Clinical and Experimental Health Sciences

Development of Hypoglycemia Management Scale for Teachers

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ABSTRACT

Objective: Hypoglycemia which is an acute complication of diabetes is an absolutely serious and may possibly develop at any moment. Each of the schools do not have a nurse to intervene in emergency. Thus, the responsibility for such emergency situations put on the shoulders of teachers. The objective of this research was to develop and test the psychometric properties of Hypoglycaemia Management Scale for Teachers.

Methods: It was a scale development study with a methodological design. 400 teachers of primary, secondary and high schools were included in the study. The item pool was 30. The scale was presented to 5 of the experts and after the content validity the draft scale was 31 items. Data collected between the dates 6th Feb to 11th March 2020. Teachers filled the data collection tools by themselves. Factor analyses, item-total correlation, split-half reliability, test-retest reliability was tested for psychometric properties.

Results: The scale had 11 items and 2 subscales named "Hypoglycemia Knowledge" included some hypoglycemia-related expressions and "Hypoglycemia Management" included some expressions related with the practices to be followed in hypoglycemia situations.

Conclusion: A reliable and valid scale was developed to measure hypoglycemia management of teachers. It may be used in practice to assess hypoglycemia management of teachers in school setting.

Keywords: Scale development, hypoglycemia management, teacher, school, type 1 diabetes.

1. INTRODUCTION

Type 1 diabetes is a chronic disease occurring at every period of life but in childhood and adolescence with the highest incidence. People with type 1 diabetes need daily insulin treatment and regular blood glucose follow-up in order to control blood glucose level (1). Clinical symptoms were observed after the 80%-90% destruction of beta cells in pancreas (2).

According to 2017 data of International Diabetes Federation, approximately 7,5 million people have type 1 diabetes in the World and this number is estimated to reach 9,5 million by the year 2045 (3). Nearly 10% of the people with diabetes have type 1 diabetes (1). According to Diabetes Atlas 2017, the number of children and adolescences between the ages of 0-19 with type 1 diabetes were 25.669 in Turkey (3). In recent years, an increase was detected in type 1 diabetes incidence around the World and in our country as well. Type 1 diabetes incidence under 19 years in our country was reported as 10,7/100000 and prevalence as 0.75/1000 (3). Type 1 diabetes mostly develops in youth less than 15 years of age (4).

Hypoglycemia is the most frequently observed acute complication of type 1 diabetes and defined as reducing blood glucose level. The symptoms appear when the blood glucose level reduce under 70 mg/dl. Among the common reasons of hypoglycemia are rapid development of the child, malnutrition, excessive exercises, getting too much insulin, wrong insulin injection technique and skipping a meal. Hypoglycemia begins with such symptoms as anger, fatigue, dizziness, sweating and shivering. Change in behaviors is the very first symptom for majority of children (4).

It has been estimated that around 20.000 students with diabetes are available according to "Students with Diabetes Instruction" announced by Ministry of Education in 2013 (5). This number is considered to increase due to rising prevalence (4).

Adolescences with a chronic disease like type 1 diabetes attach importance academic success as well as social life and struggle to manage their conditions (6,7). However, school management, school/pediatric nurse, classmates, canteen personnel, school bus drivers should be aware of the condition of the child and be informed in advance to support the child with type 1 diabetes (7).

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Pediatric/school nurses have a crucial role by encouraging the child to overcome with his/her condition to develop their health by providing care and education (8). However, each of the schools do not have a nurse to intervene in emergency. Thus, the responsibility for such emergency situations put on the shoulders of teachers. So, teachers should be able to provide emergency care to students with chronic diseases (9-11). However, the study by Clay et al. demonstrated that teachers did not always have appropriate knowledge to meet the needs of those children (12). Even though "Diabetes Education Programme in Schools" started with the protocol signed by Ministry of Education, Ministry of Health and Pediatric Endocrinology (6) approximately 40% of teachers do not have enough knowledge about hypoglycemia which is the most serious complication of type 1 diabetes (13).

Hypoglycemia which is an acute complication of diabetes is an absolutely serious and may possibly develop at any moment. Although some kind of scales are available in literature for health care providers or parents, not any scales assessing the hypoglycemia management exist for teachers in literature may not be found.

The purpose of this study was that developing a reliable and valid tool measuring the hypoglycemia management of teachers.

2. METHODS

2.1. Research Questions

Q1. Is "hypoglycemia management scale for teachers" a reliable scale?

