Effect of Family-centered Empowerment Model on Knowledge and Stress Level among Mothers of Children with Glucose-6-Phosphate Dehydrogenase Enzyme Deficiency

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Abstract

Background: Family-centered empowerment model (FCEM) greatly values the motivational, psychological, and functional roles of children and their family members in health promotion. Its main goal is to strengthen the family system to promote children and family health**. Aim:** To investigate the effect of FCEM on knowledge and stress level among mothers of children with glucose-6-phosphate dehydrogenase enzyme deficiency(G6PD). **Study design**: A quasi-experimental design was performed. **Setting:** The study was conducted in hematology outpatient clinic at Mansoura University Children's Hospital. **Subjects:** a purposive sample composed of 60 mothers and their children who are suffering from G6PD deficiency. **Tools:** Two tools were used for data collection: Glucose-6-Phosphate Dehydrogenase Enzyme Deficiency Knowledge Questionnaire and Arabic version of Perceived Stress Scale. **Results:** There were an improvement in the mean score of mothers' total knowledge with statistically significant difference (P<0.001) in the post intervention phase compared to pre intervention phase. Mean score of mothers' stress level was 26.90 ± 6.26 pre the FCEM implementation and decrease to17.36 ± 2.73 post FCEM with a statistically significant difference. **Conclusion:** Applying FCEM on mothers of children with G6PD deficiency leading to improvement of their knowledge regarding G6PD and reduce their level of stress **Recommendations:** researchers recommended implementing FCEM for all mothers and their children with chronic diseases as a strategy for education and management.

Keywords: Family-centered empowerment model, Knowledge, Stress, Mothers, Children, Glucose-6-Phosphate Dehydrogenase Enzyme Deficiency

Introduction

Glucose - 6 - phosphate dehydrogenase deficiency (G6PD) is a genetic disorder that happens when the body doesn't have enough amount of G6PD in the blood. This is a vital protein that directs different biochemical responses in the body. The condition is known to be more predominant during the early childhood period. Most children with G6PD deficiency are asymptomatic. The symptoms of G6PD deficiency are tachycardia**,** shortness of breath**,** dark or yellow-orange urine**,** fever, exhaustion**,** dizziness**,** paleness and jaundice**.** The most common enzymopathy is G6PD deficiency which affects an estimated 400 million child around the world. Hemolytic anemia, which can be life-threatening in some children, is the primary morbidity associated with G6PD deficiency. An infection, hyperglycemia,

certain foods, and certain medications may cause hemolysis. **(Manganelli, Masullo, Passarelli & Filosa, 2013 and Luzzatto, Ally&Notaro, 2020)**

Glucose – 6 - phosphate dehydrogenase deficiency has been graded by the World Health Organization (WHO) as indicated by the extent of the enzyme deficiency and severity of hemolysis. Lack states ranging from the most serious chronic non spherocytic hemolytic anemia to mild deficiency that manifests hemolysis just with openness to certain metabolic conditions, infections, drugs and nutrients are identified in Class I through Class III. Classes IV and V define non-deficient and high-enzyme-activity states. **(Minucci, Moradkhani, Hwang, Zuppi & Giardina, 2012 and Luzzatto & Seneca, 2014)**

A complete blood count, lactate dehydrogenase, and Coombs' s' test, ought to be negative in demonstrative tests that can be done, as hemolysis in G6PD is not immune-mediated; all these tests give data about the red blood cells in the body and can likewise assist with diagnosing hemolytic anemia. The diagnosis is presumed when children from certain ethnic groups suffer from anemia, jaundice and symptoms of hemolysis after excluding the other causes, especially when there is a positive family history. **(Domingo, Satyagraha, Anvikar, Baird & Bancone, 2013 and Peters, Veldthuis, Leeuwen, Bossuyt & Vlaar,2017)**

The most well-known dangerous sign of G6PD insufficiency is hemolytic weakness. In a commonplace course, there are jaundice, fatigue, back pain, tachypnea and tachycardia in children. Diminished hemoglobin and red blood cell counts, reticulocytosis, elevate lactate dehydrogenase, and hyperbilirubinemia are all important laboratory findings. **(Tahura, 2016 and Cruz,Khalid, Mostafa, Ershad & Vearrier,2019)**

