RESEARCH ARTICLE

Exploratory factor analysis on Food Insecurity Experience Scale (FIES): latest food insecurity measurement tool by FAO

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Abstract:

Food insecurity is a known health-related problem worldwide. Recently, the Food Agriculture Organisation (FAO) releases the latest measurement scale to gauge food insecurity experiences, namely the Food Insecurity Experience Scale (FIES), which was designed to have cross-cultural equivalence and validity. This study aimed to validate FIES's reliability when implementing it in Malaysia by using exploratory factorial analysis (EFA). FIES had been translated into Malay language by Malaysian Institute of Translation and Books (ITBM). This cross-sectional study was conducted among the community in Felda Bukit Cherakah, Puncak Alam Selangor (n=124), with the translated version of FIES. Factor analysis on the FIES questions showed that there were two underlying structures, while the Cronbach alpha coefficient indicates that FIES had acceptable internal consistency. FIES is a valid and reliable measurement tool for food insecurity situation among the Malaysian population.

Keywords: Exploratory factor analysis, FIES, food insecurity, Malaysia

1. INTRODUCTION

Food insecurity (FI) is a situation whereby people have limited physical, social and economic access to sufficient, safe and nutritious food preferences for an active and healthy life [1]. It is a well-known situation that is widely occurring among the population in both developed and developing countries. A report by World Bank economic development ranking in 2016 shows 27% of the global sample were experienced food insecurity. Moreover, the literature states that about half (50%) of the population in developed countries experienced food insecurity. Meanwhile, about 10% of the population in developing countries experienced food insecurity [2].

The situation had become even worse after the Food and Agriculture Organization (FAO) estimates that 821 million people across countries were undernourished [3]. Therefore, all the countries that have adopted the 2030 Sustainable Development Goals (SDGs) are committed to the common goal: End hunger, achieve food security and improved nutrition and promote sustainable agriculture. In 2013, FAO developed the Food Insecurity Experience Scale (FIES), which is a new measurement tool, through the Voice of the Hungry (VOH) project to provide up-to-date information about FI [4].

As to date, over 143 countries have adopted FIES, which consists of eight questions asking about the experience of food insecurity [4-5]. FIES differs from other scales as it is designed to have cross-cultural equivalence and validity for both developed and developing countries. Thus, FIES is capable of producing comparable FI indicators at various severity levels across cultures and countries [5].

In Malaysia, several small-scale studies on FI were conducted using different types of measurement tools, and the results showed that the prevalence varied across populations [6]. There were studies showed that households with low socioeconomic status were experiencing severe FI, especially those who live in urban, remote and rural areas [7], [8]. According to a recent report from the United Nations International Children's Emergency Fund (UNICEF) in 2018, children that living in low-cost apartments in urban areas were experiencing insufficient food variety and having malnutrition [9].

FIES is designed to benefit the food security area and is recommended by world organizations like FAO to monitor the FI issue among countries. However, not many FI studies in Malaysia were using FIES. Currently available questionnaires have limitations like the answering structure is complicated to understand, the questionnaire is too long to be administered, and the questions were developed

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specifically for a targeted population. Hence, this study was aiming to validate the suitability of FIES as the FI measurement tool for the Malaysian population.

2. MATERIALS AND METHODS

2.1 Sample and population

This study was carried out in Felda Bukit Cherakah, a housing area located in Kuala Selangor district that near to the urban region of Shah Alam and Kuala Lumpur. The population who resides in this area can be divided into two generations. The first generation was among FELDA settlers who did agriculture industry since years before. However, due to the urbanization process, most of the agriculture area was developed as a new township. Meanwhile, the second generation was among children to the settlers and was engaged in commercial and professional activities in government or private sectors [10-11].

Study participants (aged 15-year-old and above) were selected randomly among the population (n = 124). Those with psychological or mental health conditions were excluded from this study. The study protocol (Reference Number: 600 – IRMI (5/1/6)) was reviewed and approved by the Research Ethics Committee of Universiti Teknologi Mara before data collection.

2.2 Structured questionnaire

A structured FIES questionnaire was adapted. The questionnaire was then translated from English to Bahasa Malaysia (the national language of Malaysian) by the Malaysian Institute of Translation and Books (ITBM), which involves professional translation process along with appropriate nuance editor also proofreaders to ensure accuracy. FIES consists of eight questions that are asking the participants about their FI experiences within the past 12 months [4].

The first question asked whether the participant was worried that he/she would not have enough food to eat because of a lack of money or other resources. The second question asked whether there was a time when the participant was unable to eat healthy and nutritious food due to lack of money or other resources. The third question asked whether the participant ate only a few kinds of food because of lack of money or other resources. The fourth question asked whether the participant had to skip a meal because of lack of money or other resources. The fifth question asked whether the participant ate less than he/she thought he/she should because of a lack of money or other resources. The sixth question asked whether the participant's household ran out of food because of a lack of money or other resources. The seventh question asked whether the participant was hungry but did not eat because there was not enough money or other resources for food. Lastly, the eighth question asked whether the participant went without eating for a whole day because of a lack of money or other resources [12].

