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EVALUATION OF AN ADAPTED FOOD CHOICE QUESTIONNAIRE FOR CLIMATE-VULNERABLE REGIONS: COASTAL, HILL, AND PLATEAU POPULATIONS

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ABSTRACT

Background: *Food choice was driven by some motives, psychology or physiological needs. FCQ were conducted to assess and measure motives underlying of food choice, however, the original FCQ by Steptoe was over 30 years ago in U.K population. The original FCQ was urgently need to validate the factor in other population target based on cultural, social and health factors, also different of mother language of population target, especially in context of household food insecurity.*

Objectives: *Aim of this study was (1) to assess modified FCQ in household food insecurity, (2) evaluate its construct validity and reliability of modified FCQ in household food insecurity.*

Methods: *FCQ (36 items) was translated to Indonesian, back-to-back. Construct validation was performed with factor analysis (EFA and CFA). Internal consistency was performed by Cronbach's α. Participants in this study were driven by random sampling, ratio 3:1. Total participants were 108, women over 20 years old, household food handler and live on; coastal, hills and plateau areas that affected by climate change.*

Results: *15 items were excluded, and remaining 21 items perform favorable results of goodness-of-fit indices (CFI 0.968, TLI 0.965, IFI 0.969, GFI 0.932, RMSEA 0.06, and SRMR 0.11). Internal consistency also performs an excellent consistency (Cronbach's α 0.876).*

Conclusion: *This modified FCQ is a valid and reliable instrument for assessing household food choice in populations affected by climate change and food insecurity, supported by strong psychometric performance. Further validation with a larger sample is recommended to enhance generalizability.*

Keyword: *Factor analysis; food choice questionnaire; household food insecurity; reliability; validity*

INTRODUCTION

Food is no longer source of pleasure and enjoyment, but increasingly become a concern that given potential consequences for ill and health. Food choice is defined as a complex phenomenon by physiological and physicosocial, both influenced conscious and unconscious process, and affecting internal or external respons.[1] Food choice also evolving through centuries due to globalization, and shifting some tradition or lifestyle.[2,3] Attitude, beliefs and knowledge towards food as an internal respond. On the other side, the needs of biological (i.e appetite, taste, texture), psychological (i.e mood, stress), physical (i.e accessibility, availability, education, time, gender, age), social (i.e norms, family, peers) and economy (i.e price, income) also driven food choice. In food insecurity context, food choice has a key to determined quality of diet and motives on households for accessing and consuming food caused. In a food insecurity households, there is also shifting meaning of "eating", from health-being and body weight control became a chopping mechanism.[4,5]

Those multidimensional aspects were driven and had impacts on dietary pattern on some populations,[6] and FCQ were developed to measure and assess some motives behind food choice by Steptoe in 1995 and were made in U.K population.[7] In some research, some studies also combining, adding or reducing some factors of original FCQ. Recently, FCQ was widely use in other countries also combining some aspects, i.e environmental issues, political values and religion, traditional food, functional food, organic, diet, food neophobia, perception of food, availability, politics and religions. [8–11] Adaptation and validity of food choice questionnaire is needed, because nine factors of FCQ cannot represented and generalized in others

population, considering the different of representation, translation, location, cultural and mother language in population target.[12,13]

FCQ originally was developed by Steptoe in 1995, consist 36 segmented items and categorized by nine factors that assess and measure motives for choosing food.[7] The original of FCQ representing health and non-health related motives underlying food choice, and categorized by; health, mood, convenience, sensory appeal, natural content, price, weight control, familiarity and ethical concern. As well known, FCQ is a multidimensional instrument and being used for assessing latent motives of choosing food. FCQ using unique rating scale, and each factors consists three to six questions to assess and measure underlying factors and motives of food choice. Rating scale were used to answer "how much important…" those motives, which ranged from 1 = "not important at all" and 4 = "very important"[7]

Consequently, this study offers a valuable contribution to the advancement of nutrition assessment methods and public health research. Based on statement above, validity and reliability of food choice questionnaire is needed and later on can answer three main questions were sought:

1. Can original FCQ used on population target?
2. If not, what factors can be adapted and used on population target?
3. Can adapted FCQ model represented food choice on population target?

