ORIGINAL ARTICLE

Pesticide applicators questionnaire content validation: A fuzzy delphi method

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SUMMARY

Background: The most crucial step in forming a set of survey questionnaire is deciding the appropriate items in a construct. Retaining irrelevant items and removing important items will certainly mislead the direction of a particular study. This article demonstrates Fuzzy Delphi method as one of the scientific analysis technique to consolidate consensus agreement within a panel of experts pertaining to each item's appropriateness. This method reduces the ambiguity, diversity, and discrepancy of the opinions among the experts hence enhances the quality of the selected items. The main purpose of this study was to obtain experts' consensus on the suitability of the pre-selected items on the questionnaire.

Methods: The panel consists of sixteen experts from the Occupational and Environmental Health Unit of Ministry of Health, Vector-borne Disease Control Unit of Ministry of Health and Occupational and Safety Health Unit of both public and private universities. A set of questionnaires related to noise and chemical exposure were compiled based on the literature search. There was a total of six constructs with 60 items in which three constructs for knowledge, attitude, and practice of noise exposure and three constructs for knowledge, attitude, and practice of chemical exposure. The validation process replicated recent Fuzzy Delphi method that using a concept of Triangular Fuzzy Numbers and Defuzzification process.

Results: A 100% response rate was obtained from all the sixteen experts with an average Likert scoring of four to five. Post FDM analysis, the first prerequisite was fulfilled with a threshold value (d) ≤ 0.2, hence all the six constructs were accepted. For the second prerequisite, three items (21%) from noise-attitude construct and four items (40%) from chemical-practice construct had expert consensus lesser than 75%, which giving rise to about 12% from the total items in the questionnaire. The third prerequisite was used to rank the items within the constructs by calculating the average fuzzy numbers. The seven items which did not fulfill the second prerequisite similarly had lower ranks during the analysis, therefore those items were discarded from the final draft.

Conclusion: Post FDM analysis, the experts' consensus on the suitability of the pre-selected items on the questionnaire set were obtained, hence it is now ready for further construct validation process.

KEY WORDS:
Fuzzy Delphi, survey questionnaire, validation, noise exposure, chemical exposure

INTRODUCTION

The questionnaire is commonly used as a measurement tool in Public Health research. Today, varieties of validated questionnaires are easily accessible and retrievable from various databases. However, the main challenge as Public Health researcher is determining the items' suitability of the questionnaire to be used for the intended research scope. Consulting the experts of the research scope is one of the ways to solve the challenge.

Fuzzy Delphi method is the current trend in consulting those experts. It is the modification method of former classic Delphi method developed by two scientists, Olaf Holmer and Norman Dalkey, which has been used widely to get the expert opinions via surveys.[1] It has few disadvantages, such as misinterpretation of experts' opinions due to neglecting the fuzziness, no dedicated rules to yield the desired outcome, loss of experts' interest and data due to its time-consuming process which will lead to repeated surveys and ultimately make the study more expensive.[2,3,4] In view of the importance to solve the ambiguity of the experts, whom might have a common understanding,[3] Fuzzy Delphi Method (FDM) was introduced over three decades ago[5] which was again revised by previous scholars.[6,7] It uses fuzzy set numbers or fuzzy set theory whereby each set will have a value from 0 to 1. This method reduces cost and time during evaluating each item in a questionnaire. It reduces the survey rounds and increases items recovery rate, allows the experts to express their opinions without any ambiguity biases, which enhances the completeness and consistency of opinion[8] and to get the consensus from the experts without jeopardising their original opinion and by giving their real reaction towards the questions.[9]

As far as concern, there are no studies available pertaining to the Pesticide Applicators (Foggers) of the Ministry of Health. Their nature of work, which exposes them to both noise and chemical hazards warrants a set of questionnaires from the

This article was accepted: 1 February 2017
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experts from both occupational health and vector-borne disease control unit of Ministry of Health. Therefore, we feel, FDM is the most suitable method to be used to form a set of questionnaire. In this article, Fuzzy Delphi Method was used prior to constructing validation process of pesticide applicators questionnaire pertaining to knowledge, attitude and practice related to noise and chemical exposure in this study. The main purpose of this study was to obtain experts' consensus on the suitability of the pre-selected items on the questionnaire.

