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(RESEARCH ARTICLE)



Arsenic in mind: Construction of knowledge and attitude scales

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Abstract

Chronic arsenic toxicity (arsenicosis) as a result of drinking arsenic-contaminated groundwater is a major environmental health hazard throughout the world, including India. During the last four decades arsenic contamination of groundwater in nine districts out of twenty in West Bengal has become a serious problem. About 20% population of West Bengal in nine districts (Malda, Murshidabad, Nadia, North 24- Parganas, and South 24-Parganas, Kolkata, Howrah, Hooghly and Burdwan) are affected by arsenic problem. To prevent this harmful effect, every people need to have proper knowledge and positive attitude towards arsenic. In this study, the researcher constructed a standardized tool of knowledge and attitude towards arsenic to assess the knowledge and attitude level of arsenic among the people of arsenic contaminated area. The researcher took item analysis method to assess the quality of the items of every section. Then the tools were measured the reliability by the Pearson's product moment correlation method. Primarily two self-administered tools of 39 knowledge items and 32 attitude items regarding arsenic was applied among the people of Nadia district of West Bengal. Therefore, the researcher analyzed the collecting data and eliminated the poor items on the basis of difficulty value and discrimination index. After elimination of distracting items, 25 items in knowledge section and 25 items in the attitude section were retained as a final form of tool regarding arsenic. Thereafter the final form of tools applied among 60 general people to calculate the reliability of the tools by test-retest reliability method. The researcher found significant reliability in knowledge and attitude tools. These standard tools can assess the knowledge and attitude level regarding arsenic among the people of arsenic contamination area with accuracy.

Keywords: Arsenic; Knowledge; Attitude; Item analysis

1 Introduction

Arsenic contamination of groundwater is a form of groundwater pollution which is due to naturally occurring high concentrations of arsenic in deeper levels of groundwater (Santra, 2017). Historically, the Hindu civilization most likely originated in the Indus Valley region, and the Indus River was possibly a holy river for this culture (Bhargava, 1987). After the decline of the Indus Valley civilization in approximately 1900 BC, people migrated from the east to the Ganga plain and began using Ganga water to supplement their daily needs; at that time, the Ganga was considered a holy river (Bhargava, 1987). Devout Hindus still believe that the Ganga's water will never be polluted and that this holy river is the root of spiritual purification (Chakraborti, *et. al.*, 2017). However, currently available scientific literature reveals that the Ganga is considered to be one of the world's most polluted rivers, containing a number of toxins including arsenic, cadmium, chromium, copper, lead, and mercury, as well as pesticides and pathogenic microbes nearly 3000 times greater than the safe limit prescribed by the World Health Organization (WHO) (Paul, 2017). The area of West Bengal is 88752 km² with a total population of 68 million (1991 census). About 800000 people are drinking arsenic contaminated water and 175000 people are suffering from arsenic related diseases. These six districts are South 24-Parganas, North 24-Parganas, Nadia, Burdwan, Murshidabad and Malda. The total area of the affected districts is 34000 km² (38.47% of the area of West Bengal) with a population of 30 million (44.4% of total population of West Bengal) (Halder, 2019). As there is a dearth of a suitable scale for measurement of Arsenic related knowledge and attitude, the

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main objectives of this work was to prepare and standardization of a knowledge and attitude scale towards Arsenic disease among the people of Nadia district, West Bengal.

Objectives

The main purpose of this study is standardized knowledge and attitude scales towards Arsenic and to analyses the quality of each item of the knowledge and attitude scales to identify the poor items so that they can be modified or can be removed from the final test.

Research questions

The research questions of the study are-

- What are the values of difficulty index and discrimination index of the items of the knowledge and attitude towards Arsenic?
- How many numbers of items are considered as effective items for the final test after analyzing the items on the basis of items on the basis of item difficulty values and discrimination values?
- Are the scales reliable?

2 Methods

2.1 Design

A convenience sampling survey design was used to achieve the objectives of the study. This sampling technique is a kind of non-probability or non-random sampling technique (Teddlie and Yu, 2007).

2.2 Participants

The population of the study was the people of Nadia district. So, this study conducted on 50 people of arsenic contaminated area of Nadia District, West Bengal for item analysis. Then, the researcher also administered the final form of the scale among 50 people of Nadia district to calculate the item reliability.

