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Study for Development of Health Belief Scale Related to Lead Exposure

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Abstract

Background/Aim: This methodological study was conducted to develop a health belief scale for lead exposure, and to analyze the validity and reliability of the scale.

Materials and Methods: The study was carried out on 525 male workers applying to Ankara Occupational Diseases Hospital between February 1 and April 30, 2013. The Participant Information Form and the Health Belief Scale Related to Lead Exposure (HBSRLE) were used to collect data. Data content validity was analyzed with Law she technique by the experts of the subject, construct validity with factor analysis, and reliability with Cronbach's alpha coefficient and Spearman correlation analysis.

Results: Construct validity analysis revealed that the scale was composed of six factors with factor loads ranging from .615 to .832 (p<0.05). Reliability analysis revealed that HBSRLE's Cronbach's alpha reliability coefficient was .94 and sub-dimensions ranged from .81 to .94. Based on split-half reliability analysis, Spearman-Brown coefficient of the Scale was .740 and the Gutman Split-Half Coefficient was .739 (p<0.05). Spearman correlation analysis showed that item-total score correlations (Rho) ranged from .233 to .868 (p<0.001).

Discussion and Conclusions: As a result of validity and reliability analyses, it was found that HBSRLE, consisting of 33 items and six sub-dimensions, is a valid and reliable scale.

Key words: Scale development, Validation, Reliability, Lead Exposure, Health Belief Model

Introduction

Lead is a heavy metal with no biochemical or physiological function in the organism, which is long known to repress cellular events and damage vital organs. People are exposed to lead environmentally or occupationally. In parallel to increased urbanization and industrialization in today's industrializing societies, amount of lead, which is commonly found in nature, have significantly increased in human body. This problem has begun to pose a risk for public health as necessary measures are not taken simultaneously [1, 2].

Among other heavy metals, lead is the most widely used one with identified toxicological effects. Lead is used in more than 150 business lines in industry due to its availability and practical use. Therefore, lead exposure occurs in a wide range of fields [3, 4].

Lead exposure is quite common around the world, with decreasing cases in developed countries. Occupational exposure to lead occurs in extraction and processing of lead in mine quarries, preparation of lead alloys, production of lead containing batteries, paint, tires, glass, ceramics and lead compounds, firearms training, bullet production, ship making, demolition and welding, lead oil production, accumulator production and repair [5, 6]. Lead powder and fume that is produced during these activities and that intensively spreads to the environment causes occupational exposure. Lead poisoning cases mostly occur in accumulator industry and small workplaces with poor ventilation [7, 8].

Lead has been shown to have various health effects. After exposure, lead affects various systems and organs, particularly hematologic system, gastrointestinal system, central nervous system, cardiovascular system, kidneys and liver; and causes serious problems in terms of reproductive health. Blood lead causes hearing loss at a concentration of 20 μg/dl, and nephropathy and decreased nerve conduction at a concentration of 40μg/dl [9, 10, 11]. Lead encephalopathy can develop when blood lead level exceeds 80–100 μg/dl in children and 100–120 μg/dl in adults. Lead encephalopathy can be acute or chronic. Acute lead encephalopathy can develop shortly after acute lead poisoning due to lead exposure [5].

Improvement of working conditions, work hygiene, safety warnings and measurement of inorganic lead and compounds at regular intervals and keeping them at the desired level within the workplace are of vital importance [12]. Presence of an adequate and effective ventilation system and the use of wet working system should be the first measures to be taken for protection from lead. Other necessary measures include separation of cafeterias from working areas, presence of toilets, shower and changing rooms and obeying daily working hours set out by law. On the other hand, preventive health behaviors of employees are also important to prevent intake of lead powder and fume in the air. These behaviors can include effective use of protective equipment such as work clothing, mask and gloves, avoiding smoking in the working area, avoiding eating or drinking, washing hands before meals and taking a shower after each shift [13].

Perceptions and attitudes of individuals about health are closely related with their health behaviors and are particularly important in terms of preventive health services. Health perceptions indicate to what extent an individual is psychologically open to performing preventive behaviors. An employee who understands the benefits of performing preventive health behaviors and who encounters minimum obstacles in displaying these behaviors is expected to have a higher ratio of exhibiting the expected preventive health behavior. It is also important to determine whether the employee intends to exhibit preventive health behaviors and the belief of the individual in successfully performing an action [14, 15].