MATERIALS AND METHODS

Pesticide applicator questionnaire

A number of items related to knowledge, attitude and practice to noise and chemical exposure were compiled based on the literature search of previous studies instruments[10, 12,14] using keywords noise induce hearing loss, noise, pesticide and, knowledge, attitude and practice (KAP).Three main databases were explored i.e. PubMed, Ovid, and Google Scholar. Some items were obtained directly from the authors via email.[11, 13] All those studies were done on sawmill workers, vector control workers, industrial workers and the general population. A total of three constructs were finalized for each noise and chemical exposure. For noise exposure, the selected items for knowledge, attitude, and practice were 10, 14 and 6 items, respectively. Meanwhile, for chemical exposure, there were 10 items for each construct of knowledge, attitude, and practice. Only 33% of the selected items were in the English language. Due to limited resources, those items were translated from English to Malay version using simplest, traditional forward translation[15] to best of the first author's ability. The items were constructed based on the nature of work environment faced by the Pesticide Applicators and considering the purpose and conceptual basis of the questionnaire measurement. The items were developed in terms of routine, simple terminologies without deviating from the original theoretical meaning of the questions. For example, "Chemical enters the body through breathing in" and "I am confident that I can use PPE properly"[10] were translated into *"Racun memasuki tubuh badan melalui pernafasan"* and *"Saya pasti saya boleh menggunakan alat pelindung diri dengan betul"*, respectively. Apart from that, few items were adopted and modified to suit the study population, whereby originally those items were in behavioural questions, modified into a practical statement. Example, "how often do you wash your hands before putting on gloves" into *"Saya mencuci tangan sebelum memakai sarung tangan semasa mengendalikan racun serangga"*. This compilation of 60 items was later presented to a panel of experts.

Panel of experts

A panel of experts is defined as a group of persons who are skilful in the scope of a study area. They are selected based on leading position in public health care system with a significant practical knowledge in their field of practice.[16] They also should represent his/her circle of professional Occupational Health group as suggested by the previous scholar.[17] In this study, the inclusion criteria for the experts were occupational health related specialization, familiarity with the working zone, authority in the field, and the number of years of experience. Each chosen experts was at least one of the following; [1] a public health physician that has published an article related pesticide applicators, [2] an administrator who manages the pesticide applicators at district/state/national level, [3] had previously worked or experienced in pesticide application related job,[4] minimum five years of experience in the related field of noise and pesticide exposure,[5] an academician or tutor in the occupational health related field. A total of sixteen experts were recruited as the panel of experts via non-probable, purposive sampling method. The number was considered optimum and complied with previous suggestions which required 10 to 50 experts.[18] Lesser amount of experts is required, i.e. 10 to 15, if they are homogenous experts.[2,4]

The panel of experts was from various part of Malaysia. The panel consisted of eight Public Health Physicians of Occupational and Environmental Health Unit of Ministry of Health, three academicians of Occupational Health from the public and private universities, three Health Inspectors and two Entomologists who are presently working in the Vector-borne Disease Control unit of Ministry of Health. They were contacted by the researcher via a phone call to brief the FDM and get their verbal informed consent. A set of 60 items questionnaire was distributed to each expert via email between October and December 2016. They were instructed to indicate their agreement level for each item using five-point Likert scale i.e. 1= highly disagree to 5= highly agree. Upon successful completion, each answer sheets were delivered to primary researcher through emails.

Data Analysis

The analysis of the data was replicated from the latest Malay version published material,[8] which discusses two important concepts of FDM, namely Triangular Fuzzy Numbers and Defuzzification process (refer Figure 1).

Triangular Fuzzy Numbers

Triangular Fuzzy Numbers (TFN) provided an opportunity for each recorded response made by an expert in the form of Likert scale scoring to be translated into fuzzy scoring (Refer Table I). Each recorded response had three values to consider, namely the average minimum value (n1), most reasonable value (n2), and the maximum value (n3). The rationale of TFN was to show the fuzziness or inexactness in the opinion made by an expert. Every opinion had a certain amount of ambiguity which can't be addressed by using a Likert scale because it is a fixed score. Let us say an item *"Racun memasuki tubuh badan melalui pernafasan"* was scored 5 (highly agree) by an expert. The score is converted into minimum, most reasonable, and the maximum value of 0.6, 0.8 and 1.0 fuzzy scores, respectively. It indicated the expert agreeable to the item is 60%, 80%, and 100%, respectively. The fuzzy scores were averaged as indicated by m1, m2 and m3 values for further Defuzzification process.

Defuzzification process

Defuzzification process (A_{max}) is a ranking process of each item to identify the importance level of each item. This ranking process was very helpful to determine whether to keep or discard certain items based on the following formula:

$$A_{max} = 1/3 * (m_1 + m_2 + m_3)$$

Table I: The difference between Likert scale scoring and Fuzzy scoring for a five-point scale

VariaLikert Scale Scoring	Linguistic variable	Fuzzy Scoring
5	Highly Agree	0.6, 0.8, 1.0
4	Agree	0.4, 0.6, 0.8
3	Moderately/Not Sure	0.2, 0.4, 0.6
2	Not Agree	0.0, 0.2, 0.4
1	Highly Not Agree	0.0, 0.0, 0.2

Table II: The summary of All Three Pre-requisites Post Fuzzy Delphi Analysis (Noise)

