

**Prevention of Hemolytic Crisis among G6PD Children: Effect of Educational Program Intervention**<sup>1</sup>Lamia Ahmed El-Sayed; <sup>1</sup>Hyam Refaat Tantawi, <sup>2</sup>Amira A. Adly and <sup>3</sup>Mohamed Farouk<sup>1</sup>Pediatrics Nursing Department, Faculty of Nursing, Ain Shams University<sup>2,3</sup>Pediatrics Medicine Department, Faculty of Medicine, <sup>2</sup>Ain Shams University and <sup>3</sup>Cairo University[hyam.tantawi@yahoo.com](mailto:hyam.tantawi@yahoo.com); [hyam@onlinediabetes.net](mailto:hyam@onlinediabetes.net)

**Abstract: Introduction:** Glucose-6-phosphate dehydrogenase deficiency is an X-linked recessive hereditary disease (abbreviated G6PD closely linked to favism). Favism is a potentially life-threatening hemolytic anemia that can result from the ingestion of fava beans and broad beans. This is a metabolic enzyme involved in the pentose phosphate pathway important for red blood cell metabolism. Deficiency of G6PD will manifest by physically observable reaction to consumption of broad beans. The precipitating factors for G6PD are commonly infection, exposure to some medications or chemicals. **Aim of the study,** this study is a quasi experimental study, aimed to construct, implement and evaluate the effect of program intervention for prevention of precipitating factor for hemolytic crisis among G6PD children. **Subject & Methods,** This study was conducted at pediatric department at children's Hospital affiliated to Ain Shams and Cairo University Hospitals. The study included all available children and their mothers at the previously mentioned settings regardless of their age and sex. **Tools of data collection** Include pre-designed questionnaire to assess characteristics of the studied sample and their mothers' knowledge about G6PD. Program intervention was prepared by the researchers in an Arabic language according to the actual needs. **Results,** The main results showed that the majority of the studied sample acquired the hemolysis attack because of unsatisfactory knowledge of their mothers about G6PD and the predisposing factors for the disease. The actual knowledge of mothers regarding G6PD and decreasing the hemolysis factors were improving after implemented the effective educational program. **Conclusion:** The current study concluded that the majority of children suffered from favism acquired hemolytic diseases because of unsatisfactory knowledge of their mothers regarding favism and its predisposing factors. Also, an educational program intervention was effective in improving the actual knowledge of mothers regarding predisposing factors of G6PD that decreasing of the hemolytic anemia. **Recommendations** This study recommended that, establishing a system for education in the hospitals regarding G6PD from the first time of diagnosis to prevent the complications from hemolysis.

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**Key words:** favism, G6PD, diet, life style, program, guideline

**1. Introduction**

Glucose-6-phosphate dehydrogenase (G6PD) is the most prevalent genetic diseases which can lead to acute hemolytic anemia occur due to ingestion of fava beans, and certain drugs and infection with bacterial or viral infections. Favism is a potentially life-threatening hemolytic anemia that can result from the ingestion of fava beans and broad beans **Al-Azzam, et al.,2009; (Laosombat, 2006 and Guindo, 2007)**. Glucose-6-phosphate dehydrogenase deficiency is an X-linked recessive hereditary disease characterized by abnormally low levels of glucose-6-phosphate dehydrogenase this metabolic enzyme involved in the pentose phosphate pathway is particularly important for maintaining the integrity of red blood cells **(Achille,1999, Christopher et al., 2000, Kaplan, 2006, Ali, 2008)**.

Defective G6PD can cause hemolytic anemia in the presence of several precipitating factors includes infection, exposure to certain medications or chemicals characterized by a hemolytic reaction to

consumption of broad beans **(Frank and Maj, 2005 and Romanian, 2008)**. The majority of persons with inherited G6PD deficiency have no anemia and almost no hemolysis which can develop only as a result of challenge by exogenous agents. Therefore, the precipitating factors for G6PD in children are drugs induced hemolysis including certain sulfonamides, anti-malarials and other drugs or chemicals are associated with significant hemolysis In addition to Infection induced hemolysis as bacterial, viral infection. Acute Hemolytic anemia occur within 24 to 48 hours after ingesting of fava beans **(Achille,1999, Christopher et al., 2000, Kaplan, 2006, Ali, 2008)**.

