that could improve the ability of women to absorb science and technology and impact on the level of welfare of women as the members of a community. Education will affect mothers' patterns in educating and taking care of their children, gradually impacts the general level of community welfare, and finally impact the quality of future generations (CBS-RI, 2018). Male respondents were generally younger and had lower education than the female respondents, indicating that male respondents did not continue their education to a higher level and worked in the nonformal sector immediately after completing their primary education.

3.2 The correlations between respondents' demographic characteristics and food safety knowledge, attitude, and behavior

The food safety level of knowledge, attitude, and behavior were classified as good, i.e. more than 95%, following studies by Ansari-Lari *et al.* (2010) and Abdul-Mutalib *et al.* (2012). The Pearson correlation test results between the demographic characteristics and food safety knowledge, attitude, and behavior are presented in Table 1. The result suggested that the type of community

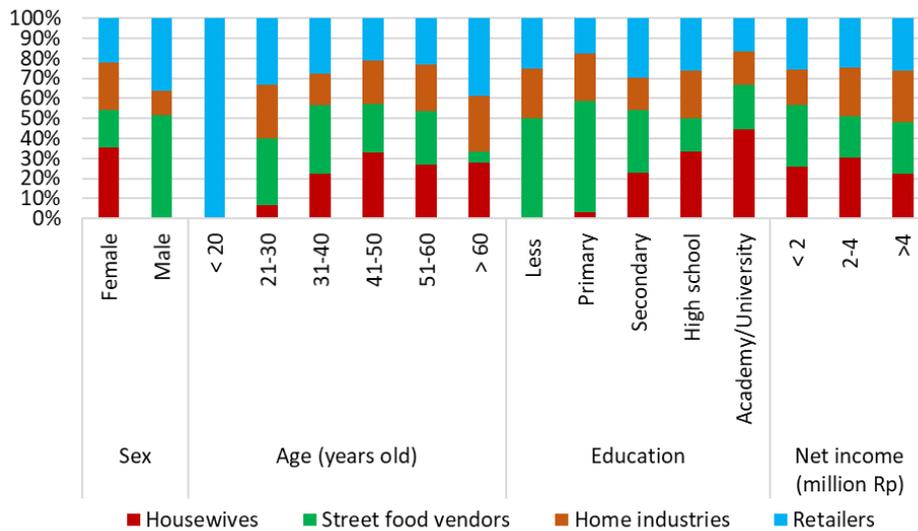


Figure 2. The demographic profile of respondents

Table 1. Pearson correlation test results

Demographic characteristics	Correlation with		
	Knowledge	Attitude	Behavior
Communities	-0.038	-0.02	0.044
Age	-0.044	-0.051	0.008
Sex	-0.074	-0.088	-0.063
Education	0.147*	0.152*	0.062
Net income	0.071	0.132*	0.012

* significant at confidence level ($\alpha = 0.05$)

did not correlate with food safety knowledge, attitude, or behavior. The respondents of this study were the NADFC food safety program participants and each of them received the same food safety material in general. This condition could be the cause of the absence of correlation of food safety knowledge, attitude, and behavior, even among food retailer respondents who had no direct contact with food. This result indicates that as long as the respondents received the same information, counseling, and assistance regardless of their gender and age, the level of knowledge, attitude, and behavior would not be significantly different. Education significantly correlated with knowledge and attitude of food safety but did not significantly correlate with food safety behavior. This result was also similar to Abdul-Mutalib *et al.* (2012), Soares *et al.* (2012), Liu *et al.* (2013), and Farahat *et al.* (2015). According to Ruby *et al.* (2019a), education level was a demographic characteristic that differentiates the level of food safety knowledge, as well as gender, age, number of children, and food preparation frequency. Tertiary level education and female gender were significant predictors of food safety knowledge. In our study, education was the only characteristic which correlates with food safety knowledge. However, the number of tertiary-educated respondents in this research was very low (7.09%). The net income of the respondents significantly correlated with food safety attitude but did not significantly correlate with the food

safety knowledge and behavior. These results were similar to Liu *et al.* (2013) who concluded that income was a factor related to food safety (behavior). For people with limited or low income, price is an important factor in buying foods compared to those with higher incomes (Dammann and Smith, 2009).

3.3 The statement characteristics for food safety knowledge, attitude, and behavior

Based on the model established in this study, several statements are determined as the characteristics for food safety knowledge, attitude, and behavior, i.e. one statement for food safety knowledge (code PU06), 3 statements for food safety attitude (code SU02, SU03, and SU05), and 6 statements for food safety behavior (code RU01 until RU06), as described in Table 2. Knowledge characteristic PU06 was related to the distribution permits for ready-to-eat foods. The average value of respondents' answers was 0.24 ± 0.027 , meaning that only 1 of 4 respondents could answer correctly. According to Government Regulation No. 28/2004 on Food Safety, Quality and Nutrition (MoSS, 2004), processed foods with a shelf life of fewer than seven days at room temperature (ready-to-eat food category) were exempted from the mandatory for the distribution permits. The result of this study indicates that respondents assume that all category of food should have distribution permits.