METHODS

In this pilot with cross-sectional study, participants were women over 20 years old, household food handler and live on; coastal, hills and plateau areas that affected by climate change. There is no consensus for determining the exact number of participants needed to perform factor analysis. Participants in this research were drawn via random sampling with ratio 3:1.[14] Accordingly, sample size was calculated 108 participants. Ethical approval was obtained from Ethical Committee of Faculty of Medicine, Diponegoro University with approval number 501/EC/KEPK/FK-UNDIP/IX/2024

Original FCQ were used with 36 items and categorized by nine factors: health, mood, convenience, sensory appeal, natural content, price, weight control, familiarity, and ethical concern. The translation and back-translation process followed good practices for cross-cultural instrument adaptation. The use of a 4-point Likert scale is also appropriate, as it avoids neutral responses and is consistent with the original Food Choice Questionnaire (FCQ). Questions were answer using 4-point Likert-scale; (1) not important at all, (2) a little important, (3) moderately important, (4) very important, and no reverse Likert-scale and scoring was adapted from original FCQ by Steptoe.[7]

First, normality test was conducted to check data distribution using Kolmogorov-Smirnov, presented by mean, standard deviation, median and interquartile. Cronbach's α was used for internal reliability with acceptable value above 0.7.[15] Structure of FCQ analyzed by Explanatory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) methods. EFA were used because there no observation of adequate-fit in the original FCQ and used to explore main themes and factor loading items into groups, consistency coefficient using Bartlett's test of sphericity and Kaiser-Meyer-Olkin (KMO) test. Bartlett's test with p-value under 0.05 and KMO test with overall MSA above 0.8 and were acceptable. Valid item with factor loading above 0.5 and overall MSA above 0.6. However, item with loading score below 0.5 or cross-loading item that load 0.32 or higher on two or more factors were dropped. Remaining items will be extracted using oblimin rotation based on principal axis factor, with kaiser criterion (eigenvalues) above 1.[14]

Lastly, the extracted factor will continue to analyze using CFA for confirm the construct validity of modified FCQ. Model fit indices will presented include χ^2, df, root mean square error of approximation (RMSEA), standardized root mean square residual (SRMR), goodness of fit (GFI), tucker lewis index (TLI), comparative fit index (CFI), bolen's incremental fit index (IFI) and relative noncentrality index (RFI). Measurement indices for TLI, CFI, IFI, RFI were acceptable if above 0.95, and for model-indices-fit acceptable if RMSEA under 0.06 and SRMR under 0.11.[16–18] Internal consistency was assessed by Cronbach's α with value above 0.7.[14] Average Variance Extracted (AVE) and Composite Reliability (CR) were assessed to determined construct validity of modified FCQ. Acceptable value is above 0.5 for AVE, and above 0.7 for CR.[19]

Data were managed, coded and analyzed by JASP ver. 0.19.3.0, with p-value < 0.05 was considered as statistically significant.

RESULT

The modified FCQ performed an acceptable internal validity and reliability (Cronbach's α 0.876) data shown on table 1. Hence, for internal reliability per factor were acceptable, except from natural content (α 0.264) however perform acceptable validity (0.425 and 0.499, p-value <0.001). Based on validity and reliability internal, this modified questionnaire was acceptable and need to further analysis with factor analysis.