All G6PD-deficient children should avoid certain medications. In addition, a list of relatively safe medications is given for those children who do not suffer from non-spherocytic hemolytic anemia. Antimalarial medication can cause intense hemolysis in G6PD deficiency children. Also giving excessive amount of vitamin C intravascularly leads to hemolysis in G6PD deficiency transporters.**(Luzzatto & Seneca 2014; Bubp, Pharm, Jen, Matuszewski& Pharm, 2015 and Quinn, Gerber, Fouche, Kenyon& Blom, 2017)**

Infections in G6PD-deficiency children are the most broadly referred to reason for hemolytic anemia. The immune system prompts an incendiary reaction during infections that also generates oxidative organisms. Oxidative stress cannot be overwhelmed by the erythrocytes of G6PD-deficient children, resulting in cell destruction. In order to prevent G6PD-deficient children, several antibiotics were added to and withdrawn from medication lists, as the hemolysis can be associated with antibiotic use. **(Luzzatto & Seneca 2014)**

G6PD deficiency treatment consists of eliminating the trigger that can leads to the appearance of symptoms. However, more aggressive treatment may be needed once G6PD deficiency causes hemolytic anemia. This incorporates oxygen treatment, a blood transfusion to compensate the levels of oxygen and red blood cell, and accurate assessment of extreme hemolytic anemia is basic for guaranteeing complete recuperation without any complications, the need to remain in the hospital while undergoing these treatments is very critical. The main measure is evasion of the medications and

nutrients that cause hemolysis, inoculation against popularmicrobes (for example hepatitis A and hepatitis B) can inhibit infection-induced attacks. **(Ho, Cheng, Chiu, 2014)**

Nurses are responsible to empower the children and their family caregivers to be able to care for themselves as much as possible. The family centered empowerment model developed in 2003 by **Alhani** and then was tested on different groups of children and their families. It has four major steps, namely perception of threat, self-efficacy, self-esteem, and evaluation. This model has been used so far to promote the quality of life among patients with chronic conditions such as anemia, coronary artery disease, type II diabetes mellitus, myocardial infarction, hypertension, multiple sclerosis, and adolescent asthma (**Alhani, 2003, Masoodi, Soleimani, Alhani, Rabiei & Bahrami, 2013; Changizi, Zeighami, Mirzaei & Alipour, 2014 and Vahedian-Azimi, Alhani, Goharimogaddam, Madani & Naderi, 2015).**

Significance of the study

The occurrence of G6PD deficiency in Egypt has been re-ported to be 4: 9.9%, which is higher than some other Mediterranean countries, G6PD occurs most often in children aged 1– 5 years who have the Mediterranean type of G6PD deficiency. It is uncommon in adults and those with other types of G6PD deficiency **(Arnaout, Hanaa , Nesrine, El-Gharbawy, Iman, 2011).**

Mother's knowledge regarding G6PD deficiency is deficient due to the expanding irregular admission of medications or nourishments that lead to intense hemolytic anemia in children, particularly in non-industrial nations. Children with a deficiency of G6PD tend to remain healthy until they are exposed to a significant number of oxidative substances. **(El-Sayed, Tantawi, Adly & Farouk, 2012)** Therefore, avoidance generally relies upon improving mothers' knowledge about G6PD deficiency, greatly values motivational, psychological, and functional roles of children and their mothers in health promotion and strengthen the family system to promote children and family health. (**Abedini, Zareian, Alhani & Teymouri, 2016)**

The study aim: the study aimed to investigate the effect of FCEM on knowledge and stress level among mothers of children with G6PD deficiency

Research hypothesis:

1.The use of FCEM on mothers of children with G6PD deficiency may improve mothers' knowledge.

2.The use of FCEM on mothers of children with G6PD deficiency may reduce the level of mothers' stress

Methodology:

Research design: A quasi-experimental design was used in this study.

Setting of the study:

This study will be conducted in hematology outpatient clinic at Mansoura University Children's Hospital. which is a specific place that provides health services for children with hematological problem for free.