Q2. Is "hypoglycemia management scale for teachers" a valid scale?

2.2. Design

The study was conducted methodologically. The instrument was developed in 3 phases. First items were generated and then content and face validity tested in second phase. In third phase other psychometric properties such as construct validity, internal consistency reliability, item to total correlation, split-half reliability and test-retest reliability was tested.

2.3. Participants

It was stated in literature that a scale should have 5-10 times more sample than item total number in order to ensure reliability and validity (14-16). Our draft scale included 31 items. So that the number of teachers included in the sample were planned to be 155-310. The study was completed with 400 volunteer primary, secondary and high school teachers. The inclusion criteria were; working as a teacher in schools where the study was conducted, being volunteer to participate in the study and not having diabetes.

2.4. Data Collection Tools

***Socio-demographic Characteristics Form*:** It was prepared by the researchers and included sociodemographic variables such as gender, characteristics students, etc.

Hypoglycemia Management Scale for Teachers (HMST)

Establishing item pool: In the development process of HMST item pool was established primarily. Researchers determined 30 items. The scale was designed in five-likert type as "1=Strongly disagree", "2=Disagree", "3=Undecided", "4=Agree" and "5=Strongly Agree". The scale was read and filled individually.

Content Validity: One of the reasonable ways to test the content validity is to get the view of an expert. The scale was presented to 5 of the experts to assess its comprehensibility. Experts' team consisted of clinicians working on diabetes and academician nurses. In order to ensure both cultural and linguistic equivalence and prove content validity with numerical values, Content Validity Index – CVI was utilized as an assessment measurement (17). Experts were scored each of the item 1-4 according to Davis method (18). The scores meant as follows: 1 = not appropriate; 2= the item should be re-designed to be appropriate; 3= appropriate but still needs minor changes; 4= very appropriate. The scores of each expert was evaluated and the items with 1 and 2 scores were removed from the scale and re-designed accordingly. When the 80% of the items were assessed as 3-4 scores, CVI score of the scale was determined as 0,80. Having a CVI score above 0,80 demonstrates an appropriate content validity (17). In addition; 1 item was added to the scale on demand of the experts and the content validity of the scale was accomplished with 31 items in total.

Face Validity: Literature suggests on development of a scale that the draft scale should be tested in a sample group with similar features (17,19). Following the accomplishment of content validity, 31 of the teachers were held a pre-implementation to evaluate face validity and to perform necessary changes on data collection tools and the 31 itemed form was implemented accordingly.

2.5. Data Collection

The study was conducted at primary, secondary and high schools between the dates of 6th Feb,2020 and 11th March,2020. Data collected with Socio-demographic Characteristics Form and Hypoglycemia Management Scale for Teachers were asked to fill in the data collection tools by themselves. Researchers accompanied to the teachers during data collection in order to prevent data loss. Duration of data collection lasted approximately 10-15 minutes.

2.6. Analysis of Data

The data were analysed by using NCSS (Number Cruncher Statistical System) 2007 software programme (Licence No:1675948377483; Serial No: N7H5-J8E5-D4G2-H5L6-W2R7). Views of the experts

were assessed through Content Validity Index. Factor analysis was performed to ensure construct validity. As for validity analysis of the scale, internal consistency (Cronbach's Alpha Coefficient), item-total score validity, test-retest validity and Split-Half validity scores were calculated. In order to calculate socio-demographic data, descriptive statistical analysis (mean, standard deviation, percentage) were performed.

2.7. Ethical Considerations

Ethical committee permission was obtained from the Ethical Committee of Non-Interventional Clinical Studies of Health Sciences Faculty University, Türkiye. (Permission no: 14.11.2019/137). Moreover, following to providing essential information to the participants, an informed consent form was asked from the volunteers.

3. RESULTS

3.1. Socio-demographic Characteristics of Teachers

Of the 73.8% of teachers had no student with type 1 diabetes before and 71% of them have not taken any diabetes education. Detailed socio-demographic data of teachers were presented at Table 1.

Table 1. *The distribution of socio-demographic characteristics of teachers (n=400)*

	n	%
Gender		
Female	285	71.25
Male	115	28.75
Education		
Primary	136	34
Secondary	124	31
High school	140	35
Any students with type-1 diabetes at school?		
Yes	174	43.5
No	226	56.5
Any students with type-1 diabetes in class?		
Yes	43	10.8
No	357	89.3
Have you ever had a student with type-1 diabetes?		
Yes	105	26.3
No	295	73.8
Have you ever encountered with hypoglycemia?		
Yes	95	23.8
No	305	76.3
Have you ever taken diabetes education?		
Yes	116	29
No	284	71

3.2. Content Validity

A consensus was generated among expert views for HMST according to Kendall's W concordance analysis performed to ensure content validity (Kendall's W_a=.32, df=29, p>.05). Content Validity Index analysed through expert views according to Davis (18) method was identified as.975.