Each of the questions was answered in yes or no and provided with a raw score of 1 and 0 by the participant. The total raw score of each participant was calculated by adding the raw score of each question given by the participant. FI severity levels were determined based on the total raw score: Food Security (total raw score from 0 - 3); Moderate FI (total raw score from 4 - 6); Severe FI (total raw score from 7 - 8) [13]. Data were entered into an Excel sheet and were cross-checked to ensure accuracy. Data were then analyzed by using SPSS version 21 (SPSS, Chicago, IL, USA). The validity of the questionnaire was determined by using the Exploratory Factor Analysis (EFA).

2.3 Statistical analyses

The questions were assessed using means and standard deviations of the individual question. The adequacy of the correlation matrix was preliminarily assessed by using the measure of sampling adequacy value (MSA). The MSA value is considered acceptable if it is more than 0.5. The sample adequacy for factor analysis was evaluated by using the Kaiser-Meyer-Olkin (KMO), and the KMO value is considered acceptable if it is more than 0.6. While Bartlett's test of sphericity was used to test the identity matrix and the p-value is considered acceptable if it is less than 0.05 [14-15]

The internal consistency of the questionnaire was assessed using Cronbach's alpha coefficient. If the Cronbach's alpha coefficient value is within the range from 0.7 and 0.9, it is considered as consistent [16]. Questions were analyzed to provide information about the question's characteristics and their association with one another. Hence, the Cronbach's alpha coefficient can be used to decide whether or not to delete or retain a particular question [16-17].

3. RESULTS AND DISCUSSION

3.1 Determining of matrix

EFA was used to determine the validity of the FIES underlying structure. It involved matrix evaluation, determinant evaluation, MSA, identity matrix evaluation, KMO value determination and principal component analysis (PCA).

The determinant obtained for the FIES was 0.107, which was within the adequate range from 0 to 1. This suggests that the questions in the FIES were acceptable for factor analysis. On top of that, Bartlett's test of sphericity was giving a significant result ($p<0.001$), which suggests that the matrix was not an identity matrix, and factor analysis is possible to be performed. Also, the results for KMO test and MSA test were 0.744 and more than 0.7, respectively, which further indicates that the data from this study were adequate for factor analysis [15].

3.2 Factor analysis

Factor analysis using the Principal Component Analysis (PCA) was then conducted to show the components involved in the questionnaires. The test showed that there were two underlying components in the questionnaire that are

inadequate of food quantity and changes in the quality of food intake. This finding was supported by the eigenvalue of more than 1 [14]. This criterion was selected to retain extracting factors since it is the most accurate criterion in achieving selected conditions.

The conditions are: when there are less than 40 variables (n = 8) and a reasonable sample size (n = 124), two (n of variables / 5) to three (n of variables / 3) underlying factors are expected [15]. Thus, this study showed that the FIES is a measurement tool that has cross-cultural equivalence to provide comparable FI information. It provides a unique opportunity to obtain the prevalence of FI across countries through the use of a single metric [13, 18].

Furthermore, the two extracted components also explain 55.5% of the total variance in the eight questions, as shown in Table 1. According to Pett et al. (2003), any cumulative variance percentage within the range from 50% to 90% is considered adequate to determine which factors to be extracted.

Table 1: Factor loading of eight items of FIES and percentage of variance of factor extracted.

Item		Extraction Factor Loadings
1.	You were worried you would not have enough food to eat because of a lack of money or other resources?	0.570
2.	Still thinking about the last 12 MONTHS, was there a time when you were unable to eat healthy and nutritious food because of a lack of money or other resources?	0.685
3.	You ate only a few kinds of foods because of a lack of money or other resources?	0.656
4.	You had to skip a meal because there was not enough money or other resources to get food?	0.678
5.	Still thinking about the last 12 MONTHS, was there a time when you ate less than you thought you should because of a lack of money or other resources?	0.754
6.	Your household ran out of food because of a lack of money or other resources?	0.763
7.	You were hungry but did not eat because there was not enough money or other resources for food?	0.650
8.	You went out without eating for a whole day because of a lack of money or other resources?	0.539
% of variance		55.5%

3.3 Internal consistency

The internal consistency value of all FIES questions was tabulated in Table 2 as follows.

Table 2: Cronbach's Alpha Coefficient of the eight items.

Item	Cronbach's alpha if item deleted	Cronbach's alpha coefficient
Item 1	0.745	0.759
Item 2	0.712	
Item 3	0.719	
Item 4	0.721	
Item 5	0.749	
Item 6	0.726	
Item 7	0.736	
Item 8	0.756	

The internal consistency of the FIES questions was tested using Cronbach's alpha coefficient and the result was 0.759, which was an adequate value based on the acceptable range from 0.7 to 0.9 [16-17]. No questions need to be deleted as all shown acceptable values between 0.72 to 0.79. These results indicate that FIES is a reliable FI measurement tool for the Malaysian population.