2.3 Instrument

The researcher first formed a draft test after reviewing various literature related to the study and consulted with experts and resource persons in the field of research under discussion. Then the set of items were examined through its purposes, clarity of language, intensity and appropriateness of each statement by the experts and resource person. Thereafter a set of thirty-nine statements of the knowledge scale and thirty-two statements of attitude scale were framed. The knowledge and attitude scale towards Arsenic are of five point Likert summative rating five alternative responses were kept for each item, these are – ‘Fully agree’, ‘Partial agree’, ‘Neutral’, ‘Partial disagree’ and ‘Fully disagree’. There were a sufficient number of favorable and unfavorable statements in the questionnaire; the favorable statements were scored from maximum to minimum as: ‘5’, ‘4’, ‘3’, ‘2’ and ‘1’. While the unfavorable statements were scored from minimum to maximum as: ‘1’, ‘2’, ‘3’, ‘4’ and ‘5’.

2.4 Data collection

The researcher gave a specific instruction with the questionnaire when the test was administered in the participants. The participants were carefully read the questionnaire and gave response of each item of the knowledge and attitude test. Then, the researcher collected the response sheet from each participant and acknowledged them.

2.5 Data Analysis

After the data collection, the researcher analyzed the data by the method of item analysis. In this study items were assessed the quality by their value of difficulty index and discrimination index. The formula of difficulty value (p-value):

$$p = \frac{R}{N} \times 100$$

Where, p denotes the difficulty index, R denotes the number of people who given the answer rightly and N denotes the total number of people who responded.

The values of the discrimination of item was determined by the help of the formula –

$$DI = \frac{RU - RL}{\frac{T}{2}}$$

Where, DI stands for discrimination index, RU denotes the number of right responses from the upper group. RL denotes the number of right answers from the lower group and T denotes the total number of respondents from both groups.

For the determination of the test reliability, the test-retest method was used. Karl Pearson's product moment method was used to calculate the correlation between two sets of scores

3 Results

3.1 Research Question- I

What are the values of difficulty index and discrimination index of the items of the knowledge and attitude towards Arsenic?

Table 1 Presents p-values and DI values of the items of knowledge scale

Item no.	p-value	DI	Item no.	p-value	DI
K1	0.68	0.32	K21	0.92	0
K2	0.88	0	K22	0.10	0.12
K3	0.18	0.12	K23	0.56	0.48
K4	0.24	0.08	K24	0.88	0.08
K5	0.62	0.36	K25	0.28	0.16
K6	0.70	0.44	K26	0.98	-0.04
K7	0.24	0.16	K27	0.70	0.36
K8	0.98	0.04	K28	0.50	0.36
K9	0.32	0.24	K29	0.56	0.24
K10	0.58	0.44	K30	0.22	0.12
K11	0.68	0.56	K31	0.64	0.32
K12	0.48	0.24	K32	0.20	0.08
K13	0.70	0.36	K33	0.60	0.56
K14	0.66	0.52	K34	0.44	0.32
K15	0.68	0.48	K35	0.36	0.48
K16	0.26	-0.04	K36	0.44	0.48
K17	0.64	0.24	K37	0.96	0
K18	0.52	0.56	K38	0.38	0.52
K19	0.58	0.36	K39	0.70	0.60
K20	0.44	0.32			

Table 2 Presents p-values and DI values of the items of attitude scale

Item no.	p-value	DI	Item no.	p-value	DI
A1	0.66	0.36	A17	0.68	0.56
A2	0.48	0.32	A18	0.64	0.48
A3	0.52	0.24	A19	0.62	0.44
A4	0.12	0.12	A20	0.58	0.28
A5	0.28	0.08	A21	0.28	0.16
A6	0.68	0.56	A22	0.72	0.56
A7	0.68	0.32	A23	0.60	0.32
A8	0.64	0.48	A24	0.42	0.36
A9	0.70	0.60	A25	0.42	0.44
A10	0.66	0.52	A26	0.64	0.48
A11	0.38	0.52	A27	0.90	0.04
A12	0.88	0	A28	0.66	0.28
A13	0.58	0.36	A29	0.58	0.36
A14	0.54	0.36	A30	0.46	0.28
A15	0.96	-0.08	A31	0.88	0.16
A16	0.44	0.24	A32	0.66	0.52

3.2 Research Question – II

How many numbers of items are considered as effective items for the final test after analyzing the items on the basis of item difficulty values and discrimination values?