Table 1 Validity and Reliability of Modified FCQ

Number	Item	Reliability	Validity	Mean ± SD	Median	IQR
	Health	**0.739**				
9	… is high fibre and roughage		0.351**	2.81 ± 0.94	3	2
10	… is nutritious		0.373**	3.51 ± 0.71	4	1
22	… contains lots of vitamins and minerals		0.521**	3.23 ± 0.80	3	1
27	… is high in protein		0.519**	2.88 ± 1.00	3	2
29	… keeps me healthy		0.309*	3.42 ± 0.63	3.50	1
30	… is good for my skin/teeth/hair/nails/etc		0.484**	2.82 ± 1.02	3	2
	Mood	**0.838**				
13	… cheers me up		0.652**	2.67 ± 0.87	3	1
16	… helps me cope with stress		0.652**	2.38 ± 0.90	2	1
24	… keeps me awake and alerts		0.669**	1.87 ± 1.08	1	2
26	… helps me relax		0.649**	2.54 ± 0.93	3	1
31	… makes me feel good		0.579**	2.62 ± 0.90	3	1
34	… helps me cope with life		0.652**	2.44 ± 0.85	2	1
	Convenience	**0.667**				
1	… is easy to prepare		0.221	3.06 ± 0.78	3	1
11	… is easily available in shops and supermarkets		0.096	3.15 ±0.78	3	1
15	… can be cooked very simply		0.433**	3.42 ± 0.74	4	1
28	… takes no time to prepare		0.251*	3.14 ± 0.96	3	2
35	… can be bought in shops close to where I live or work		0.209	3.31 ± 0.90	4	1
	Sensory appeal	**0.746**				
4	… tastes good		0.267*	3.42 ± 0.82	4	1
14	… smells nice		0.292*	3.33 ± 0.82	4	1
18	… has a pleasant texture		0.389**	2.89 ± 1.21	3	2
25	… looks nice		0.437**	2.94 ± 1.14	3	2
	Natural content	**0.264**				
2	… contains no additives		0.214	1.18 ± 0.83	2	2
5	… contains natural ingredient		0.415**	2.50 ± 1.06	2	1.25
23	… contains no artificial ingredient		0.499**	2.32 ± 1.08	2	2
	Price	**0.678**				
6	… is not expensive		0.311*	2.96 ± 0.94	3	2
12	… is good value money		0.409**	2.90 ± 0.85	3	2
36	… is cheap		0.389**	3.22 ± 0.96	4	2
	Weight control	**0.789**				
3	… is low in calories		0.381**	2.50 ± 0.84	3	1
7	… is low in fat		0.582**	2.45 ± 0.90	2	1
17	… helps me control weight		0.521**	2.71 ± 0.99	3	2
	Familiarity	**0.724**				
8	… is familiar to me		0.338**	2.91 ± 0.84	3	0
21	… is like food I ate when I was a child		0.420**	2.44 ± 0.83	3	1
33	… is what I usually eat		0.546**	2.77 ± 0.75	2	1
	Ethical concern	**0.797**				
19	… is packaged in an environmentally friendly way		0.731**	1.89 ± 1.13	1	1
20	… comes from countries I approve of politically		0.668**	1.56 ± 0.92	1	1
32	… has the country origin clearly marked		0.551**	1.59 ± 0.96	3	0

* Data presented p-value < 0.05

**Data presented p-value < 0.01

There are a different item and factor between an original and modified FCQ. The modified FCQ has 15 items excluded (KMO <0.6, factor loading<0.5, cross loading >0.32) together with reduced seven of nine factors EFA (eigenvalues >1) that explained 47.6% of variance (table 2). Eigenvalues score for factor 1 was 6.682 and factor 2 was 4.291. Overall MSA for modified FCQ was scored 0.815, with factor loading ranged 0.525 to 0.866 (table 2), indicated that sample was adequate for factor analysis. Bartlett's test also finds a meaningful finding (χ^2 1152.126, df 210, p-value <0.001), shown that modified FCQ was valid and had significant correlations. Hence, the

communalities were ranged between 0.377 to 0.819 that means items can be described by variants 37.7% to 81.9%, communalities below 0.5 still acceptable and can described the variants because of higher loading factor.

Table 2 Explanatory Factor Analysis of Modified FCQ

Item	Question	Health and well-being	Convenience and sensory appeal	Communalities
Item 7	… is low in fat	0.866		0.819
Item 34	… helps me cope with life	0.764		0.598
Item 30	… is good for my skin/teeth/hair/nails/etc	0.739		0.645
Item 26	… helps me relax	0.686		0.666
Item 19	… is packaged in an environmentally friendly way	0.682		0.568
Item 16	… helps me cope with stress	0.671		0.504
Item 24	… keeps me awake and alerts	0.656		0.534
Item 13	… cheers me up	0.648		0.536
Item 22	… contains lots of vitamins and minerals	0.618		0.765
Item 23	… contains no artificial ingredient	0.606		0.368
Item 17	… helps me control weight	0.601		0.458
Item 5	… contains natural ingredient	0.536		0.617
Item 3	… is low in calories	0.532		0.496
Item 9	… is high fibre and roughage	0.525		0.377
Item 15	… can be cooked very simply		0.803	0.794
Item 28	… takes no time to prepare		0.787	0.673
Item 6	… is not expensive		0.754	0.593
Item 14	… smells nice		0.698	0.582
Item 1	… is easy to prepare		0.630	0.472
Item 36	… is cheap		0.626	0.399
Item 25	… looks nice		0.601	0.377