G6PD deficiency is mostly an asymptomatic trait, but it predisposes to acute hemolytic anemia in response to exogenous triggers, including first, ingestion of fava beans second, certain bacterial and viral infections and third some drugs notably some antimalarials (e.g. primaquine), some antibiotics (e.g. sulphanilamide, dapsone, nitrofurantoin), and even aspirin in high doses. Clinical manifestations include

severe neonatal jaundice, chronic nonspherocytic haemolytic anaemia. The acute haemolytic attack starts with malaise, weakness, paleness, dizziness, headache and abdominal or lumbar pain, followed by passage of dark urine (haemoglobinuria). Hemolytic anemia, when very severe, can end in death (Prchal and Gregg, 2005, Ali, 2008). Identifying these precipitating factors that lead to hemolytic crisis play an important role for prevent the development of hemolytic crises in children by improving parental awareness to change or alter eating habits and avoiding trigger factors such as fava beans and certain drugs, in order to minimize haemolytic crisis and to improve the patients' quality of life should be launched in to reduce the incidence acute hemolytic anemia (Cappellini and 2008, (Al-Azzam *et al.*, 2009, Cappellini and Fiorelli, 2008; Balgir, 2010).

G6PD deficiency is a genetic abnormality affecting over 200 million people worldwide. The genetic and hemolytic defects are the cause of morbidity, mortality that effect on the reproductive outcome and cause poor health. Therefore; there is an urgent need to find out strategies to combat the genetic health problems especially in the developing countries. The development of a weaning food containing fava would appear to be a potential health hazard to infants with the G6PD deficiency. The only way of diminishing the risk of favism is to identify the toxic factors in the bean by modifying the way in which the bean is prepared for use in a weaning food. The prevention of hereditary hemolytic disorders by promotion of health care for better quality of life of the children, improving awareness of the mothers regarding genetic diseases through health education, carrier detection, and prenatal diagnosis are vital role for prevent complications (Achille *et al.*, 1999; Abdou and Amer, 2005, Cappellini and Fiorelli, 2008, Balgir, 2010).

Mothers information regarding favism is lacking because of the increasing unusual consumption of drugs or foods that lead to acute hemolytic anemia in children especially in developing countries. Therefore, prevention is simple and largely depend on increase awareness of the parents for existence problems. Health education include the following, advising parents not to feed children with fava beans, keep your list of oxidative substances in a handy place, do not ignore infections and Memorize the signs and symptoms of hemolytic anemia: paleness, dizziness, headache, difficulty in breathing, tea-colored urine and bring the child at once to his pediatrician. Children with G6PD deficiency appears and remains healthy until he is exposed to a large amount of oxidative substances. When this happens, his red blood cells are destroyed, a process known as

hemolysis therefore, the parents should be trained to avoid traditional use of medicine and avoiding exposure to triggering factors that lead to appear hemolytic anemia for children with favism. Prompt blood transfusion is indicated in severe acute hemolytic anemia and may be life-saving. Finally, the best way to care for a child with G6PD deficiency is to limit exposure to the triggers of its symptoms and preventing complications of G6PD deficiency depend heavily on education of the people at risk by using effective educational aids as booklets or leaflets should be given for parents to keep your child living healthy (Hoffbrand and Moss, 2011).