A high number of people work in metal sector, which is a dangerous and hazardous work group where lead is used. Negative effects of lead on health and workforce losses can be prevented by taking precautionary measures for this work group [16]. Within the framework of Health Belief Model, there is a need to develop a scale to determine the internal factors that affect employees to display or not to display preventive health behaviors. If the developed model is found to be valid and reliable, it can be used by occupational health professionals to explain preventive health behaviors in improving the health of employees.

The aim of this study is to develop a health belief scale for lead exposure, and to analyze the validity and reliability of the scale.

Materials and methods

In this methodological study, three steps were undertaken to develop a scale:

The creation of scale items and submission to experts for evaluation in terms of content validity.

Scale items were developed based on Health Belief Model (HBM). Literature on Fundamentals of Health Belief Model [31-34] and studies that used HBM [15, 19-25] were used to create an item pool in line with the determined framework. The statements in the scale were tried to be structured in six sub-dimensions (perceived sensitivity, perceived seriousness, perceived usefulness, perceived obstacle, health motivation, and self-sufficiency) in accordance with Health Belief Model.

In order to meet the criteria prescribed in item writing, and to make statements clear and understandable, care was taken not to imply different meanings, and an item pool consisting of 107 items were created this way. This item pool was sent to six people who were specialized in the fields of public health, occupational health, and scale development. Lawshe technique was used to evaluate experts' views. Content Validity Ratios (CVR) were calculated with the Lawshe technique according to experts' views for each item as "appropriate or highly appropriate" using the following formula [17]:

$$CVR_i = \frac{ne - N/2}{N/2}$$

CVR$_i$: Content Validity of item iof the scale.
ne: Number of referees who stated that the statement is "appropriate or highly appropriate".
N: Total number of referees.

The CVR values calculated by the applied formula varied between -1 and +1. Items with negative orzero values in the first stage were excluded from the scale. In order to decide on items with positive values, minimum content validity ratios were determined at Lawshe p=0.05 (one-way) confidence interval. 67 items with validity ratios below .99 according to number of experts were excluded from the scale [17, 27]. 40 items with a CVR value of +1 remained in the scale. The remaining items were arranged according to expert views.

7 more items were excluded from the scale after validity and reliability analyses. Health Belief Scale Related to Lead Exposure containing 33 items on the specified behaviors of the workers was

given its final form. The scale consisted of 3 statements for "Perceived Sensitivity" sub-dimension, 5 statements for "Perceived Seriousness" sub-dimension, 6 statements for "Perceived Benefit" sub-dimension, 8 statements for "Perceived Obstacles" sub-dimension, 6 statements for "Health Motivation", and 5 statements of "Self-Sufficiency" sub-dimension.

Of the determined 33 statements, 25 are positive, while 8 are negative (items21-28). It is a five-pointLikert scale with scores ranging from 1 to 5 (1=strongly disagree, 5=strongly agree). Negative items are scored inversely. Minimum and maximum possible scores that can be obtained from the scale are 33 and 165, respectively. A preliminary application was performed on a group of 20 people to determine the comprehensibility and application time of the scale. The items that could not be comprehended were reorganized and application time was determined as 5-10 minutes.

Implementation of Draft Scale

At this stage of the study, we tried to reach 10 times the number of items while determining the sampling size. Drafted scale was applied to 525 workers who were employed in jobs related with lead or lead compounds who were admitted to Ankara Occupational Diseases Hospital occupational outpatient clinic between February 1 and April 30 2013 for periodical examination. In addition, some of the data was collected via Participant Information Form consisting of socio-demographic characteristics of the workers, working time, smoking status, and status of being affected by lead.

Data were collected as self-statement in a room reserved for this purpose in the outpatient clinic. The participants were informed about the research and their written consents were collected after the explanations.

Reliability and Validity Analysis of Draft Scale

SPSS 15.0 package software was used to evaluate the collected data. Kaiser Meyer Olkin (KMO) Coefficient and Bartlett's Sphericity Test were used to analyze whether the data were appropriate for analysis [29].