Subjects:

A purposeful sample of 60 mothers who were able to engage in the empowerment program, feel responsible and able to make decisions and have children with G6PD deficiency at the previously mentioned setting and fulfilled the following criteria:

1.Age: school age children regardless their gender, residence

2.Confirmed diagnosis of G6PD disease.

3.Regular attendance at the outpatient clinic.

4.Children who have no, physical or mental chronic illness.

The exclusion criteria of this study were unhealthy mothers and mothers who could not read and write.

Tools: The data collected by:

Tool I: Glucose-6-Phosphate Dehydrogenase Enzyme Deficiency Knowledge Questionnaire (pre & post questionnaire): It was designed by the researchers after a thorough review of literature to assess mothers' knowledge about G6PD deficiency. The questionnaire was used pre/ post intervention; it was designed in the form of MCQ Arabic questions. Validity and reliability of the tool was done accordingly. Two parts were included:

Part 1: Mothers and their children sociodemographic characteristics including mothers' age, education, occupation, residence, history of G6PD deficiency in the family, positive family history for G6PD deficiency, positive kin relationship between the couples, child age, gender and education.

Part 2: Mothers' knowledge about G6PD disease. Such as definition, causative factors, symptoms, complications & treatment modalities for G6PD disease, symptoms of haemolytic crisis, food that should be avoided by G6PD deficiency child, medications that should be avoided by G6PD deficiency child and different types or classification of G6PD deficiency.

Scoring system for the studied mothers' knowledge about G6PD disease

The overall interview questionnaire score was 50. The responses of mothers were evaluated using the model response sheet designed and evaluated by the researchers as the following: Each correct answer took one score and the wrong answer or do not known response took (zero). If scores >70 means good knowledge, 50-70 score means average knowledge and <50 score mean poor knowledge.

Tool II: Arabic version of Perceived Stress Scale

This scale was adopted to assess the experience of stress by mothers from **Almadi, Cathers, Mansour & Chow, 2012.** It comprises 10 elements of a five-point scale self-report instrument: (0 = never, 1 = almost never, 2 =sometimes, 3 = fairly often, 4 = very often). During the previous month, the Perceived Stress Scale asked about emotions and thoughts. In each case, mothers were asked how much they felt in a particular way. Stress was considered normal if it ranges from 0-7,mild 8-11, moderate 12-15, severe 16-20 and extremely severe 21+.

Method

- This study was approved by Mansoura Faculty of Nursing. Agreement was obtained from the hematology outpatient clinics' Board after discussing the purpose and content of the research. Official permission was taken from the director of the clinic after describing the purpose of the study.
- The tool (I) was translated into Arabic by the researchers. The tool was validated by the jury to ensure the validity of the content of the original translated edition. The jury consisted of five pediatric nursing science experts. The required corrections and changes were made accordingly. A jury of five pediatric nursing experts assessed the validity of the content of the Glucose-6-phosphate dehydrogenase knowledge questionnaire and Arabic version of perceived stress scale. Crombach Alpha calculated reliability and gave an internal consistency of alpha =0.86 for Glucose-6-phosphate dehydrogenase enzyme deficiency knowledge questionnaire and α =0.90 for perceived stress scale which were acceptable.
- For ethical consideration, informed consent was obtained from the

subjects of the study to participate in the study after specifying the purpose of the study and guaranteeing the subjects the privacy and confidentiality of the data obtained. The research subjects have been told that if they do not want to complete the study, they have the right to withdraw at any time.

- A pilot study on 10 percent of the sample size was performed. The goal of this pilot study was to test the clarity of the questions and statements, the feasibility, objectivity and accuracy of the instruments, and to identify the uncertainty of the tools in the study. Based on the pilot study; the necessary modifications were made to the study instruments.

- Mothers were individually interviewed in the study setting to assess their knowledge about G6PD deficiency using tool (1) and their stress level using tool (II) (before implementing FCEM).

- Family-centered empowerment model intervention was built based on the evaluation of the learning needs of the mothers.

- The general objective of the FCEM was to improve mothers' knowledge about the disease and empowering them against stressful circumstances.

- General principles specified in this empowering intervention were educating, guaranteeing, guidance, empathy, encouragement and the chance to express emotions to promote social support from others.