Construct/Items	Average Likert Score	Threshold Value (d) ≤ 0.2	Percentage of Experts' Consensus (%)	Average of Fuzzy Numbers	Ranking	Verdict
Noise-Knowledge		0.00				Acceptable
NK-1	5		75	0.738	2	Retained
NK-2	5		75	0.738	2	Retained
NK-3	5		75	0.738	2	Retained
NK-4	5		75	0.738	2	Retained
NK-5	5		81	0.750	1	Retained
NK-6	5		75	0.738	2	Retained
NK-7	5		75	0.738	2	Retained
NK-8	5		81	0.750	1	Retained
NK-9	5		81	0.750	1	Retained
NK-10	5		81	0.750	1	Retained
Noise-Attitude		0.01				Acceptable
NA-1	5		94	0.738	3	Retained
NA-2	5		94	0.700	5	Retained
NA-3	5		94	0.725	4	Retained
NA-4	5		81	0.738	3	Retained
NA-5	4		31*	0.588	6	Discarded
NA-6	5		81	0.763	1	Retained
NA-7	5		75	0.750	2	Retained
NA-8	5		81	0.763	1	Retained
NA-9	5		94	0.725	4	Retained
NA-10	5		94	0.725	4	Retained
NA-11	5		88	0.763	1	Retained
NA-12	4		25*	0.583	7	Discarded
NA-13	5		88	0.725	4	Retained
NA-14	4		38*	0.533	8	Discarded
Noise-Practice		0.01				Acceptable
NP-1	5		75	0.738	3	Retained
NP-2	5		81	0.750	2	Retained
NP-3	5		81	0.738	3	Retained
NP-4	5		81	0.738	3	Retained
NP-5	5		88	0.775	1	Retained
NP-6	5		88	0.725	4	Retained

* Item with Experts' consensus ≤ 75% and lowest ranking within their construct

Determination of item acceptability

There were three prerequisites to be fulfilled to determine the acceptability of the constructs and its respective items. The prerequisites were (1) threshold value, d-construct ≤ 0.2[19], (2) experts agreement on evaluated items ≥75%[20] and (3) ranking of the item. The threshold value,d-construct indicates the selection of certain construct based on the consensus of the experts for each construct. However, prior to that, a threshold value (d) for each itemwas found, by calculating the difference between average fuzzy number and each expert fuzzy number (refer Figure 2& 3)using the formula below:

$$d(\tilde{m},\tilde{n}) = \sqrt{\frac{1}{3}\left[(m1-n1)^2 + (m2-n2)^2 + (m3-n3)^2\right]}$$

Once the value was obtained, a threshold value (d-construct) was calculated by using the formula below:

$$\text{Threshold Value (d-Construct)} = \frac{\sum \text{Average Threshold Value, (d) for each item}}{\text{Total Experts x Total Items in Constructs}}$$

Based on the value, the acceptability of the construct was determined, whereby a construct was accepted if the Threshold value (d-construct) ≤ 0.2. Expert agreement on each evaluated item was also based on threshold value (d) for each item, whereby (d) ≤ 0.2 are accepted. The frequency of accepted values was presented as percentage as shown in Figure 3. Items with expert agreement of less than 75% were discarded. The rank of an item within a similar construct was determined after Defuzzification process as mentioned earlier (refer Figure 1). All respondents data were entered and analysed using Microsoft excel version 2013. A complete

Table III: The summary of All Three Pre-requisites Post Fuzzy Delphi Analysis (Chemical)

Construct/Items	Average Likert Score	Threshold Value (d) ≤ 0.2	Percentage of Experts' Consensus (%)	Average of Fuzzy Numbers	Ranking	Verdict
Chemical-Knowledge		0.00				Acceptable
CK-1	5		94	0.788	1	Retained
CK-2	5		88	0.696	6	Retained
CK-3	5		94	0.788	1	Retained
CK-4	5		88	0.750	3	Retained
CK-5	5		88	0.788	1	Retained
CK-6	5		81	0.733	4	Retained
CK-7	5		88	0.775	2	Retained
CK-8	5		88	0.788	1	Retained
CK-9	5		94	0.713	5	Retained
CK-10	5		94	0.775	2	Retained
Chemical-Attitude		0.01				Acceptable
CA-1	5		94	0.729	4	Retained
CA-2	5		88	0.742	3	Retained
CA-3	5		88	0.704	6	Retained
CA-4	5		88	0.717	5	Retained
CA-5	5		94	0.788	1	Retained
CA-6	5		94	0.717	5	Retained
CA-7	5		88	0.775	2	Retained
CA-8	4		81	0.692	7	Retained
CA-9	5		88	0.717	5	Retained
CA-10	5		94	0.729	4	Retained
Chemical-Practice		0.01				Acceptable
CP-1	4		31*	0.600	6	Discarded
CP-2	4		38*	0.575	8	Discarded
CP-3	4		94	0.725	3	Discarded
CP-4	4		75	0.750	2	Discarded
CP-5	5		94	0.692	4	Retained
CP-6	4		94	0.679	5	Retained
CP-7	4		94	0.725	3	Discarded
CP-8	4		88	0.775	1	Discarded
CP-9	5		13*	0.592	7	Retained
CP-10	5		13*	0.592	7	Retained

* Item with Experts' consensus ≤ 75% and lowest ranking within their construct

summary of the study flow process has been illustrated in Figure 4.