Kaiser Meyer Olkin (KMO) value was found to be 0.90 (>0.60) as presented in Table 1. Bartlett Sphericity test result was found to be 19057.439 (p<0.05). The result of the Bartlett Sphericity test was 19057.439 (p<0.05).

KMO	0.907		
Bartlett Sphericity Test	X²	Degree of Freedom (df)	p
	19057.439	780	.000

Table 1: KMO and Bartlett Sphericity Test Results of HBSRLE

Factor analysis was used for construct validity. Principal Component Analysis was conducted to test construct validity and Varimax Rotation method was used to interpret the factors more conveniently [30].

Spearman's correlation analyses (item-total score correlation, sub-dimension-total score correlations) were used to test the reliability of the scale. Guttman Split-Half method was used to test consistency between observers for split-half reliability and Spearman-Brown Reliability Coefficient was used to balance internal consistency

Results

Descriptive Findings

The study group consisted of male workers. Mean age was 35.7 ± 7.9 years (lowest: 21, highest: 63), % 75.4 (n: 396) were married, while 24.6% (n:129) were single. Of the workers, 4% (n:2) were

literate, 8.2% (n:43) were primary education graduates and 91.4% (n: 480) were high school or higher education graduates. 7.8% were working in lead bullet production, 19.4% were working in lead and lead compounds production, 18.7% were working in explosive capsule production, 10.3% were working accumulator production, 9.5% were working in paint production, 5.7% were working in welding, 4.8% were working in metal coating, and 3.8% were working in battery production. Average weekly working hours for the workers was 53.2 ± 11.4 hours (minimum: 40, maximum: 90).

Findings Regarding the Validity and Reliability of HBSRLE

Factor analysis, Principle Components Analysis and Varimax Rotation method were used in the study. Number of factors was not limited; the factors having an eigenvalue of 2 were included in the study. Initially, an eight factor structure was obtained from the principle components analysis. 34 items with similar factor loads in three different sub-dimensions (Table 2) and 8 factors with an eigenvalue of 1.96 (items 5, 7 and 15) were excluded from the scale. The analysis was re-applied and the scale was divided into seven factors. 18 items with similar item loads in three dimensions (Table 2) and 7 factors with an eigenvalue of 1.94 (items 13 and 20) were excluded from the scale. A total of seven items were removed from the scale. Factors analysis was conducted again and six factors with an eigenvalue of 2 were obtained. It was found that the scale had six sub-factors with factor loads varying between 0.613 and 0.885 (p<.05). Results of factor analysis are presented in Table 2. It was found that the first factor with an eigen value of 7.21 and an explained variance of 21.86% had the highest values, while the sixth factor with an eigenvalue of 2.58 and an explained variance of 7.84% had the lowest values. Total variance for which all factors were explained was 73.29%.

Analysis of six-factor structure of HBSRLE with factor analysis revealed that Factor 1 consisted of 10 items (items 21, 22, 23, 24, 25, 26, 27 28, 16 and 19) and constituted "Perceived Obstacle" sub-dimension. Factor 2 consisted of 5 items (items 36, 37, 38, 39 and 40) and constituted "Self-Sufficiency" sub-dimension. Factor 3 consisted of 6 items (items 29, 30, 31, 32, 33 and 35) and constituted "Health Motivation" sub-dimension. Factor 4 consisted of 5 items (items 4, 6, 8, 9 and 10) and constituted "Perceived Seriousness" sub-dimension. Factor 5 consisted of 4 items (items 11, 12, 14 and 17) and constituted "Perceived Benefit" sub-dimension. Factor 6 consisted of 3 items (items 1, 2 and 3) and constituted "Perceived Sensitivity" sub-dimension.

Reliability Findings of the Scale

Cronbach's Alpha (Internal Consistency Analysis), Spearman-Brown and Guttman Split- Half Reliability Coefficient and Correlation Analysis (Item-Total Correlation, Sub-dimension-Total Score Correlation) were used to evaluate total internal reliability of the scale.

Prior to item analysis of HBSRLE, the scale was analyzed to verify whether it fit normal distribution. Non-parametric Kolmogorov-Smirnov Test was used to test whether the scores of the scale in general and sub-dimensions were normally distributed. Obtained data revealed that significance level was higher than .25. The scores of HBSRLE and its sub-dimensions were considered to show normal distribution.