- The FCEM intervention was implemented in the following steps: It was started by interviewing mothers at the above-mentioned setting. The researchers started by introducing themselves to study subjects and giving them a brief idea of the study's target, its components and expected results.

First step: Understanding the threat this step focuses on the importance of the problem that threatens their children who suffer from G6PD deficiency through improving knowledge about G6PD deficiency, to have better information and understanding about their children disease. Mothers were divided into groups with 7–8 members and took part in 3 educational sessions (45 min) the number and duration of sessions were based on the pilot study. The subjects that discussed in these sessions were: definition, causative factors, symptoms, complications & treatment modalities for G6PD disease. Symptoms of hemolytic crisis, food that should be avoided by G6PD deficiency child, medications that should be avoided by G6PD deficiency child and different types or classification of G6PD deficiency. The place of sessions was picked to be in the clinic after consultation with the clinic matron and the concerned professors, in order to comfort mothers. Different teaching approaches have been used, such as group discussion, brief lectures, and role playing. Pamphlets, various audio-visual materials were also used; hand out, photographs, and posters to promote teaching each topic.

Second step: Self-efficiency: After increasing the awareness and knowledge of mothers about G6PD deficiency, subsequent part (problem solving) was designed to increase participation in order to increase self-esteem and self-efficacy of the mothers, practical presentation, and discussion group methods were used. In this step, again, they were divided into groups with 7–8 members and received 2 sessions. This step was taken 30-45 minutes. Problem solving for children through the scientific show of the skills needed

(mothers were asked about how to assess manifestations of hemolytic crisis and determine action that must be taken). Children and mothers become conscious of the disease process and its complications at this point and feeling that they may assume a part in improving the condition of the child.

Third step: Self-esteem: In this step, the mothers were asked to inform their children who suffer from G6PD deficiency about what being discussed (in group discussions), and taught (by educational cards or pamphlets), to ensure that the children understand the given information, once being informed by the mothers.

Fourth step :(Evaluation process and final evaluation)

Evaluation Process: during the FCEM sessions the mothers were ready to raise their questions and discussed in groups. Such sessions continued till all questions were answered. The mothers were evaluated at the end of each session to ensure that they understand the given information.

- **Final evaluation (after intervention):**Post-test was carried out for mothers after two months of providing the FCEM interventions, during their children's follow-up in the out-patient hematology clinic. Each mother was evaluated using the study tools to determine the improvement of their knowledge as well as their level of stress.

Statistical analysis: Data arranged, coded, coordinated, sorted and afterward moved into particularly planned configurations .Statistical tests performed using SPSS (Statistical Package for the Social Sciences) version 21. Categorical variables were portrayed utilizing number and percent. Continuous variables were presented as mean ± SD (standard deviation). Repeated calculated variance analysis (RM-ANOVA) was used to compare the three-point period mean (pre-implementation of model and after 2 months). Testing was conducted to evaluate the relevant correlation between the demographic variables of the sample and the level of education of mothers. The significance was tested by means of the Chi-square test, the Monte Carlo test, and the exact fish test was described as $p < 0.05$.

Results

Table (1) shows that more than two-thirds of the mothers were at age group 28- <39 (70%) and 30% of them were at age group 39-<50. Forty percent of them had university education. The highest percentage of the studied mothers were housewife (65%). As regard to mothers' residence, 60% of them were from rural areas, while 40% of them were from urban areas. The minority of the studied mothers (20%) had a positive kin relationship. Sixty percent had a positive family history of the disease, and 40% had a negative family history of the disease. Regarding the age of the studied children, it was found that 70% of them were 6-<10 years of age and about two-thirds (65%) of them were males**.**

Table (1) shows that: There was an improvement in the mean score of mothers' total knowledge with statistically significant difference (P<0.000) in the post intervention phase compared to pre intervention phase**.**

Figure (I) figure portrays that only 10% of the studied mothers had good knowledge score about G6PD deficiency pre FCEM implementation and this percent improve post FCEM implementation to 91.7%.