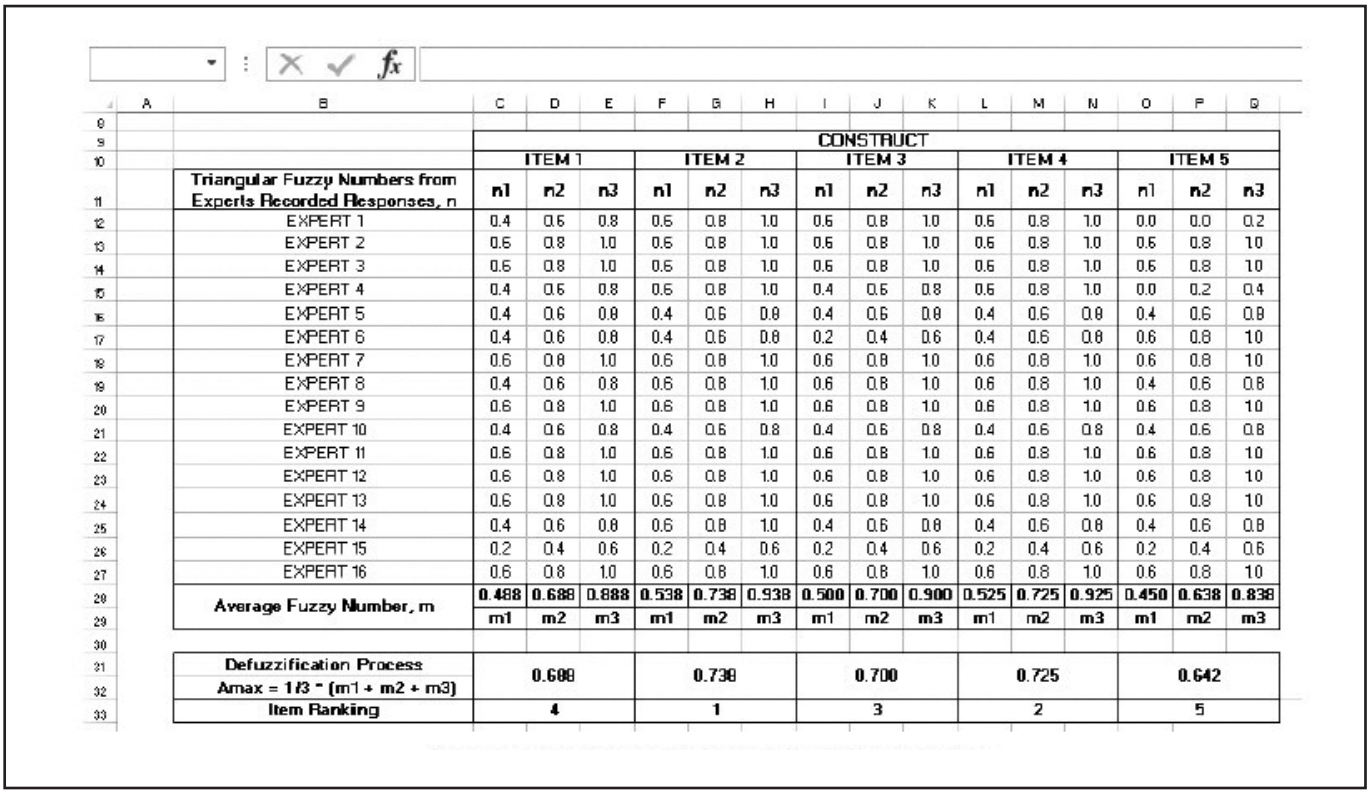
RESULTS

A 100% response rate was obtained from all the sixteen experts. All the items within the six constructs had scored average Likert scoring of four to five, which was in the scale of agree to highly agree. These scores were converted into fuzzy numbers. Post FDM analysis, the first prerequisite was fulfilled whereby all the six constructs had threshold value (d) ≤ 0.2. For the second prerequisite, three items (21%) from noise-attitude construct and four items (40%) from chemical-practice construct had expert consensus lesser than 75%, which giving rise to about 12% from the total items in the questionnaire. The third prerequisite was used to rank the items within the constructs by calculating the average fuzzy numbers. The seven items which did not fulfill the second prerequisite similarly had lower ranks during the analysis. The whole findings were summarised in the Table II and Table III.

Those seven items were discarded and the remaining which fulfilled the pre-requisites was retained for the final draft for content validation process. Apart from discarding items based on these prerequisites, little modification of items in terms of the structure, position and wordings were done based on the comments by the experts. These were some minor changes and it didn't alter the objective and nature of the items. As a final draft, a total of six constructs with 53 items were finalised as the result of this Fuzzy Delphi analysis.