Spearman correlation analysis results presented in Table 3 showed that total score correlations (Rho) varied between 0.252 and 0.788 (p<0.001). Arithmetic mean of the item scores of the scale varied

Factor Loads							
Item No	Commonality (Common Factor Variance)	1st Factor	2nd Factor	3rd Factor	4th Factor	5th Factor	6th Factor
1	.824						.862
2	.793						.846
3	.829						.885
4	.649				.626		
6	.803				.821		
8	.750				.819		
9	.749				.777		
10	.686				.764		
11	.556					.676	
12	.621					.592	
14	.723					.835	
16	.757	.661					
17	.785					.844	
19	.812	.686					
21	.606	.623					
22	.667	.832					
23	.799	.827					
24	.686	.761					
25	.780	.819					

Table. 2 Cont...............

26	.763	.810					
27	.646	.615					
28	.797	.783		.688			
29	.755			.728			
30	.801			.817			
31	.700			.728			
32	.716			.697			
33	.654			.613			
35	.703						
36	.719		.740				
37	.763		.669				
38	.903		.754				
39	.667		.595				
40	.734		.750				

* Principal Component Analysis

Table 2: Factor Analysis Results* of HBSRLE

Sub-Dimensions	X	SS	Item-Total Score Correlation (Rho)
Perceived Sensitivity			
1.My chances of being exposed to lead is higher than people working in other jobs.	4.05	.75	.290
2.The chances of my health being deteriorated due to lead in a few years is high	4.10	.75	.252
3.My chances of getting cancer due to lead exposure is high	4.06	.74	.261
Perceived Seriousness/Importance			
4.Health hazard of lead frightens me	4.04	.78	.469
6.If I become an occupational patient due to lead, my whole life will change	4.13	.74	.627
8.If I become an occupational patient due to lead, I may lose my job	3.82	.74	.484
9.If I become an occupational patient due to lead, I will not be able to pay for my health expenses	4.04	.68	.626
10.It is not possible to remove lead from the body in a short time with treatment	4.07	.76	.444
Perceived Benefit			
11.If I regularly use personal protective equipment, my chance of getting lead poisoning will decrease	4.54	.76	.388
12.Learning how to use personal protective equipment will allow me to be better protected from lead	4.30	.75	.535
14.Having sufficient ventilation in the work environment can reduce risk of lead exposure.	4.25	.72	308
16.Avoiding eating and drinking during work reduces risk of lead exposure	4.24	.72	.783

17.Washing my hands, face, mouth and nose before meals helps me be protected from lead	4.31	.66	.337
19.Putting my work clothes in separate closets is helpful in reducing lead exposure	4.31	.60	.761
Perceived Obstacles			
21.I don't use personal protective equipment because they are uncomfortable	4.16	.99	.788
22.I can't use personal protective equipment because they are not provided regularly	4.27	.88	.654
23.I don't believe that using personal protective equipment is helpful	4.24	.64	.694
24.I can't take a shower when I leave work because I don't have time	4.26	.71	.708
25.I don't use protective equipment because they are barely used in the workplace	4.31	.69	.743
26.I forget to wash my face, nose and mouth frequently	4.32	.71	.744
27.Using a mask obstructs comfortable breathing	4.27	.73	.768
28.I don't think my work clothes need to be put to a different closet than my regular clothes	4.31	.73	.737
Health Motivation			
29.I want to detect the harmful effects of lead on my health as early as possible	4.52	.61	.707
30.I search for new information to protect myself from lead	4.48	.62	.637
31.I think that performing protective activities is important for preventing lead exposure	4.54	.63	.293
32.Protecting my health from the harmful effects of lead is important to me	4.37	.64	.602
33.Being healthy and energetic is important to me	4.41	.67	.488
35.I try to make a habit of using protective equipment	4.41	.66	.630
Self-sufficiency			
36.I know what I need to do to protect myself from lead.	4.42	.62	.658
37.I can decide when personal protective equipment need to be renewed/replaced	4.32	.58	.617
38.I do not mind talking to my employer if there are any safety problems arising from work	4.37	.55	.770
39.I don't smoke in a work environment	4.26	.59	.686
40.I follow all the precautions to protect myself from lead	4.52	.56	.617
* Spearman's correlation coefficient was found to be p<0.001 for all correlations.			