Table (3). The table shows that, majority of the studied mothers were suffering from extremely severe level of stress (85%) pre the FCEM implementation compared to 10% post its implementation. It is revealed from the same table that, mean score of mothers' stress level was 26.90 ± 6.26 pre the FCEM implementation and decrease to17.36 ± 2.73 post FCEM with a statistically significant difference.

Table (1): Distribution of the mothers and their children related to their socio-demographic characteristics:

Socio-demographic characteristics	N=(60)	%
Mothers' age		
28- <39	**42**	**70**
39-<50	**18**	**30**
Mean ± SD	**32.90 ± 8.68**	
Mothers' education		
Primary/Preparatory	**15**	**25**
Secondary	**21**	**35**
University	**24**	**40**
Mothers' occupation		
Housewife	**39**	**65**
Working	**21**	**35**
Residence		
Urban	**24**	**40**
Rural	**36**	**60**
Positive kin relationship between the couples		
Yes	**12**	**20**
No	**48**	**80**
Positive family history for G6PD deficiency		
Yes	**36**	**60**
No	**24**	**40**
Child age		
6<10 ys	**42**	**70**
10-<12ys	**18**	**30**
Mean ± SD	**6.80 ± 2.67**	
Child gender		
Male	**39**	**65**
Female	**21**	**35**
Childs' education		
Primary	**48**	**80**
Preparatory	**12**	**20**

Table (2): Distribution of the studied mothers according to their knowledge about G6PD deficiency

Items of Knowledge	Pre	Post	Test of significance	
	Mean ±SD	Mean ±SD	F	P
Definition of G6PD deficiency	.90± 0.54	1.61± 0.49	0.000*	0.42
Causative factors of G6PD deficiency	.69 ± 0.65	1.59 ± 0.49	0.000*	0.53
Symptoms of G6PD deficiency	.95 ± 0.68	1.61± 0.49	0.000*	0.40
Complications of G6PD deficiency	.75 ± 0.63	1.63± 0.48	0.000*	0.63
Protective measures of G6PD deficiency	.80 ± 0.60	1.66±0.47	0.000*	0.54
Treatment modalities G6PD deficiency	.69 ± 0.46	1.73±0.44	0.000*	0.51
Symptoms of haemolytic crisis	.80 ± 0.60	1.41± 0.49	0.000*	0.33
Food that should be avoided by G6PD deficiency child	.64 ± 0.66	1.88±0.32	0.000*	0.66
Medications that should be avoided by G6PD deficiency child	.59 ± 0.49	1.51±0.50	0.000*	0.60
Relationship between G6PD deficiency and Malaria	.34 ± 0.47	.07±0.25	0.000*	0.20
Symptoms of G6PD deficiency differ from child to another	.59 ± 0.49	.90±0.30	0.000*	0.22
Different types or classification of G6PD deficiency	.49 ± 0.50	.90±0.30	0.000*	0.33
know that your child should avoid foods and medicines contain Vit C&K	.44 ± 0.50	.92±0.28	0.000*	0.34
know that G6PD deficiency child should avoid using henna	.20 ± 0.40	.88±0.32	0.000*	0.56
Total knowledge score	**8.95± 5.2**	**19.16 ± 2.29**	**0.000***	**0.80**

Figure (I): Total mothers' knowledge scores about G6PD deficiency pre and post FCEM implementation