#### Significance of the study

Glucose-6-phosphate dehydrogenase (G6PD) deficiency is one of the most common genetic enzyme deficiencies leading to hemolytic anemia affecting more than 400 million people worldwide. Which is precipitated by several factors, such as infections, drugs and ingestion of fava beans? Favism is a potentially life-threatening hemolytic anemia that results from the ingestion of fresh, frozen, cooked, raw or dried fava beans determining the toxic factors in fava beans, the pyrimidic glycosides have been responsible for favism induction (Hky-Lau, 2006, Vichai, 2006, Issam *et al.*, 2007, Cappellini, Fiorelli, 2008). In this study, we investigate precipitated factors that might contribute to the development of hemolytic crisis in G6PD deficiency in children. Therefore, It is our hope providing An educational program for mothers with their children can raise their awareness, and can help to improve their Knowledge and practice toward their children suffering from G6PD. Thus, this study aims to construct, implement and evaluate the effect of intervention program for prevention of precipitating factors which lead to hemolytic crisis among G6PD children (Bushra, 2007).

#### Aim of the study

This study is a quasi experimental study, aimed to construct, implement and evaluate the effect of an intervention program for mothers of their children suffering from G6PD for prevention of precipitating factors for hemolytic crisis among G6PD children.

#### Research Questions:

- 1-What are the precipitating factors that lead to hemolytic anemia among children suffering from G6PD?
- 2-What are the mothers knowledge regarding G6PD for their children?
- 3-Are the educational program raising mothers awareness regarding G6PD?

#### 2. Subjects and Methods

**Research design:** This study is a quasi experimental study

**Setting:**

This study was conducted at pediatric department at children's Hospital affiliated to Ain Shams and Cairo University Hospitals.

**Sampling:**

The study sample included all available children and their mothers regardless of their age and sex, over a 6 months period from identifying the disease in the previously mentioned settings,

**Selection Criteria:**

All available children and their mothers (120) in the previously mentioned settings (60 from children hospital at Ain shams university hospital and 60 from children hospital at Cairo University Hospital), regardless of their age and sex.

**Ethical considerations**

A verbal consent was obtained from all subjects enrolled in the current study. All data are confidential for the research use only. Data were coded and kept in saved place.

**Data collection tool:**

Data were collected through use of the following tools twice:

(Pre and post educational program Intervention)

**1-A pre-designed questionnaire** that was designed by the researchers and was written in an Arabic language which covered the following:

- A- Sociodemographic characteristics of the children include the following age, sex, residence, time of illness, blood group.....etc.
- B- Sociodemographic characteristics of the their mothers including the following age, level of education, occupation, family history, blood group....etc.
- C- Mothers' knowledge related to G6PD deficiency to assess mother's knowledge about (Favism) definition, causes of favism, heredity factors, family history, signs and symptoms of favism as paleness, extreme tiredness, rapid heartbeat, and jaundice, medical diagnosis and medical treatment and methods of prevention of G6PD deficiency.
- D- Questions for mothers to assess mothers performance regarding the precipitating factors for G6PD deficiency or triggers factors for favism, what are the forbidden foods which contains fava beans that lead to hemolytic crisis?, what are the common drugs which should be avoid to give for their children suffering from G6PD deficiency? examples, antibiotics (Sulphonamides, Cotrimoxazole, Bactrim, Septrin, chloramphenicol, Nitrofurantoin, Nalidixic acid), others drugs as Aspirin, Phenacitin, Sulphasalazine, large doses of vitamin C, Hydralazine, Quinidine. Finally questions about caring for the child when he have hemolytic crisis.

**Scoring system:**

Regarding the knowledge of mothers related to G6PD (Favism) 120 scores were allocated at all items of questionnaire, mother's answers were checked with key model answer then their answer's categorized into two levels:

≥ More than 50% considered satisfactory knowledge.

Less than 50% considered unsatisfactory knowledge.

**2- Construction of educational intervention program:**

Actual needed assessment was done and accordingly the program was pervaded. A guiding booklet was designed by the researchers after reviewing the related literature; it was designed in an Arabic language. The guiding booklet was evaluated for its content validity and clarity by a panel of experts' professions in field of the study including the supervisors of this work. In the light of their comments, the necessary modifications were carried out and the final form of the guiding booklet was stated. A variety of teaching strategies were used in implementation of the educational intervention program.