Characteristic statements SU02 and RU05 were associated with the consumption of unboiled refill drinking water. Recently, there is an increase in the demand for drinking water but not accompanied by adequate supply. The percentage of households in DKI Jakarta consuming bottled drinking water and refill water had increased from 4.32% in 2000 to 72.31% in 2016 (CBS-RI, 2019). Unfortunately, several studies suggested that refill water was susceptible to microbial

Table 2. The statement characteristics for food safety knowledge, attitude, and behavior

Variables	Code	Descriptions	Outer loading	p-value
Knowledge	PU06	Ready-to-eat food must have distribution permits	1	0
	SU02	Water from refill depots is safe to consume directly without boiling	0.544	0
Attitude	SU03	Washing hands with water only without soap is adequate	0.715	0
	SU05	Sneezing without covering your mouth and nose towards food is correct	0.553	0
Behavior	RU01	I use the same cloth to wipe the dishes, wipe the hands, and wipe the table (one cloth for all)	0.664	0
	RU02	I do not wash my hands after I use the bathroom	0.594	0
	RU03	I do not close food containers tightly	0.545	0
	RU04	I store pasteurized milk at room temperature for a long time	0.58	0
	RU05	I drink refill-water without boiling prior to consumption	0.611	0
	RU06	I sneeze toward food without covering my nose and mouth	0.502	0

contamination, i.e. coliforms (Walangitan *et al.*, 2016; Hilmarni *et al.*, 2018), *Bacillus subtilis* (Rumondor *et al.*, 2014), *Klebsiella pneumonia* and *Pseudomonas aerogenosa* (Birawida *et al.*, 2018), and *Escherichia coli* (Apriliana *et al.*, 2014; Walangitan *et al.*, 2016). Thus, it is recommended to reduce microbial contamination by boiling (Septiani *et al.*, 2018).

Characteristic statements pertaining to food safety attitude SU03 and food safety behavior RU02 were related to hand washing. "Handwashing" is an effective way to inhibit the spread of microorganisms. Other studies using SEM also concluded "handwashing" as an indicator for food safety knowledge (Lim *et al.*, 2016) and food safety behavior (Baser *et al.*, 2016). Food safety characteristics of attitude SU05 and behavior RU06 were related to preventing contamination by covering nose and mouth when sneezing and coughing. The characteristic was not determined as a food safety indicator in previous studies using SEM (Ko, 2013, Baser *et al.*, 2016; Lim *et al.*, 2016). However, the statement had been used in other studies on food safety knowledge, attitude, and behavior. Tegegne and Phyto (2017), Agüeria *et al.* (2018), and Prabhusaran *et al.* (2018) suggested that respondents who answered correctly pertaining the habit of covering nose and mouth when sneezing and coughing would generally have good attitude.

Food safety behavior statement characteristic RU01 was associated with the use of kitchen cloths for multiple purposes. Previous studies suggested that kitchen wipes could be a source of coliform contamination (Oxford *et al.*, 2013; Gil *et al.*, 2014), *E. coli*, *Enterobacteriaceae* as well as *Pseudomonas* spp. (Gil *et al.*, 2014). Additionally, the environment could also become a source of contamination. Therefore, processed food must be stored in closed containers (characteristic RU03) and safe temperatures (characteristic RU04). An example to characteristic RU04 is preventing post pasteurization contamination by storing pasteurized milk at lower

temperatures, which is a key in producing safe pasteurized milk, thus storage of pasteurized milk at room temperature should be avoided. This result was supported by Ruby *et al.* (2019b) who reported that keeping cooked food at a safe temperature was an indicator of food safety attitude.

3.4 A model for the relationships between food safety knowledge, attitude, and behavior of the intervened communities

The analysis using PLS-SEM showed that the path coefficient for food safety knowledge and behavior was 0.169 (p-value < 0.05) suggesting that food safety knowledge affects food safety behavior. This result indicated the importance of developing food safety knowledge improvement programs to improve food safety behavior among communities. The result was similar to Abdul-Mutalib *et al.* (2012), Lim *et al.* (2016) and Al-Shabib *et al.* (2017).

The path coefficient for food safety attitude and behavior was 0.223 (p-value > 0.05) thus food safety attitude does not affect food safety behavior. The result was different from Abdul-Mutalib *et al.* (2012), Rahman *et al.* (2016) and Lim *et al.* (2016) who suggested that the food safety attitude would affect food safety behavior. One theory related to attitude and behavior is the Theory of Planned Behavior, which postulates three conceptually independent determinants of intention or important factors that transform an attitude into behavior. The three factors are intention or attitude, perceived social pressure, and perceived behavioral control (Ajzen, 1991). The first factor, intention or attitude, denotes the need for a good attitude to encourage good behavior. A person will perform certain behavior (action) if she/he has a positive attitude towards a subject. In this research, the respondents had a good attitude as shown by the high percentage of the food safety attitude level thus they will have good behavior. The second postulate states that perceived social pressure, or subjective norm, will affect