3.3. Construct Validity

Exploratory Factor analysis was implemented to identify factor structure of the scale. In order to determine the compatibility of the data to factor analysis, Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity were implemented. Kaiser-Meyer-Olkin (KMO) value of HMST was found .838. On the other hand, Bartlett's test of sphericity score was found statistically significant (c^2=934,446 df=55 p<.001).

In factor analysis varimax rotation technique was used. As the result of factor analysis 13 items taking load from more than one factor and having a difference more than .10 between loads were removed from the scale. The scale has a two-factor structure. Two factor structure explains 45.20% of the total variant of scale. "Scree plot" graphic demonstrates the factor structure of the scale (Figure 1).

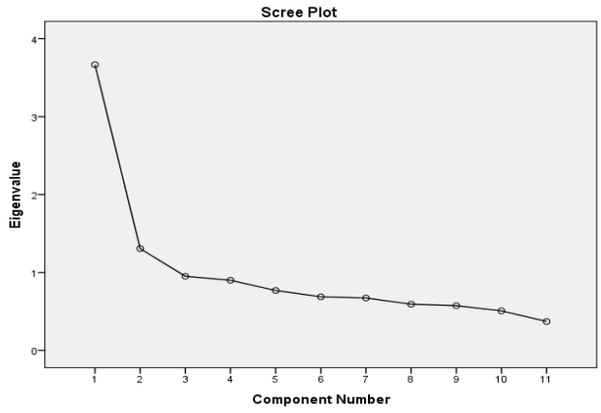

Figure 1. *Scree Plot Graphic of HMST*

Factor 1: Items 1-2-3-4-5-7 were gathered under factor 1. Those items includes essential information about hypoglycemia that is an acute complication of Type 1 diabetes. Thus, the factor was named as "Hypoglycemia Knowledge"

Factor 2: Items 6-8-9-10-11 were placed under factor 2. Those items includes certain expressions about teachers' practises in hypoglycemia condition. Thus the factor was named as "hypoglycemia management".

When the factor loads of items were examined, item loads were identified between .49 and .77. The findings obtained from exploratory factor analysis were presented at Table 2.

Table 2. *Hypoglycemia management scale for eachers and characteristics of sub-groups (n=400)*

Factors	Factor load	Item total correlation values
Factor 1 (Hypoglycemia Knowledge)		
1. Blood glucose level at 70 mg/dl or less is defined as hypoglycemia	0.66	0.55
2. Loss of the consciousness and seizure are among the symptoms of hypoglycemia.	0.72	0.45
3. I would think hypogelycemis might develop if I notice shivering in my student with type-1 diabetes.	0.77	0.54
4. In hypoglycemia situation form y student with type-1 diabetes. the very first thing I should do is to provide carbohydrate (sugar. fruit juice.honey etc.) if he/she is concious.	0.71	0.54
5. I encourage my student with type-1 diabetes measuring the blood-glucose in P.E lessons.	0.60	0.49
7. Hypoglysemis is not a severe condition.	0.49	0.32
Factor 2 (Hypoglycemia management)		
6. I measure the blood-glucose with glucometer if necessary	0.57	0.27
8. I am able to recognize hypoglycemia in my student with type-1 diabetes.	0.68	0.49
9. I always have sugar and fruit juice in my class.	0.67	0.35
10. If I have to administer glucon to my student with type-1 diabetes. I take him/her side-lying position after the administration.	0.62	0.36
11. I inform other students about the hypoglycemia in case of emergency situations when I am not with them (breaks).	0.52	0.48

3.4. Reliability

Item total correlation of HMST ranged between .27 and .55 (Table 2). 7 of the items were removed from the scale since their correlation coefficient calculated via item total correlation were beneath .30 and exploratory factor analysis was implemented again to get the final shape of the factor structures (Table 2). 6th item was decided to remain in the scale because its item total score correlation was 0.27 but its factor load was .57. Cronbach's alpha coefficient of the scale was found .777.

Spearman Brown and Guttman Split Half coefficients calculated for split-half reliability of the scale and it was presented at Table 3.