Factoring method: principal axis factors.
Rotation: oblique oblimin.
Factor loading below 0.4 are not shown

Table 3 Confirmatory Factor Analysis of Modified FCQ

Indicator	Estimate	Std. Error	z-value	95% CI	
				Upper	Lower
Health and well-being (AVE 0.426, CR 0.901)					
Item 3	0.487	0.038	12.978	0.414	0.561
Item 5	0.581	0.049	11.917	0.486	0.677
Item 7	0.820	0.043	19.000	0.736	0.905
Item 9	0.530	0.044	12.083	0.444	0.616
Item 13	0.591	0.042	13.912	0.508	0.675
Item 16	0.554	0.043	12.933	0.470	0.638
Item 17	0.605	0.045	13.530	0.517	0.692
Item 19	0.710	0.051	13.868	0.609	0.810
Item 22	0.489	0.035	14.017	0.421	0.558
Item 23	0.654	0.048	13.590	0.560	0.748
Item 24	0.666	0.048	13.821	0.571	0.760
Item 26	0.640	0.045	14.092	0.551	0.729
Item 30	0.788	0.045	17.615	0.700	0.876
Item 34	0.645	0.042	15.194	0.562	0.729
Convenience and sensory appeal (AVE 0.483, CR 0.824)					
Item 1	0.494	0.060	8.265	0.377	0.612
Item 6	0.719	0.063	11.385	0.595	0.842
Item 14	0.604	0.066	9.191	0.475	0.733
Item 15	0.583	0.055	10.699	0.476	0.690
Item 25	0.636	0.075	8.424	0.488	0.784
Item 28	0.820	0.077	10.683	0.669	0.970
Item 36	0.557	0.061	9.086	0.437	0.677

The remaining 21 items continued to confirmatory using CFA (table 3) also performed favorable outcomes (CFI 0.968, TLI 0.965, IFI 0.969, GFI 0.932, RMSEA 0.06, and SRMR 0.11). AVE and CR measurement also perform a "good fit" model for modified FCQ. The following two factors were extracted and renamed: **(1) health and well-being** (14 items, AVE 0.426, CR 0.901, α 0.909 ω 0.908) reflect aspects that related with the health, nutritional characteristic, mood and environmental issue; and **(2) convenience and sensory appeal** (7 items, AVE 0.483, CR 0.824, α 0.861 ω 0.863) covering for prices, accessibility, convenience, efficiency and sensory appeal. Correlation between two factor was assessed using rank spearman correlation, with rho -0.239 (p -value 0.022) conducted there's a negative correlation. Matrix distribution of CFA was shown below (Figure.1)