one's intention or attitude positively. A person most likely will perform an intention if the people around him/her have the same attitude because he/she will try to fulfill the surrounding people's expectations, e.g. parents or other family members, in practicing food safety (Mullan *et al.* 2013; Ruby *et al.* 2019b). Ruby *et al.* (2019b) determined that subjective norm was the strongest factor, amongst others e.g. attitude and perceived social behavior, in driving someone's intention of food safety. The third factor is perceived behavioral control (PBC), i.e. how easy the behavior to be done. If the behavior is easy to be done, there is a greater chance for someone to implement it. For example, based on this research, low-income communities will likely face difficulties in choosing safe foods because they cannot afford the price. Thus, food safety behavior would not be expressed. The role of PBC in affecting intention was studied previously by Ruby *et al.* (2019b) who concluded that PBC was a significant predictor in food handling intentions.

The path coefficient of food safety of knowledge and attitude was 0.363 (p -value < 0.05) suggesting that food safety knowledge affects food safety attitude. This result is in accord with studies by Abdul-Mutalib *et al.* (2012), Al-Shabib *et al.* (2017), and Ruby *et al.* (2019b). Abdul-Mutalib *et al.* (2012) stated that that good knowledge could lead to a good attitude, while a study by Ansari-Lari *et al.* (2010) found that there was a significant positive correlation between knowledge and attitude. This result indicated the need to improve food safety knowledge as a strong foundation to establish food safety attitude. The model for food safety knowledge, attitude, and behavior are illustrated in Figure 3.

4. Conclusion

This study concludes that there is no correlation between community, age, and gender with food safety knowledge, attitude, and behavior. Conversely, there is a significant correlation between education and food safety knowledge and attitude, and between net income and food safety attitude.

The statement characteristics for food safety knowledge, attitude, and behavior are those related to food distribution permits, refill water safety, personal hygiene, kitchen equipment hygiene, and food-storage. Food safety knowledge affects food safety attitude and behavior significantly. Therefore, there is a need to improve food safety knowledge in order to improve food safety attitude and behavior of the communities. Food safety attitude does not affect food safety behavior significantly. Based on the Theory of Planned Behavior, there may be other factors that drive changes in behavior such as perceived social pressure and behavioral control.

Conflict of Interest

The first author works at and has received a scholarship from The National Agency of Drug and Food Control (NADFC). The second and third authors declare no potential conflict of interest.

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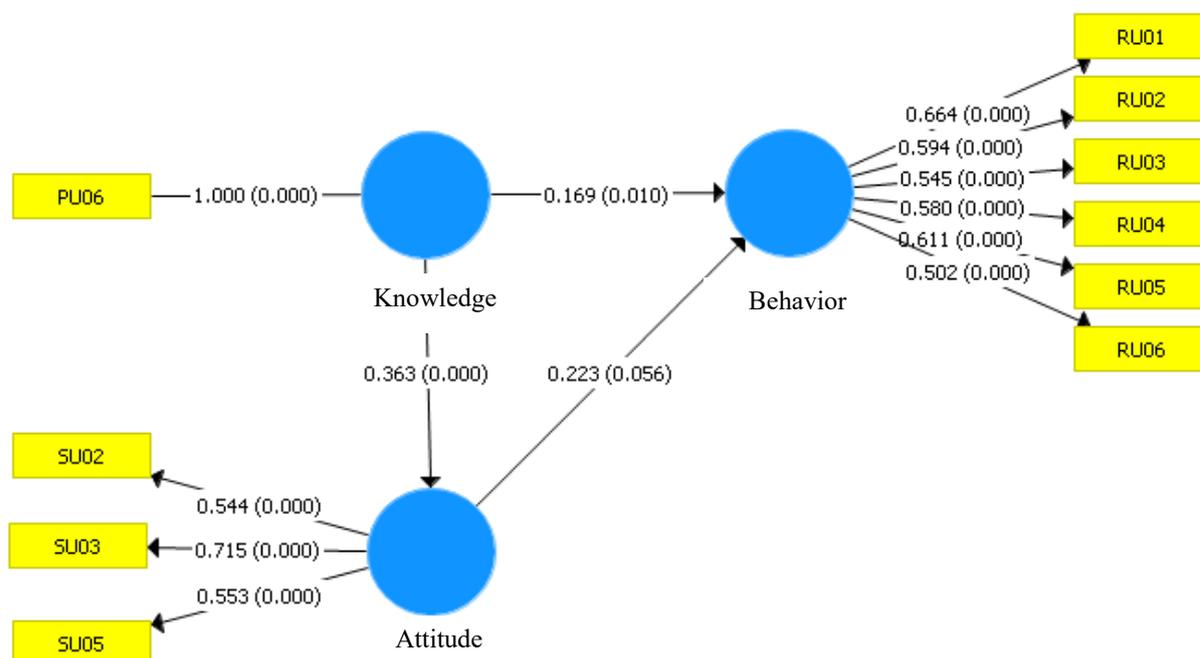


Figure 3. The model of food safety knowledge, attitude, and behavior

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