Table 3 Presents distribution of knowledge and attitude items on the basis of difficulty index (p-value)

p-value	Total Item	
	Knowledge	Attitude
Easy ($p > 0.70$)	6	4
Moderately Difficult ($0.31 \leq 0.70$)	25	25
Difficult ($p \leq 0.30$)	8	3

A general guideline to interpreting the values of item difficulty index (Bichi, 2015)

On the basis of set standards for the interpretation of difficulty indices 25 items of knowledge test were identified as moderately difficult and 6 items were identified as easy and 8 items were identified as difficult. From Table-1, it is clear that in case of knowledge test, 6 easy items and 8 difficult items were unable to satisfy the condition, these items were considered as 'poor' items. This 'poor' items were K2, K3, K4, K7, K8, K16, K21, K22, K24, K25, K26, K30, K32 and K37. In the Attitude test, 25 items were moderately difficult, 4 items were very easy and 3 items were very difficult. In the attitude test, 7 items were considered as 'poor' item. This item was A4, A5, A12, A15, A21, A27 and A31.

Table 4 Presents Discrimination of Knowledge and Attitude Items based on Discrimination Indices

Discrimination Index	Total Items	
	Knowledge	Attitude
Very Good($D > 0.40$)	12	12
Reasonably Good($0.30-0.39$)	9	8
Marginal ($0.20-0.29$)	4	5
Poor($D < 0.19$)	14	7

A general rule to interpret the item discrimination (Ebel and Frisbie, 1991)

According to the criteria of the discrimination index, results of the knowledge test indicates that 14 items failed to distinguish between students of different abilities, 4 items were marginal which needs to be reviewed, 9 items were satisfactory and the function of the 12 items were very well. In the case of attitude test, 7 items failed to discriminate the different abilities of the students, 5 items were marginal, 8 items were satisfactory and 12 items functioned as very good.

The details of item analysis of the knowledge scale of Arsenic questionnaires are presented in the table below:

Table 5 Presents item analysis of the knowledge scale of Arsenic

Item no.		p-value	DI	Item no.		p-value	DI
Before	After			Before	After		
K1	K1	0.68	0.32	K21*	-	0.92	0
K2*	-	0.88	0	K22*	-	0.10	0.12
K3*	-	0.18	0.12	K23	K15	0.56	0.48
K4*	-	0.24	0.08	K24*	-	0.88	0.08
K5	K2	0.62	0.36	K25*	-	0.28	0.16
K6	K3	0.70	0.44	K26*	-	0.98	-0.04
K7*	-	0.24	0.16	K27	K16	0.70	0.36
K8*	-	0.98	0.04	K28	K17	0.50	0.36
K9	K4	0.32	0.24	K29	K18	0.56	0.24
K10	K5	0.58	0.44	K30*	-	0.22	0.12
K11	K6	0.68	0.56	K31	K19	0.64	0.32
K12	K7	0.48	0.24	K32*	-	0.20	0.08
K13	K8	0.70	0.36	K33	K20	0.60	0.56
K14	K9	0.66	0.52	K34	K21	0.44	0.32
K15	K10	0.68	0.48	K35	K22	0.36	0.48
K16*	-	0.26	-0.04	K36	K23	0.44	0.48
K17	K11	0.64	0.24	K37*	-	0.96	0
K18	K12	0.52	0.56	K38	K24	0.38	0.52
K19	K13	0.58	0.36	K39	K25	0.70	0.60
K20	K14	0.44	0.32				

Note: *Item Rejected

The details of item analysis of the Attitude scale of Arsenic are presented in the table below:

Table 6 Item analysis of the attitude scale of Arsenic

Item no.		p-value	DI	Item no.		p-value	DI
Before	After			Before	After		
A1	A1	0.66	0.36	A17	A13	0.68	0.56
A2	A2	0.48	0.32	A18	A14	0.64	0.48
A3	A3	0.52	0.24	A19	A15	0.62	0.44
A4*	-	0.12	0.12	A20	A16	0.58	0.28
A5*	-	0.28	0.08	A21*	-	0.28	0.16
A6	A4	0.68	0.56	A22	A17	0.72	0.56
A7	A5	0.68	0.32	A23	A18	0.60	0.32
A8	A6	0.64	0.48	A24	A19	0.42	0.36
A9	A7	0.70	0.60	A25	A20	0.42	0.44
A10	A8	0.66	0.52	A26	A21	0.64	0.48
A11	A9	0.38	0.52	A27*	-	0.90	0.04
A12*	-	0.88	0	A28	A22	0.66	0.28
A13	A10	0.58	0.36	A29	A23	0.58	0.36
A14	A11	0.54	0.36	A30	A24	0.46	0.28
A15*	-	0.96	-0.08	A31*	-	0.88	0.16
A16	A12	0.44	0.24	A32	A25	0.66	0.52

Note: * Item Rejected

3.3 Final form of knowledge scale

The final form of knowledge and Attitude scale contains 25 & 25 items respectively covering all dimension of Arsenic.

Table 7 Shows the distribution of the items after item analysis among different dimension of knowledge and attitude towards Arsenic

Test	Sl. No.	Dimensions	Raw Score		Total items of the dimension	Total items
			Favorable	Unfavorable		
Knowledge Scale	1	Concept	2, 5	1, 3, 4, 6	6	25
	2	Effect of Arsenic	7, 8, 9	10	4	
	3	Preventive Measures	11, 14, 15	12, 13, 16	6	
	4	Prognosis & Symptoms	17, 20	18, 19	4	
	5	Superstition	21, 23, 25	22, 24	5	
Attitude Scale	1	Concept	1, 2, 7, 8, 9	3, 4, 5, 6	9	25
	2	Degree of Harmfulness	10, 13	11, 12	4	
	3	Government & NGO Initiatives	15, 17	14, 16	4	
	4	Satisfaction about Government Initiatives	18, 20, 21	19	4	
	5	Preventive Measures	22, 23	24, 25	4	

3.4 Research Question – III

Are the scales reliable?

After item analysis, the researcher conducted a test-retest on 60 male and female people from various demographic locations of Nadia district to determine the accuracy of the test items. In this test Pearson's Product Moment technique was utilized to calculate the correlation between the two tests.

Table 8 Represents the correlation between T₁ and T₂

Test	Coefficient of correlation(r)
Knowledge	0.97
Attitude	0.95

The test-retest coefficient of the knowledge scale found as 0.97 which is very positive high correlation and reliability of attitude scale found as 0.95 which is very significant correlation.

4 Discussion

In the Knowledge scale regarding Arsenic fourteen (14) items of knowledge test (K2, K3, K4, K7, K8, K16, K21, K22, K24, K25, K26, K30, K32 and K37) that failed to satisfy the condition based on both difficulty index (p-value) and discrimination index (DI) were eliminated. Totally, twenty-five (25) items of knowledge scale were selected as a final form based on both difficulty value & discrimination value.

In the case of attitude test, seven (7) items of attitude scale (A4, A5, A12, A15, A21, A27 and A31) that failed to satisfy the condition based on both difficulty index (p-value) and discrimination index (DI) was eliminated. And twenty-five (25) items were selected in the attitude questionnaire.

The final form of knowledge and attitude scales towards arsenic was measured the reliability that found as very significant correlation.

5 Conclusion

To conclude, this study has been showed how to construct a standardized tool to assess knowledge and attitude towards Arsenic that has a good items and significant reliability. The tool is standardized to assess knowledge and attitude towards arsenic disease among the people in the demographic area of Nadia district, West Bengal. By this tool, researcher can gather information about knowledge and attitude towards arsenic of Nadia district's people. This study will help to increase social awareness about the adverse effect of Arsenic.

Compliance with ethical standards

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Disclosure of conflict of interest

There are no disclosed conflicts of interest for the authors. The content of the paper have been reviewed and approved by each co-author and there are no competing interests to disclose. We attest that the submission is unique and is not already being considered by another publisher.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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