Table 3: Arithmetic Mean, Standard Deviation, and Item-Total Score Correlation Values* of All Items of HBSRLE (N = 525)

between 3.82 ± 4.54, while standard deviation values varied between 0.55 ± 0.91.

Reliability analysis showed that Cronbach's Alpha of HBSRLE was 0.94 and its sub-dimensions varied between 0.81 and 0.94. Split-half test consistency showed that Spearman-Brown Coefficient

Internal Consistency Coefficients	r	p
Cronbach Alfa Split-Half Test Reliability	.943	P<0.05
Spearman- Brown Coefficient	.740	P<0.05
Guttman Split- Half Coefficient	.739	P<0.05

Table 4: Internal Consistency Coefficients of Entire HBSRLE

of the scale was 0.740 and Guttman Split-Half Coefficient was 0.739 (p<0.05). Internal consistency coefficients for the general of HBSRLE are presented in Table 4.

Discussion

A KMO value of 0.60 and above is accepted as normal; while a KMO value between 0.80 and 0.90 is considered as very good (17, 26).In this study the KMO value was 0.90. Samplesize wasadequate to conduct factor analysis. Bartlett's test value was 19057.439 (p< 0.05) (Table 1). It was concluded that the data was appropriate for factor analysis.

Analysis of the items in sub-dimensions according to the results of factor analysis showed that items 16 and 19 wereunder another sub-dimension (perceived obstacle) rather than their own sub-dimension (perceived benefit) (Table 2). As these items showed a similar

correlation with the score of their own sub-dimension, they were added to the perceived benefit sub-dimension and kept in the scale.

Cronbach's alpha coefficient forHBSRLE in its entiretyand for all sub-dimensions varied between 0.81 and 0.94. Since Cronbach's alpha values of the entire scale and all its sub-dimensions were greater than 0.70, it can be stated that all items in the scale measure the same characteristic. According to this result, HBSRLE is a reliable measurement instrument [17].

Guttman and Spearman-Brown reliability coefficientswere used for analyses conducted for split-half test consistency within internal consistency analyses. In split-half method, the reliability coefficient should be minimum 0.70 [17, 28].

It was found that Guttman Split-Half reliability coefficient calculated for the entire scale and sub-dimensions of HBSRLE varied between 0.739 and 0.951, while Spearman-Brown reliability coefficient varied between 0.740 and 0.953 (Table 4). The fact that reliability coefficient for the entirety and all sub-dimensions of the scale are higher than > 0.70 indicates that the scale and its sub-dimensions are reliable (p< 0.005).

Correlation analysis between the items is performed to show whether the relationships between the items are strong or weak and to determine consistency between the items. Correlation analysis between total score and item scores aim to determine the reliability of items. When calculating correlation between items, since total scores are considered as uniform data while item scores are considered as ranked data in item-total score correlation, Spearman's rank correlation analysis was used. Items should have a high correlation with total score. Items with a total score-item correlation coefficient below 0.30 are excluded from the scale. If the item-total score correlation coefficient is below 0.20 in a sample with four hundred or more participants, it means that these items are problematic. Those items have to be removed from the scale [17].

In our study, analysis of the correlations between item-total scores of HBSRLE revealed that item-total score correlations for all questions (rho) varied between 0.252 and 0.788. As no items had a correlation value below 0.20, no item was removed from the scale (Table 3).

Analysis of sub-dimension-total score correlations of HBSRLE showed that "Perceived Obstacles" sub-dimensionhad the strongest correlation with a 0.790 sub-dimension-total score correlation. On the other hand, "Perceived Sensitivity" sub-dimension with sub-dimension-total score correlation of 0.283 had the weakest correlation. As for all sub-dimensions of the scale, it was observed that they were correlated with total scores and that all sub-dimensions excluding perceived sensitivity had a moderately strong positive correlation.

Conclusion

Validity and reliability analyses showed that HBSRLE consisting of 33 items and six sub-dimensions is a valid and reliable scale. The scale can be used in studies to determine health beliefs and protective heath behaviors of workers with lead exposure in the field of occupational health.

Conflict of Interest

The authors have no conflict of interest.

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