**2- Implementation phase:**

A prepared booklet for mothers their children suffering from favism considered as an educational support for them through session of the intervention program through session two day per weeks for mother their children at Ain shams university and two day per weeks for children in Cairo university hospital. It was enriched the mothers a lot of knowledge about definition of favism, causes, signs and symptoms of favism, treatment strategies for treatment, complications from G6PD deficiency, Consequences from hemolytic anemia & Measures follow to stay healthy, and preventive measures from favism. Also nutritional plan consists of forbidden foods and forbidden drugs and what are the suitable nutrition for children.

**3-Evaluation phase:**

The researchers evaluate the effect of an educational program materials (booklet) that equipped for the mothers and upon the completion of the intervention program. The post test was done for mothers to evaluate the outcomes of the educational intervention program using the same preprogram tools.

**Field work:**

Once permission was granted to proceed in this study and an informed consent was obtained from the mothers of the children to be engaged in the current study, the researchers contacted the mothers before collecting data of the actual study for the purpose of providing a simple explanation of the objective of the study to gain their cooperation & to assure the studied

subject about the anonymity of their answers and that the information will be used for scientific research only and will be strictly confidential. The actual field work was carried out at the first week of January (2011) up to the end of June (2011) for data collection and program implementation. The investigator was available 2 days/week from 8 Am to 1 pm for each hospital

The implementation of educational intervention program regarding G6PD (Favism) was carried out at the previously mentioned settings. The investigator distributed the guiding booklet to the mothers, where the investigator explained the content of the guiding booklet and how to use it as a personal reference.

The total number of sessions was 7 (3 sessions for theory, each session took about 1 hour and 45 minutes and 2 session for practice in addition to two sessions for pre and post educational intervention test. Session of theory include acquire mothers information about favism through using booklets(definition of favism, predisposing causes or factors, signs and symptoms, treatment, health education and session of practice includes increase mothers their performance about what the suitable nutrition for their children with favism, forbidden nutrition which should be restricted from their children which lead to hemolytic anemia, actual performance in the critical situations as fever, cough and finally methods of prevention. At the beginning of every session a feed back about the previous session was done and the objective of new topic was explained, the researchers allowed the mothers to ask and share in discussion, mothers' were discussed to correct any errors in additions.

Different teaching strategies were used such as open discussion, small group discussion (in case of more than one detected cases, role play, using real objects (e.g all types of Fava.....). Suitable teaching aids prepared especially for the program such as booklet, colored posters and module.

#### **Administrative design:**

An official written letter approval was obtained from the college of medicine and nursing Ain Shams University/Cairo University in order to clarify the purpose of the study and was submitted to the authorities in the study settings.

#### **Statistical analysis:**

Data were tabulated and SPSS (Statistical Package for the Social Science, SPSS Inc, Chicago, IL, USA, 1999) version 15 for Microsoft Windows was used for statistical analysis. Quantitative data were presented in the form of mean  $\pm$  SD. Qualitative variables were compared using chi-square test ( $X^2$ ) to compare between 2 qualitative variables. Statistical significance was considered at P-value <0.05.

### **3. Results**

**Table (1)** reveals that, about two thirds (61.0%) of the studied sample were aged from 1-3 years, while 82.5% of them were males. In relation to children's residence, it was found that 55.0% of them were from rural areas.

**Table (2)** shows that 47.5% and 55.8 of fathers and mothers were respectively aged from 20-years, while 37.5 % and 40.0% of them were respectively illiterate. In relation to parent's occupation it was observed from table that 83.3% % of mothers were not workings compared with 96.7% of fathers were working.

**Table (3)** clears that, 82.5% of the studied sample have positive family history to G6PD while 17.5 of them have negative history of G6PD.

**Table (4)** reveals that 41.7 % and 40.0% of the mothers and their children blood group were (A) respectively also, there was high significant statistically difference ( $p < 0.0001$ ) between maternal and their children related to their Blood group.

**Table (5)** showed that 80.8% of them were lived in separate home, while 80.83 % of them were has good ventilation home and 62.5% of their home has 1-2 windows.