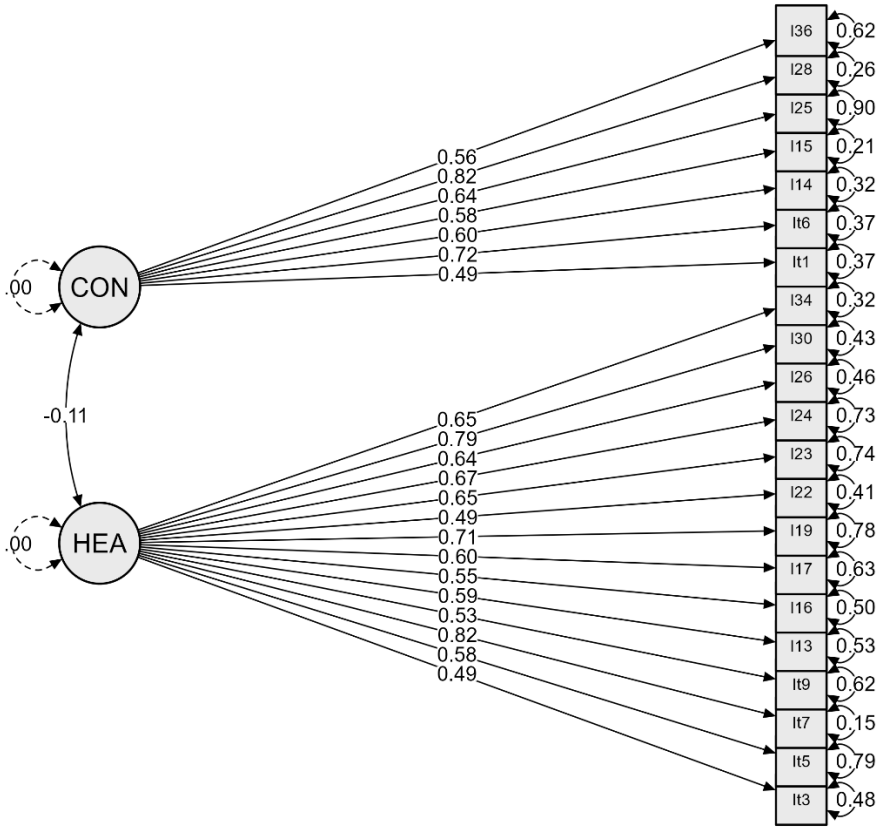

Figure 1. Fitting Result CFA of Modified FCQ

DISCUSSION

The first two question of this research are discovering whether the original FCQ can be applied, if not, what factor can be used for the modified FCQ. To the best of our knowledge, this is the first study to assess an instrument for measuring household food choices in populations affected by climate change within the context of food insecurity. The modified FCQ was designed by simplified and translating the original FCQ also combined with social and cultural background of household that affected climate change, in coastal, hills and plateau. Factor analysis, EFA and CFA, were performed to evaluate the latent factor of food choice and construct validity of modified FCQ.[14]

Although there is no agreement on how to adapt an instrument in another cultural setting, there is agreement that it is inappropriate to simply translate and use a questionnaire in another linguistic context. Even in many studies perform comprehensive linguistic translation process, but still cannot ensure the construct validity and reliability of modified tools.[20] Based on previous research, there is a necessity for validity and reliability the modified questionnaire for target populations. Thereover, we intend to modify items suggested by the target population, as well as the original FCQ was not applicable in our context, similar with other studies that adapted this questionnaire.[12,21,22]

The FCQ was developed by Steptoe and Pollard over 30 years ago[7] and cannot be generalized in Indonesia, especially on household that affected by climate change in context of food insecurity. The nine factors of original FCQ consist of health, mood, convenience, sensory appeal, natural content, price, weight control, familiarity, and ethical concern. In this pilot study, we used 4-point Likert-scale that

adopting the original FCQ form Steptoe, [7] this differs from previous other studies that used five-point[13] or seven-point Likert-scale.[23] Even number of Likert-scale (4-point) were chosen to presented the original FCQ and been described has better reliability than odd number Likert-scale that prevent participants to choose neutral answer and perform better results. [24] Pilot study with factor analysis were used because the prior research may not generalizable across different context, emphasize the need of suitable instruments.[7]

The modified FCQ were perform favorable outcomes based on validity and reliability, that can be used in population target, in context of "household food insecurity whose outcome rely from climate". Based on the fit-model, we concerning some indices. Most of goodness-of-fit show robust results; CFI 0.968, TLI 0.965, IFI 0.969, GFI 0.932 and RMSEA 0.06. However, SRMR 0.11, showed acceptable score. Rather, CFI and RMSEA showed a "good" fit, that indicate modified CFQ suitable and valid for population target. Furthermore, CFI indicate for explanatory contexts, while RMSEA is suitable for confirmatory contexts.[16] Those agreement led us to decide to retain two factor of modified CFQ and can be explained for 47.6% variance, in contrast with original FCQ can explained 49.5% of variance.[7] Acceptable of goodness-of-fit and model-of-fit in modified FCQ indicate that the modified FCQ can be used in later study.