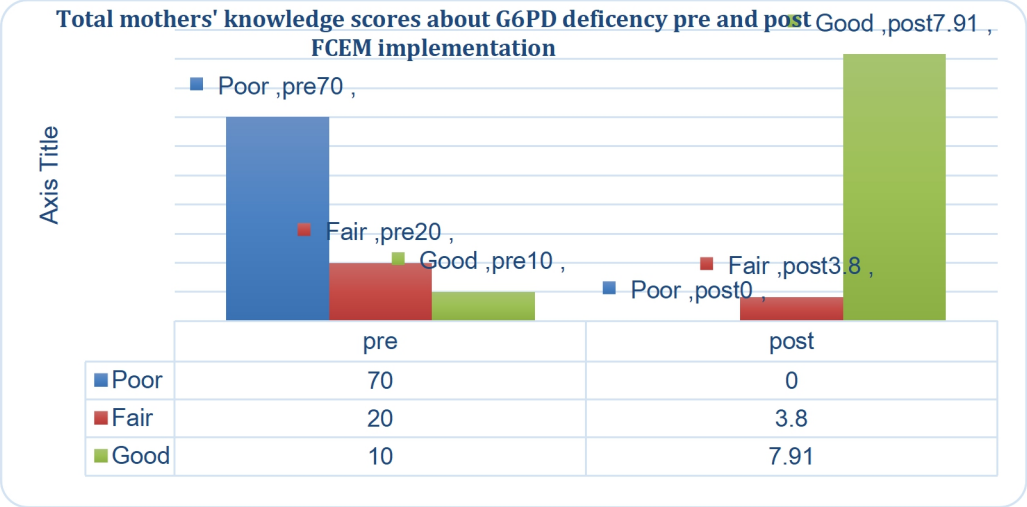

Table (3): Level of stress among the studied mothers pre and post FCEM implementation

Stress level	Pre FCEM		No =60 Post FCEM		Test of significance	
	No.	%	No.	%	T	P
Normal (0-7=very low health concern)	-----	-----	-----	-----		
Mild (8-11 is a low health concern)	-----	-----	-----	-----	12.31	0.000
Moderate (12-15= average health concerns)	6	10	23	38.3		
Sever (16-20=high health concern)	3	5	31	51.7		
Extremely sever (21+ =very high health concern).	51	85	6	10		
Mean ± SD	26.90 ± 6.26		17.36 ± 2.73			

Table (4): Correlation between total knowledge of the studied mothers and their stress level regarding G6PD deficiency

Variables	Pre FCEM		Post FCEM	
	r	P-value	r	P-value
Total mothers' knowledge & total stress level	-0.014	0.918	0.045	0.735

(*) Statistically significant at p ≤0.05

Discussion

The most widely recognized enzyme deficiency disorder in humans is G6PD deficiency. The clinical aggregate is variable and involves asymptomatic children, oxidative stress-related episodic hemolysis, and chronic hemolysis. (**Siler, Romao, Tejera, Pastukhov & Kuzmenko, 2017)**

The current study found that more than two thirds of studied mothers were at age group 28- <39 and 40% of them had university education. In contrary with the current finding of **Mahdi & Hasan, (2018**), who reported that only 12.5% of the mothers who had G6PD deficiency children were at age group 26 - 36 years old and 16.5% of them had institutes or above as an educational level.

As regard to the mothers' occupation, the present study illustrated that the highest percentage of mothers were housewife. This finding agreed with **Mahdi & Hasan (2018),** who found that the majority of mothers **(82%)** were housewife. Additionally, in relation to mothers' residence, the present study found that, two thirds of the studied mothers were from rural areas. This result is highly supported by **El-Sayed et al., (2012),** who found that more than half of their studied parents **(55%)** were from rural areas.

Glucose – 6 - phosphate dehydrogenase (G6PD) deficiency is a hereditary metabolic abnormality caused by deficiency ofG6PD enzyme. The findings of the current study showed that most of the studied mothers had a positive consanguinity and slightly more than two

thirds of them had a positive family history for G6PD deficiency. This finding was in a similar line with **Kasemy, Bahbah, El Hefnawy & Alkalash, (2020),** who found that 67.3% of the studied parents had a positive consanguinity and more than three quarters of them (75.5%) had a positive family history. This result was also compatible with **El-Sayed et al., (2012),** who reported that, almost of the studied sample had positive family history of G6PD deficiency. Also, **Wynne, (2011)** reported that all sample had positive history related G6PD deficiency.

In contrary with, **Tsuzuki, Akahira-Azuma, Kaneshige, Shoya, Hosokawa, (2013)** who stated that there was not any family history for G6PD deficiency among their studied sample. Also the current results were contradicted by **Athab, Al-Zubaidy & Al-Momen, (2017)** who found that more than two thirds **(62.6%)** of the studied parents had non-consanguineous marriages.

In relation to the age of the studied children, the current research found that two-thirds of them aged from 6-<10 years**.** This result wasn't in congruity with **Athab et al., (2017)** who represented that, the peak incidence age of children who were suffer from G6PD deficiency was between 1-5 years of age, and the highest age is 2yr-3yr.