**Table (6)** reveals that, 35.8 % and 33.3% of them were having hemolytic crisis from falafel and fava beans respectively. In relation to duration of attack, it was found that 53.3% of them were has one day duration of attack.

**Table (7)** reveals that, % 66.7 them were has history of hospitalization. In relation to causes of hospitalization it was found that %50.8 of them were hemolytic crisis as causes of hospitalization, while 25.8% of them that dehydration has a causes of hospitalization.

**Table (8)** showed that, the majority of mothers' knowledge were unsatisfactory pre program intervention related to G6PD deficiency, namely, definition, causes, predisposing factors, heredity factors, family history, signs and symptoms of favism, extreme tiredness, rapid heartbeat, and jaundice, medical diagnosis and medical treatment and methods of prevention of G6PD deficiency and modified their knowledge after the intervention program < 0.001\*

**Figure (1)** illustrates that, there was a highly improvement of mothers' total knowledge regarding G6PD post program intervention compared with pre program intervention.

**Figure(2)** clears that the performance of mothers regarding G6PD were improved post program intervention

**Table (9)** reveals that there was a highly significant statistically difference ( $p < 0.001$ ) between age, gender and residence and parent's knowledge regarding G6PD Pre and post program intervention.

**Table (10)** illustrates that there was a highly significant statistically difference ( $p < 0.001$ ) between mothers' age and their knowledge regarding G6PD Pre and post program intervention. While the same table reveals that, there was no significant statistically difference ( $p > 0.05$ ) between mothers level of education, mothers occupational state and their knowledge regarding G6PD Pre and post program intervention.

**Table (11)** reveals that, there was a highly significant statistically difference ( $p < 0.0001$ ) between father's age and their knowledge regarding G6PD Pre and post program intervention. While the current result cleared that, there was no significant statistically difference ( $p > 0.05$ ) between father's level of education and occupational state and their knowledge regarding G6PD Pre and post program intervention.

**Table (12)** clears that, there was a highly significant statistically difference ( $p < 0.001$ ) between positive family history and parent's knowledge regarding G6PD Pre and post program intervention.

**Table (13)** shows that, there was a highly significant statistically difference ( $p < 0.001$ ) between children blood group and parent's knowledge regarding G6PD Pre and post program intervention.

**Table (14)** this table revealed that there was a highly significant statistically difference ( $p < 0.001$ ) between

type of home and parent's knowledge regarding G6PD Pre and post program intervention. Also, there was a highly significant statistically difference ( $p < 0.01$ ) between ventilation status and parent's knowledge regarding G6PD Pre and post program intervention.

**Table (15)** reveals that there was a highly significant statistically difference ( $p < 0.01$ ) between previous hospitalization and its causes and parent's knowledge regarding G6PD Pre and post program intervention

#### Part I: Characteristics of the study subjects.

**Table (1):** Distribution of the studied children according to their characteristics (n=120).

Items	No	%
<b>Age / years</b>		
< 1	1.00	51
1- 3	2.00	61
3- 6	3.00	4
$\geq 12$	4.00	4
$\bar{X} \pm SD$	24.50 $\pm$ 16.35	
<b>Gender</b>		
Male	99	82.5
Female	21	17.5
<b>Residence</b>		
Rural	66	55.0
Urban	54	45.0

**Table (2):** Distribution of the studied mothers according their characteristics.

Items	Mothers		Fathers		X <sup>2</sup>	P value
	No	%	No	%		
<b>Age / years</b>						
< 20	11	9.2	15	12.5		
20 < 30	57	47.5	67	55.8	95.73	0.0001 *
30 < 35	41	34.2	34	28.3		
$\geq 35$	11	9.2	4	3.3		
$\bar{X} \pm SD$	4.66 $\pm$ 29.97		24.80 $\pm$ 3.58			
<b>Education</b>						
Illiterate	45	37.5	48	40.0		
Primary	7	5.8	11	9.2		
Preparatory	11	9.2	17	14.2	55.81	0.0001 *
Diploma	37	30.8	24	20.0		
Bachelor	20	16.7	20	16.7		
<b>Occupation</b>					60.0	* 0.0001
Working	20	16.7	116	96.7		
Not working	100	83.3	4	3.3		

**Table (3):** Number and percentage distribution of the studied sample according to their family history of G6PD (n=120).