Table 3. *Cronbach's alpha and split-half reliability results of hypoglycemia management scale for teachers*

Sub-scales (n=400)	Items	Cronbach's Alpha Coefficient	Split-half Reliability	
			Spearman-Brown Coefficient	Guttman Split-half Coefficient
Hypoglycemia knowledge	6	.720	.702	.700
Hypoglycemia management	5	.601		
Total scale	11	.777		

Test-retest reliability results were presented at Table 4. According to ICC analysis: 85.4% of fit was found between first and last measurements of "Hypoglycemia Knowledge" sub-group (factor 1); 86.5% of fit between first and last measurements of "Hypoglycemia Management" sub-group and 86.3% of fit in total score were determined.

Table 4. *Test-retest results of hypoglycemia management scale for teachers*

Sub-scales (n=112)	First measurement Mean ± SD	Second measurement Mean ± SD	ICC (%95 CI)	*p*
Hypoglycemia Knowledge	22.72 ± 3.44	23.22 ± 3.24	0.854	*.000**
Hypoglycemia management	17.33 ± 3.27	17.53 ± 3.09	0.865	*.000**
Total scale	40.62 ± 5.59	43.65 ± 5.07	0.863	*.000**

† *ICC: Intraclass Correlation Coefficient * p<.001*
‡. *CI: Confidence interval*
§ *SD: Standart deviation*

3.5. Scoring of Hypoglycaemia Management Scale for Teachers

The scale had a five-likert type and included 11 items and two sub-dimensions. The first factor included 6 items. The minimum score of this factor was 6 and the maximum one was 30. Increasing score for this factor meant high level of hypoglycemia knowledge. The 7th item in the factor should be scored reversely. The second factor consisted of 5 items. The minimum score was 5 and the maximum one was 25. High scores in this factor meant positive attitudes towards hypoglycemia management.

Minimum score for the scale was 11 and the maximum one was 55. High scores stood for high level of hypoglycemia management.

4. DISCUSSION

Scale development study was begun with the scanning of related literature. The scanning of the literature demonstrated that even though some hypoglycemia related scales were available for health care providers and parents, not any scale existed to assess hypoglycemia management of teachers. Hypoglycemia which is a complication of diabetes is a rather serious and fast developing condition. School administration, nurse, teachers, classmates, canteen personnel and school bus drivers should be aware of the chronic conditions the child has experienced. However, teachers are the front-line supporters for children with chronic conditions just like type 1 diabetes (11). It is highly crucial that teachers should have enough knowledge and experience to meet the needs of children with type 1 diabetes specifically in hypoglycemia situation. This scale would enable to measure hypoglycemia management of teachers.

A newly developed scale should fulfill two important factors: reliability and validity. Validity refers to how accurately a method measures what it is intended to measure. So, a scale can be considered valid if it measures the intended features without interfering with any other features. A valid scale requires to be reliable. Reliability refers to consistency among the responses to each of the items (17). At present study content and construct validity were utilized to test the validity of the scale.

4.1. Content Validity

Content validity refers to the degree to which an assessment instrument is relevant to, and representative of, the targeted construct it is designed to measure (17, 20). In order to ensure content validity Kendall's W concordance analysis was performed and not any significant difference was detected among the views of experts. Such a result is the indicator of items' comprehensibility by the experts. The scale is a comprehensible tool to assess hypoglycemia management of teachers.

4.2. Construct Validity

Construct validity refers to how well a test or tool measures the construct that it was designed to measure. Factor analysis is one of the methods to examine construct validity (16, 17). Explanatory factor analysis-EFA is the technique used to determine the number of sub-dimensions and the relations between them (16, 17, 19, 21). Explanatory factor analysis-EFA is used to test construct validity of scales. However, prior to implementation of Explanatory factor analysis-EFA, Kaiser-Meyer-Olkin (KMO) test was utilized to test the appropriacy of number of sample and Bartlett's test of sphericity to identify the appropriacy of relations between variables (14). Kaiser-Meyer-Olkin (KMO) is an index comparing the size of observed correlation coefficients with partial correlation coefficients. Kaiser-Meyer-Olkin (KMO) value ranges between 0 and 1. Kaiser-Meyer-Olkin (KMO) value is .80 or above meritorious, .70 or above middling, .60 or above mediocre, .50 or above miserable, and below .50, unacceptable. As for Bartlett's test of sphericity, having p value smaller than .05 means that the correlation between variables is sufficient for a factor analysis (14). At present study, Kaiser-Meyer-Olkin (KMO) value was found.838 and p value of Bartlett's test of sphericity was found p<.001 and significant showing that the sample was sufficient for factor analysis and correlation matrix of the items is appropriate to fulfill factor analysis respectively.