VOH project stated that FIES is a measurement scale based on Item Respond Theory Model (IRT), hence, can be used across cultures. Apart from that, FIES differs from other measurement tools as the questions are about food-related behaviour and experiences related to FI. It also provides actionable information to policymakers [12] to overcome FI in Malaysia.

Nevertheless, this study has its limitations as the sample size was small and only focus on one ethnic group. Yet, this study might be the pioneering research that proves the FIES is a valid and reliable global FI measurement tool to investigate the severity of FI among the Malaysian population.

4. CONCLUSION

In conclusion, this study has revealed that FIES is a suitable measurement tool for food insecurity experience among the Malaysian population. Nonetheless, further studies which involve different ethnic group(s) and/or study location(s) (such as rural or urban area) in Malaysia is always welcomed. Also, it is recommended to have a validity study by using confirmatory factor analysis (CFA) and Rasch analysis to further validate the reliability of this measurement tool for the Malaysian population.

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REFERENCES

[1] Food and Agriculture Organization, "The state of food and agriculture: food security: some macroeconomics dimensions." Rome, 1996.

[2] Smith, M. D., Rabbitt, M. P., Jensen, A. C., "Who are the World's Food Insecure ? New Evidence from the Food and Agriculture Organization's Food Insecurity Experience Scale," *World Development*, 93: 402-412, 2017.

[3] FAO, IFAD, UNICEF, WFP, WHO, "Food Security and Nutrition in the World the State of Building Climate Resilience for Food Security and Nutrition." 2018.

[4] FAO, "The Food Insecurity Experience Scale Frequently Asked Questions - FAQs," Food and Agriculture Organization, 2013.

[5] FAO, IFAD, UNICEF, WFP, WHO, "The State of Food Security and Nutrition in the World: Building Resilience for Peace and Food Insecurity; Global Nutrition Report 2017: Nourishing the SDGs.," Rome, 2017.

[6] Ahmad, M. H., Naidu, B. M., Salleh, R., "Exploratory Factor Analysis on Six Food Insecurity Questions: Data from Malaysian Adult Nutrition Survey 2014," *Health Science Journal*, 12 (2): 1-5, 2018.

[7] Naser, I. A., *et al.*, "Association between household food insecurity and nutritional outcomes among children in Northeastern of Peninsular Malaysia," *Nutrition Research and Practice*, 8 (3): 304-311, 2014.

[8] Cooper, E. E., "Evaluating household food insecurity : applications and insights from rural Malaysia," *Ecology of Food and Nutrition*, 52 (4): 294–316, 2013.

[9] Aula, W., "Terbantut , kurus kering : Ada keluarga di PPR hanya hidangkan satu lauk sehari," *Astro Awani*, 2018.

[10] "Kampung Felda Bukit Cherakah." [Online]. Available: https://chefared17.wordpress.com/.

[11] Wikipedia contributors, "Puncak Alam," *Wikipedia, The Free Encyclopedia*, 2019. [Online]. Available: https://en.wikipedia.org/w/index.php?title=Puncak_Alam &oldid=890270524. [Accessed: 23-Dec-2019].

[12] Food and Agriculture Organization, "Voices of the Hungry - GLOBAL FOOD INSECURITY EXPERIENCE SCALE," 2016. [Online]. Available: http://www.fao.org/in-action/voices-of-the-hungry/using-fies/en/. [Accessed: 22-Mar-2018].

[13] Wambogo, E. A., Ghattas, H., Leonard, K. L., Sahyoun, N. R., "Validity of the Food Insecurity Experience Scale for use in Sub-Saharan Africa and characteristics of food-insecure individuals," *Current Developments in Nutrition*, 2 (9): 6–8, 2018.

[14] Williams, B., Brown, T., Onsman, A., "Exploratory factor analysis: A five-step guide for novices," *Australasian Journal of Paramedicine*, 8 (3): 1-13, 2010.

[15] Pett, M., Lackey, N., Sullivan, J., "*Making Sense of Factor Analysis*," Sage Publications Inc, California, USA, 2003.

[16] Tavakol, M., Dennick, R., "Making sense of Cronbach's alpha," *International Journal of Medical Education*, 2: 53–55, 2011.

[17] Taber, K. S., "The use of Cronbach's alpha when developing and reporting research instruments in science education," *Research in Science Education*, 48 (6): 1273–1296, 2018.

[18] Depa, J., Gyngell, F., Müller, A., Eleraky, L., Hilzendegen C., Stroebele-benschop, N., "Prevalence of food insecurity among food bank users in Germany and its association with population characteristics," *Preventive Medicine Reports*, 9: 96–101, 2018.