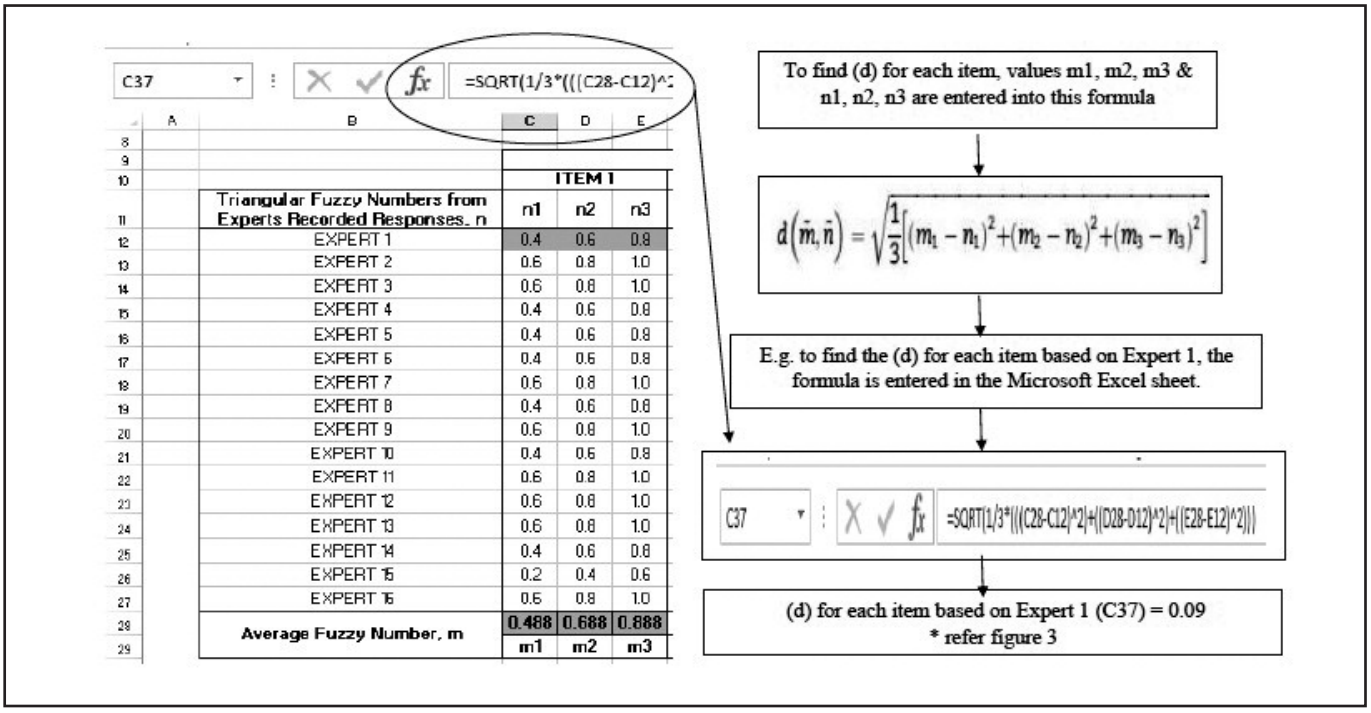
DISCUSSION

This article demonstrated the study objective which was the content validation of pesticide applicators questionnaire by obtaining the experts' consensus on suitability of the pre-selected items on the questionnaire and using FDM to ultimately remove the unfit items. This study found that the average Likert scale scoring by the experts for all the items are from agreeable to highly agreeable range, which means all 60 items can be accepted. However, post FDM analysis, only 53 items were fulfilled all the pre-requisites. About 12% of the items didn't match the terms, hence those items were regarded as failure to achieve consensus from the expert panel and removed. This 12% is the fuzziness or uncertainty among the expert panel which was not detected by the usual Likert Scale scoring system. Every expert will have their own uncertainty towards certain variable, which often regarded as the "grey area". The use of FDM is to deal with those "grey area", ensuring a qualified analysis outcome. Furthermore, this method catered all the experts' opinion, considering