In explanatory factor analysis, it was paid a special attention that eigenvalue of items should be 1.00 at least, item factor load value .30 the least, and .10 the least for items with sufficient factor load between two factors (14, 22). As the result of analyses, the number of factors were determined as two. "Screeplot" graphic presented the factorial structure of the scale (figure 1).

According to "Scree plot" graphic, by taking into consideration that the distance between two points is accepted as a factor and the distance following the second factor both small and similar (14), it was approved as two-factor scale. Literature suggests that factor loads should not be less than .30. Factor loads' being ±.70 and above are considered indicative of well-defined structure, ± .50 or greater are considered practically significant, in the range of ±. 30 to ±. 40 are considered to meet the minimal level for interpretation of structure and less than ± .10 can be considered equivalent to zero for purposes of assessing simple structure (14). At present study, it was detected that factor loads were rather high (Table 2) and it explained factorial structure of the scale.

4.3. Reliability

Reliability studies refer the extent to which an experiment, test, or measuring procedure yields the same results on repeated trial. It measures the stability of a test over time. Although a valid test is always reliable, a reliable test is not always valid (19).

The reliability of HMST was tested via internal consistency, item total correlation, split-half method and test-retest reliability analysis. Internal consistency reflects the extent to which items within an instrument measure various aspects of the same characteristic or construct (17). The most frequently used method to test internal consistency is Cronbach's alpha reliability and represented with alpha value. When the Cronbach's alpha value was found .00<α <.40, it represents an unreliable scale; .40<α <.60 lower reliability; .60<α <.80 rather reliable and .80<α <1.00 high level reliability (23). The Cronbach's alpha value of our scale was found .777 showing that the scale is rather reliable (Tablo 3).

Item total correlation explains the relation between the scores obtained from items and total score of the test. Higher item correlation means the items exemplify similar behaviours and high level of internal consistency as well. Literature suggests on this issue that item total score correlation's being .30 and above represents that items distinguish the participants well (24, 25); .20-.30 can remain in the test if necessary; .20 and less means that those items should be removed (26). At present study, even though item total score correlation of the 6th item was .27, it was decided to remain in the test since its factor load was .57 (Table 2).

Another way to test the reliability is the split-half method. Split-half method refers to splitting a body of supposedly homogeneous data into two halves and calculating the results separately for each to assess their reliability by using Spearman-Brown formula and Guttmann split-half formula (27). Reaching a value of .70 and above represents a reliable measurement for the scale (26). In our study, Spearman Brown split-half correlation was found 0,702 and Guttman Split-half coefficient was calculated as .70 (Table 3). Reliability coefficient obtained in this study demonstrated that it was a reliable scale.

According to test-retest result performed to test the reliability of the scale, a positive high level relation was identified for the overall scale (r=.863; p<.01) and it was determined as .865 for hypoglycemia knowledge sub-dimension and .865 for hypoglycemia management sub-dimension (Table 4). Test-retest method, used to measure scale's do not change in time, is expected to have a value over .70 (26). When those values are taken into account, this scale has an appropriate reliability to be implemented.

Completion of the study with more participants (n=400) than expected is the strength of our study. The limitation is that psychometric properties only tested on Turkish culture and language. Completion of the study with more participants (n=400) than expected is the strength of our study. Concurrent validity would not be able to test due to absence of a similar scale is the limit of the study.

5. CONCLUSION

It was observed in terms of reliability and validity tests that the proofs are rather strong related with psychometric aspects of the tool. In this study, a scale was developed to measure hypoglycemia management of teachers with an acceptable evidence of reliability and validity. It is considered to be a reference on the issue since not any similar studies exist in literature.

Strong and weak sides of teachers on hypoglycemia management can be identified with HMST. This scale is absolutely essential to determine hypoglycemia management skills of teachers in emergency situations of children with type 1 diabetes especially when there is no school nurse. Hypoglycaemia Management Scale for Teachers can also help diabetes nurses to identify teachers' ability on hypoglycaemia management and, plan and perform education for teachers to improve effective hypoglycaemia management in school settings.

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Design of the study: ÇÇÖ
Acquisition of data for the study: RNA, ASB, FÇ
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