Items	No	%
<b>Family History</b>		
No	21	17.5
Yes (99)	99	82.5
• Father	9	7.5
• Mother	8	6.7
• Uncle	13	10.8
• Aunt	22	18.3
• Cousin	33	27.5
• Other	14	11.7

**Table (4):** Number and percentage distribution of the studied sample according to their ABO (n=120).

Items	Child		Maternal		X2	P value
	No	%	No	%		
<b>Blood group</b>						
A	50	41.7	48	40.0		
B	25	20.8	17	14.2	112.02	* 0.0001
AB	35	29.2	24	20.0		
O	10	8.3	31	25.8		

**Table (5):** Number and percentage distribution of the studied sample according to their housing condition (n=120).

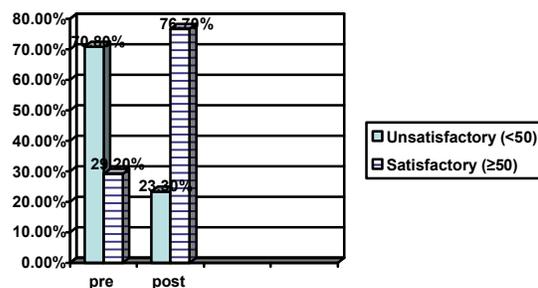
Items	No	%
<b>House</b>		
Separate	97	80.8
Share <b>Ventilation</b>	23	19.2
No	23	19.2
Yes (97)	97	80.83
• 1-2	75	62.5
• 3-4	22	18.3

**Table (6):** Number and percentage distribution of the studied sample according to their precipitating factors related hemolytic crisis (n=120).

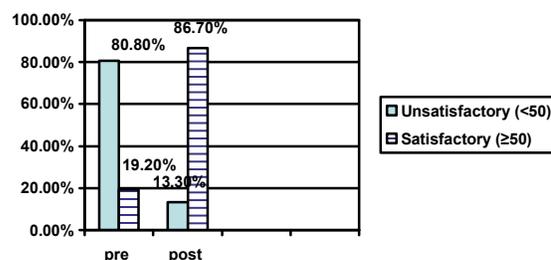
Items	No	%
<b>Cause of Attack</b>		
Asprin	14	11.7
Belila	4	3.3
Falafel	43	35.8
Fava beans	40	33.3
Paints	4	3.3
Septin	15	12.5
<b>Duration of Attack</b>		
1 day	64	53.3
1 day ≤ 2 days	49	40.8
2 days ≤ 3 days	7	5.8

**Table (7):** Number and percentage distribution of the studied sample according to their past history of hospitalization (n=120).

Items	No=100	%
<b>Hospitalization</b>		
Yes	80	66.7
No	40	33.3
<b>Causes of Hospitalization (80)</b>		
Hemolytic crisis	61	50.8
Infection	28	23.3
Dehydration	31	25.8



**Figure (1):** Number and percentage distribution of the studied sample in relation to their total knowledge regarding G6PD Pre and post program intervention (n=120).



**Figure (2):** Number and percentage distribution of the studied sample in relation to their total performance regarding G6PD Pre and post program intervention (n=120).