Concerning gender of the studied children, the finding of this study revealed that, more than two thirds of them were males. This result may be explained within the lightweight of the actual fact that X-linked recessive conditions are much more common in males, who have only one X chromosome (and one Y chromosome). While, Females have two X chromosomes, so if they have a mutation on one of them, they still have one X chromosome without the mutation. This rationalization are available in identical line with **Athab et al., (2017)** who found that the general idea that the disease was purely X-linked, and no autosomal element was there, which contributed to increase incidence of G6PD deficiency among male than female**.**

Similarly, the current finding was agreed by **Broek, Heylen, and Akker, (2016)** who found that G6PD is X-linked genetic deficiency that primarily affects males, however ought to even be thought of in female presenting with a hemolytic anemia, even when family ancestry is negative and the G6PD level is normal at presentation. In addition, the study results were consistent with the findings of **Devi, Kodi & Devi, (2016)** who stated that G6PD deficiency was more common in males. On the other hand, this is not in the same line with **Mahdi & Hasan (2018)** who found that, the prevalence in males was 38.5% and in females was 61.5%.

The current research showed that the mean score of the total knowledge of mothers increased with a statistically significant difference. These results have been strongly supported by the studies of **Hassan, Varughese & Kristiansson, 2011; El-Sayed et al., (2012); Guan, Roter, Huang, Erby & Chien, (2014) and Yetti, Syafar, Zulkifli, Indriasari & Bahar, (2019**) who noticed that there was a substantial increase of mothers' knowledge after application of FCEM compared with pre FCEM implementation. This improvement could be clarified by the positive effect of FCEM on the mothers` knowledge. Also, it might be explained by the interest of the mothers with the teaching methods and therefore the audio-visual materials utilized in the FCEM. Also, the improvement of the mothers` knowledge might be as a results of their

active involvement in FCEM sessions through discussion and therefore the frequent review of knowledge by the researcher and inspired them to have an interest to possess a full of life role in their children education.

This study results demonstrated that majority of mothers were suffering from extremely severe level of stress (85%) pre the FCEM implementation compared to 10% post its implementation. Also mean score of mothers' stresses was 26.90 ± 6.26 pre the FCEM implementation and decrease to17.36 ± 2.73 post FCEM with a statistically significant difference. This finding was in harmony with **Bevans, Wehrlen, Castro, Prince, Shelburne & Soeken, (2014)andHendrix, Bailey, Steinhauser, Olsen & Stechuchak, (2016)** who cited that FCEM have positive effects of FCEM on caregivers' stress. Also, **Etemadifar, Heidari, Jivad & Masoudi (2018)** in their study about Effect of FCEM on stress, anxiety and depression among family caregivers of patients with epilepsy; stated that there was statistically significant difference related to stress level in the study group compared with the control group. Moreover, two former studies reported that the applying of FCEM had significant positive effects on chronically ill patients' stress and treatment outcomes as well as their caregivers' stress and self-esteem. **(Masoodi et al., 2013 and Vahedian-Azimi et al., 2015)**

As regard to correlation between total knowledge of the studied mothers and their stress level regarding G6PD deficiency, the present study clarified that there was no statistically significant difference between total knowledge of the studied mothers regarding G6PD deficiency and their stress level pre and post implementation of FCEM, which was contrary to **Nair, Paul, Latha, and Parukkutty (2017)** who conducted study about Parents' knowledge and attitude regarding their child's cancer and effectiveness of initial disease counseling in pediatric oncology patients and reported that there is a positive correlation between parents' knowledge about cancer and their level of stress, that in turn can increase the level of cooperation from parents in relation to care and treatment. Also **Patra, Arun, and Chavan (2015)** conducted study about Impact of psychoeducation intervention module on parents of children with autism spectrum disorders: apreliminary study and found a significant correlation between parents' knowledge and their stress level.

Conclusion:

Applying FCEM on mothers of children with G6PD leading to improvement of their knowledge regarding G6PD deficiency and reduce their level of stress

Recommendations

The researchers recommended implementing FCEM for all mothers and their children with chronic diseases as a strategy for education and management.

Conflict of interest:

There is no conflict of interest and no fund from any institution.

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