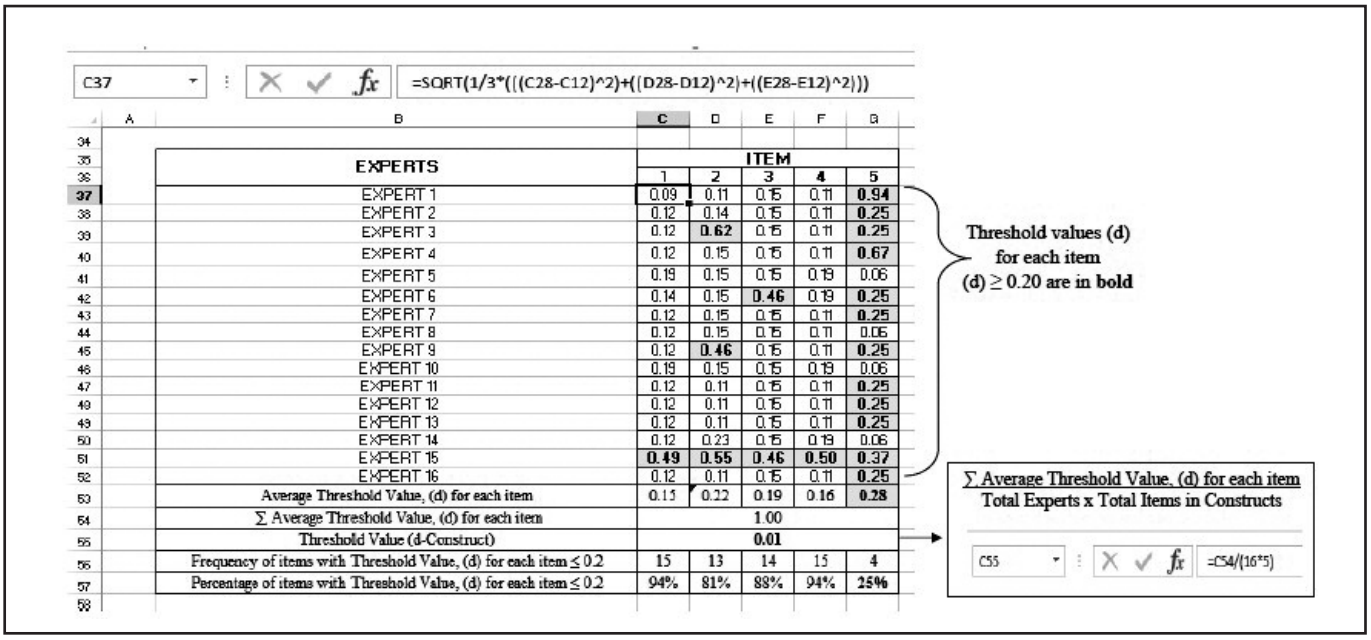
	CONSTRUCT														
	ITEM 1			ITEM 2			ITEM 3			ITEM 4			ITEM 5		
Triangular Fuzzy Numbers from Experts Recorded Responses, n	n1	n2	n3	n1	n2	n3	n1	n2	n3	n1	n2	n3	n1	n2	n3
EXPERT 1	0.4	0.6	0.8	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0	0.0	0.0	0.2
EXPERT 2	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0
EXPERT 3	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0
EXPERT 4	0.4	0.6	0.8	0.6	0.8	1.0	0.4	0.6	0.8	0.6	0.8	1.0	0.0	0.2	0.4
EXPERT 5	0.4	0.6	0.8	0.4	0.6	0.8	0.4	0.6	0.8	0.4	0.6	0.8	0.4	0.6	0.8
EXPERT 6	0.4	0.6	0.8	0.4	0.6	0.8	0.2	0.4	0.6	0.4	0.6	0.8	0.6	0.8	1.0
EXPERT 7	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0
EXPERT 8	0.4	0.6	0.8	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0	0.4	0.6	0.8
EXPERT 9	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0
EXPERT 10	0.4	0.6	0.8	0.4	0.6	0.8	0.4	0.6	0.8	0.4	0.6	0.8	0.4	0.6	0.8
EXPERT 11	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0
EXPERT 12	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0
EXPERT 13	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0
EXPERT 14	0.4	0.6	0.8	0.6	0.8	1.0	0.4	0.6	0.8	0.4	0.6	0.8	0.4	0.6	0.8
EXPERT 15	0.2	0.4	0.6	0.2	0.4	0.6	0.2	0.4	0.6	0.2	0.4	0.6	0.2	0.4	0.6
EXPERT 16	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0	0.6	0.8	1.0
Average Fuzzy Number, m	0.488	0.688	0.888	0.538	0.738	0.938	0.500	0.700	0.900	0.525	0.725	0.925	0.450	0.638	0.838
	m1	m2	m3	m1	m2	m3	m1	m2	m3	m1	m2	m3	m1	m2	m3
Defuzzification Process	0.688			0.738			0.700			0.725			0.642		
Amax = 1/3 * (m1 + m2 + m3)															
Item Ranking	4			1			3			2			5		

Fig. 1: Triangular Fuzzy Number and Defuzzification Process.



	ITEM 1		
Triangular Fuzzy Numbers from Experts Recorded Responses, n	n1	n2	n3
EXPERT 1	0.4	0.6	0.8
EXPERT 2	0.6	0.8	1.0
EXPERT 3	0.6	0.8	1.0
EXPERT 4	0.4	0.6	0.8
EXPERT 5	0.4	0.6	0.8
EXPERT 6	0.4	0.6	0.8
EXPERT 7	0.6	0.8	1.0
EXPERT 8	0.4	0.6	0.8
EXPERT 9	0.6	0.8	1.0
EXPERT 10	0.4	0.6	0.8
EXPERT 11	0.6	0.8	1.0
EXPERT 12	0.6	0.8	1.0
EXPERT 13	0.6	0.8	1.0
EXPERT 14	0.4	0.6	0.8
EXPERT 15	0.2	0.4	0.6
EXPERT 16	0.6	0.8	1.0
Average Fuzzy Number, m	0.488	0.688	0.888
	m1	m2	m3

Fig. 2: Method to obtain Threshold value (d) for each item.