**Table (8): Distribution of mothers according to their Knowledge about Favism Pre and Post Program Implementation (n=120)**

Items	Satisfactory		Satisfactory		X <sup>2</sup>	P value
	Pre		Post			
	No	%	No	%		
<b>Definition</b>	14	11.6	75	62.5	32.1 30.4	< 0.001* < 0.001*
<b>Causes of favism</b>	11	9.1	76	63.3		
<b>precipitating factors</b>	10	8.3	90	75		
<b>Heredity factors</b>	12	10	78	65		
<b>Family history</b>	10	8.3	71	65		
<b>Signs and symptoms of favism</b>	11	9.1	75	62		
<b>Medical diagnosis</b>	13	10.8	79	65.8		
<b>Medical treatment</b>	11	9.1	80	66.6		
<b>Methods of prevention</b>	11	9.1	65	54.2		

NB number not exclusive \* Statistically significant

### Part II: Relations between Variables of the Study

**Table (9): Relation between Socio-demographic characteristics of the children and their mothers' total knowledge about G6PD (n=120)**

Characteristic	Knowledge								X2	p-value
	Pre				Post					
	Satisfactory (<50 %) N= 35		Unsatisfactory (>50 %) N= 85		Satisfactory (<50 %) N= 92		Unsatisfactory (>50 %) N= 28			
	No.	%	No.	%	No.	%	No.	%		
<b>Age / years:</b> < 1	16	45.7	35	41.2	40	43.5	11	39.3	15.03	*<0.001
1-3	17	48.6	44	51.8	46	50.0	15	53.6		
3- 6	1	2.9	3	3.5	3	3.3	1	3.6		
≥12	1	2.9	3	3.5	3	3.3	1	3.6		
<b>Gender:</b> Male	18	51.4	81	95.3	75	81.5	24	85.7	28.04	*<0.001
Female	17	48.6	4	4.7	17	48.6	4	4.7		
<b>Residence:</b> Rural	18	51.4	48	56.5	50	54.3	16	57.1	14.9	*<0.001
Urban	17	48.6	37	43.5	42	45.7	12	42.9		

**Table (10): Relation between mothers' characteristics of the studied sample and their total knowledge about G6PD (n=120).**

Characteristic	Knowledge								X2	p-value
	Pre				Post					
	Satisfactory (<50 %) N= 35		Unsatisfactory (>50 %) N= 85		Satisfactory (<50 %) N= 92		Unsatisfactory (>50 %) N= 28			
	No.	%	No.	%	No.	%	No.	%		
<b>Age / years:</b> < 20	4	11.4	7	8.2	9	9.8	2	7.1%		
20< 30	17	48.6	40	47.1	44	47.8	13	46.4		
30<35	12	34.3	29	34.1	32	34.8	9	32.1	15.21	*<0.001
≥ 35	2	5.7	9	10.6	7	7.6	4	14.3		
<b>Education</b>										
Bachelor	7	20.0	13	15.3	16	17.4	4	14.3		
Diploma	5	17.2	18	21.2	16	17.4	8	38.6		
Illiterate	13	37.1	35	41.2	37	40.2	11	39.3	5.82	>0.05
Preparatory	6	17.1	11	12.9	14	15.2	3	10.7		
Primary	3	8.6	8	9.4	9	9.8	2	7.1		
<b>Occupation</b>										
Working	7	20.0	13	15.3	16	17.4	4	14.3	0.87	>0.05
Not working	28	80.0	72	84.7	76	82.6	24	85.7		

**Table (11): Relation between fathers' characteristics of the studied sample and their total knowledge about G6PD (n=120)**

Characteristic	Knowledge								X2	p-value
	Pre				Post					
	Satisfactory (<50 %) N= 35		Unsatisfactory (>50 %) N= 85		Satisfactory (<50 %) N= 92		Unsatisfactory (>50 %) N= 28			
	No.	%	No.	%	No.	%	No.	%		
<b>Age / years:</b> < 20	4	11.4	11	12.9	11	12.0	4	14.3		
20<30	22	62.9	45	52.9	52	56.5	15	53.6		
30<35	8	22.9	26	30.6	26	28.3	8	28.6	19.8	*<0.0001
≥ 35	1	2.9	3	3.5	3	3.3	1	3.6		
<b>Education</b>										
Bachelor	7	20.0	13	15.3	16	17.4	4	14.3		
Diploma	10	28.6	27	31.8	27	29.3	10	35.7		
Illiterate	11	31.4	34	40.0	34	37.0	11	39.3	2.69	>0.05
Preparatory	4	11.4	7	8.2	9	9.8	2	7.1		
Primary	3	8.6	4	4.7	6	6.5	1	3.6		
<b>Occupation</b>										
Working	34	97.1	82	94.5	89	96.7	27	96.4	1.71	>0.05
Not working	1	2.9	3	3.5	3	3.3	1	3.6		