Based on factor analysis, the remaining item of questionnaire were 21 items, and divided by two categories. Questionnaire with fewer questions show best results and suitable for framework, provided acceptable balance between practical and psychometric needs.[25] In previous study, there also integrating dimensions in modified FCQ, and it shown necessary to simplify and reorganize the original FCQ for robust outcome.[10,12] As well-known, FCQ is a multidimensional questionnaire that cover multidimensional motives underlying food choice, latent or not. Considering to Fornerll-Lacker criterion, there may be overlapping dimensions in this case.[26] Later on, in modified FCQ only two factor that can describe population target: **"health and well-being"** and **"convenience and sensory appeal"**. These two factors were renamed by similarity themes and motives, that reflected on health, nutritional characteristic, weight control, mood, ethical concerns, price, convenience, and sensory appeal. In this pilot study, we renamed 5 factors from original FCQ (weight control, health, mood, ethical concern and natural content) that distribute in 14 items and related with **health and well-being**. The rest of factors were renamed by **convenience and sensory appeal** that conclude price, convenience and sensory appeal covering for 7 items. In this modified FCQ were excluding one factor, familiarity that respectively does not have any correlation and factor loading for our population target. Consistent with previous study, familiarity was least important when choosing food, especially in lower income cluster.[10]

Previous study was conducted that food choice was driven by some motives, especially in latest century people tend to choose healthy diet and food is not only for pleasure and joy. Healthy diet was defined by eating pattern that has beneficial or unharmful effects,[27] choosing certain nutritious ingredients also raising awareness of ethical issues, and representing their concern about health, weight control also mood. These factors are correlated and support well-being in individual, respectively diet high in nutritious food can help to maintain weight control, mood and any environmental issues.[28–30] Our finding was respectively with previous study by Stewart-Knox et al,[31] that healthy diet is consistence and has correlation with increasing self-efficacy by weight control motivation and mood, consider and willing to pay food with "good" nutrition characteristics also associated with environmental issues, especially of what kind of packaged its use. The combined of **health and well-being** factor was representative with research from Szakály[12], Ooi[32], Milošević[33], and others.

Conversely, **convenience and sensory appeal** covering some aspects that related with some social economic such as price, convenience (availability, accessibility and time preparation) and sensory appeal. Price and convenience aspects driven motives of food choice, especially in lower income.[31] Following price and convenience, sensory appeal also integrated with low-cost food and convenience, make them an easy choice and contain hyper-palatable food (ultra processed food).[34,35] As well-known ultra processed food was dominate food chain as replacement of home-cooked meals and its convenience to consume RTE-food.[36,37] Respectively with our finding, in terms of convenience are corelated with practicality and high sensory appeal food, that cheaper than nutritious food and less concern for health.[38] In context of low-income and food insecurity, food choice's motives was consciously driven by social economic aspects rather than healthy aspect.[39–41] Line with our research, consumption of ultra food process may lead harm form health. Respectively with our study that "health and well-being" factor had negatively correlated (-2.390) with "convenience and sensory appeal" due to price, unhealthy ingredients such high calories, fat, and sugars. Based on previous research,

food literate, attitude and economic ability also contributing this negatively correlation. In low-income and food insecurity household may prioritizing satiety that less importance to health and equally importance of taste also tends to give up on nutritional food or ingredients.[39,41] Sensory appeal such as visual, smell, taste and texture have role to stimulating sensory aspects, satiety and taste. High sensory appeal of food, makes them wanted high palatable food which can lead unhealthy diet and disturbing weight control management.[42–44]

CONCLUSION

This modified CFQ proposed a useful for assessing and measuring food choice in targeted population, household that affected climate change in context of food insecurity. Internal validity of modified CFQ perform excellent score with; overall MSA 0.815, Bartlett's test of sphericity χ^2 1152.126, df 210, p-value <0.001, and Cronbach's α 0.876. Factor analysis conducted on modified FCQ has resulted two new factor and 21 items with favorable goodness-of-fit for EFA dan CFA (CFI 0.968, TLI 0.965, NFI 0.883, RFI 0.869, IFI 0.969, ENI 0.968, RMSEA 0.06, SRMR 0.11). Further analysis of FCQ validation will need in a large sample size, at least 10:1 sample, for obtaining better result of validation.

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