EXPERTS	ITEM 1	2	3	4	5
EXPERT 1	0.09	0.11	0.15	0.11	**0.94**
EXPERT 2	0.12	0.14	0.15	0.11	**0.25**
EXPERT 3	0.12	**0.62**	0.15	0.11	**0.25**
EXPERT 4	0.12	0.15	0.15	0.11	**0.67**
EXPERT 5	0.19	0.15	0.15	0.19	0.06
EXPERT 6	0.14	0.15	**0.46**	0.19	**0.25**
EXPERT 7	0.12	0.15	0.15	0.11	**0.25**
EXPERT 8	0.12	0.15	0.15	0.11	0.06
EXPERT 9	0.12	**0.46**	0.15	0.11	**0.25**
EXPERT 10	0.19	0.15	0.15	0.19	0.06
EXPERT 11	0.12	0.11	0.15	0.11	**0.25**
EXPERT 12	0.12	0.11	0.15	0.11	**0.25**
EXPERT 13	0.12	0.11	0.15	0.11	**0.25**
EXPERT 14	0.12	0.23	0.15	0.19	0.06
EXPERT 15	**0.49**	**0.55**	**0.46**	**0.50**	**0.37**
EXPERT 16	0.12	0.11	0.15	0.11	**0.25**
Average Threshold Value, (d) for each item	0.15	0.22	0.19	0.16	**0.28**
∑ Average Threshold Value, (d) for each item			1.00		
Threshold Value (d-Construct)			**0.01**		
Frequency of items with Threshold Value, (d) for each item ≤ 0.2	15	13	14	15	4
Percentage of items with Threshold Value, (d) for each item ≤ 0.2	94%	81%	88%	94%	25%

Fig. 3: Construct and items acceptability based on experts' consensus.

some expert are more experienced, some are more knowledgeable, some with relevant skills and some has the policy making authority in the field. This variety of opinions is merged together to support each other's deficiency to derive at the desirable outcome. Moreover, the final draft of the questions was arranged based on priority ranking derived by the analysis. On the positive note, although the items were picked from variety of literature which was very unusual compared to the traditional practice of selecting a questionnaire, the difference between the initial selection of items and the level of experts' opinion was very minimal (12%). This could be possibly due to majority of the items are originally from the local language and the remaining items were hand-picked, translated and modified by the author who is equally experienced and knowledgeable in the similar field.

Generally, an indoor meetings or workshops will be conducted to gather the experts under a roof in order to get their consensus. This involves tedious process, starting from the calling letter, arranging the venue, travelling expenses, refreshment beverages and obviously plenty of time will be spent. The main significant advantage of this study was, it was conducted in a very short span of time, with zero costing involved. It was also a hustle-free job for the experts as well. The experts' responses were gathered via emails and messages at their convenience. This method will certainly reduce the risk of bias by ensuring anonymity and welcoming the opinion of atypical views among the experts and the responses are totally independent without the fear of judgemental by others which usually present in any routine group discussions or meetings.[21]

Pertaining to this study, it introduces that FDM can be used to get expert's opinion and consensus in order to achieve a decision. This method can be used as a pre-construct validation tool to select the suitable items before subjecting it to a construct validation process. Most importantly, this method gives a proper quantitative approach to usual group discussions or meetings which are in a qualitative manner. This questionnaire can be considered as accepted by the experts without any prejudice and it can be used for the targeted population after confirmatory validation process.

However, there are some limitations with this method, whereby, the researcher or a person who is conducting this FDM should have some pre-existing background knowledge regarding the subject, whereby he/she must be an expert too. Moreover, FDM requires existing kinds of literature or matter, to begin with, and this method is not suitable for developing brand new items. On the other note, this study required constant reminder to the experts to give their response. This is mainly due to limited time factor and this might lead to the emotional bias among the experts. In addition to that, the selection of the expert was by purposive sampling method based on their willingness and availability. A probable sampling method among the experts and more time frame would have been yielded a different result.

As a recommendation, FDM should be widely used in medical related studies, to get expert's opinion and consensus especially in developing a protocol or guidelines related to medical practices. Although limited, there are some studies which use this method for medically related researches. It was used in one of the studies to find consensus for Asthma management guidelines.[22] Another study in Mexico which used this technique to determine the socio-ecological factors that influence adherence to mammography screening.[3] However, locally in Malaysia, this method is yet to be introduced in the field of medicine. Furthermore, it is hoped that this study can be beneficial as a guidance for any future medical or health related research which intends to use FDM for their studies.

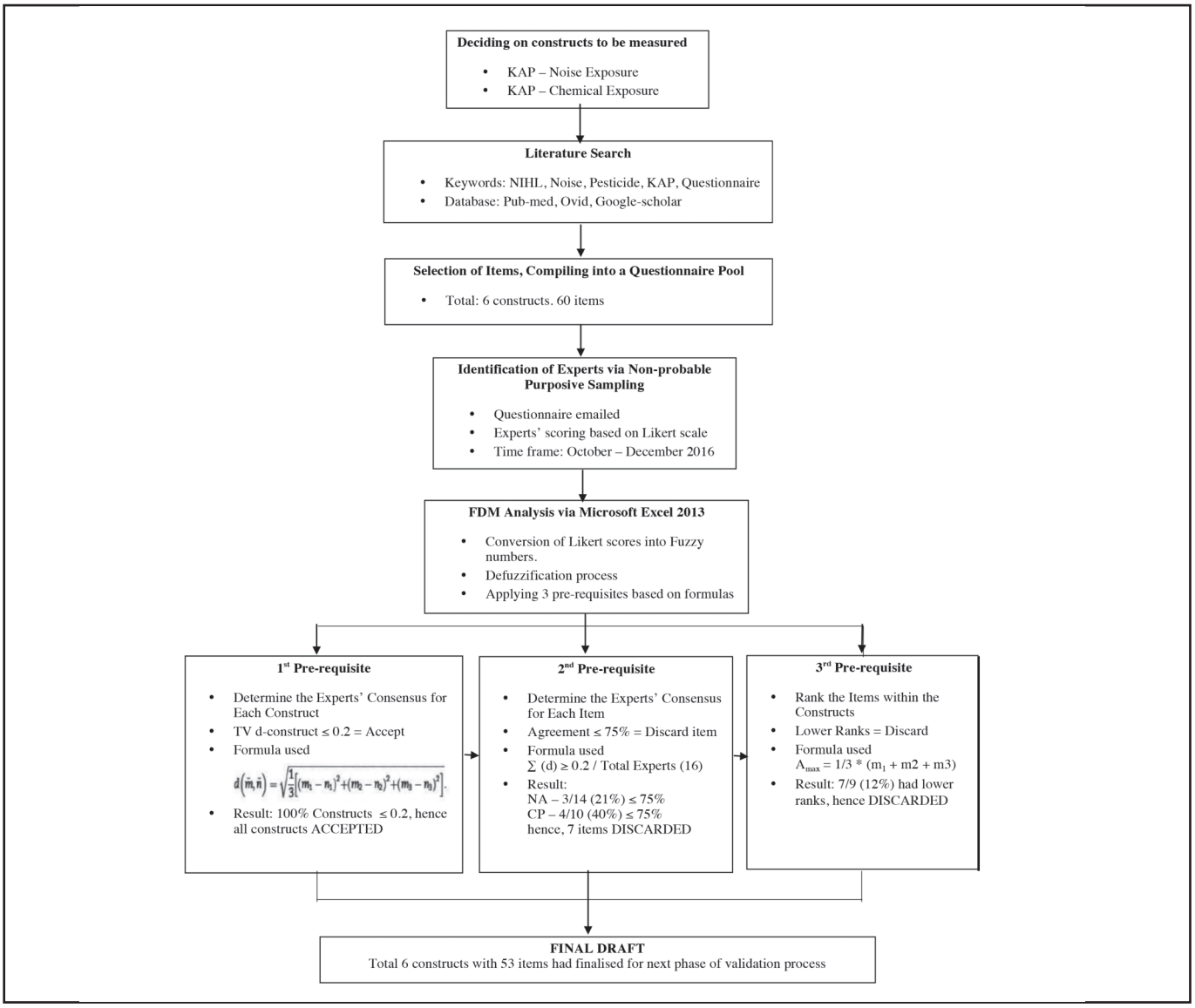


Fig. 4: Summary of content validation using Fuzzy Delphi Method.

CONCLUSION

Post FDM analysis, the experts' consensus on suitability of the pre-selected items on the questionnaire set were obtained, hence it is now ready for further construct validation process.

ACKNOWLEDGEMENT

We would like to thank the Director General of Health Malaysia for his permission to publish this article. This study is part of doctorate research which is supported by the Dana Fundamental PPUKM (Project code: FF-2016-291) and ethical approval from the Medical Research and Ethics Committee (MREC), Ministry of Health (NMRR-16-660-30666-IIR). The research team would like to thank the sixteen experts for their contribution to this study. Our sincere acknowledgment to Associate Professor Dr. Retneswari Masilamani and Associate Professor Dr. Razman Mohd Rus for their inputs in forming the items. Last but not least, we express our gratitude to the Department of Community Health, PPUKM and to those who had extended their help in contributing to this manuscript.

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