**Table (12): Relation between family history of the studied sample and their total knowledge about G6PD (n=120)**

Characteristic	Knowledge								X2	p-value
	Pre				Post					
	Satisfactory (<50 %) N= 35		Unsatisfactory (>50 %) N= 85		Satisfactory (<50 %) N= 92		Unsatisfactory (>50 %) N= 28			
	No.	%	No.	%	No.	%	No.	%		
<b>Family History</b>										
No	34	97.1	82	96.5	89	96.7	27	96.4	14.6	*<0.001
Yes	1	2.9	3	3.5	3	3.3	1	3.6		

**Table (13): Relation between blood group of the studied sample and their total knowledge about G6PD (n=120)**

Characteristic	Knowledge								X2	p-value
	Pre				Post					
	Satisfactory (<50 %) N= 35		Unsatisfactory (>50 %) N= 85		Satisfactory (<50 %) N= 92		Unsatisfactory (>50 %) N= 28			
	No.	%	No.	%	No.	%	No.	%		
<b>Blood Group</b>										
A	22	62.9	28	32.9	50	54.3	0	0.0		
B	0	0.0	25	29.4	18	19.6	7	25.0	19.53	*<0.001
AB	13	37.1	22	25.9	18	19.6	17	60.7		
O	0	0.0	10	11.8	6	6.5	4	14.3		

**Table (14):** Relation between home condition of the studied sample and their total knowledge about G6PD (n=120)

Characteristic	Knowledge								X <sup>2</sup>	p-value
	Pre				Post					
	Satisfactory (<50 %) N= 35		Unsatisfactory (>50 %) N= 85		Satisfactory (<50 %) N= 92		Unsatisfactory (>50 %) N= 28			
	No.	%	No.	%	No.	%	No.	%		
<b>House</b>										
Separate	28	80.0	69	81.2	74	80.4	23	82.1		
Share	7	20.0	16	18.8	18	19.6	5	17.9	12.23	*<0.001
<b>Ventilation</b>										
No	7	20.0	16	18.8	18	19.6	5	17.9		
Yes	28	80.0	69	81.2	74	80.4	23	82.1	9.12	*<0.01

**Table (15):** Relation between hospitalization of the studied sample and their total knowledge about G6PD (n=120)

Characteristic	Knowledge								X <sup>2</sup>	p-value
	Pre				Post					
	Satisfactory (<50 %) N= 35		Unsatisfactory (>50 %) N= 85		Satisfactory (<50 %) N= 92		Unsatisfactory (>50 %) N= 28			
	No.	%	No.	%	No.	%	No.	%		
<b>Hospitalization</b>										
Yes	22	62.9	58	68.2	64	69.6	16	57.1		
No	13	37.1	27	31.8	28	30.4	12	42.9	7.58	*<0.01
<b>Causes of Hospitalization</b>										
Hemolytic Crisis	22	62.9	39	45.9	61	66.3	0	0.0		
Infection	7	20.0	21	24.7	12	13.0	16	57.1	12.44	*<0.001
Dehydration	6	17.1	25	29.4	19	20.7	12	42.9		

#### 4. Discussion

This study is a quasi experimental study, aimed to construct, implement and evaluate the effect of program intervention for prevention of precipitating factor for hemolytic crisis among G6PD children.

The current study revealed that, about two thirds were aged from 1-3 years, while the majority of them were males. In relation to studied sample children's residence, it was found that more than half of them were from rural areas. This finding is highly supported with similar study in Ain shams university hospital of **Fathy, (2008)**, mentioned that the majority of the studied sample were males and from rural areas. The investigator believes that the age of weaning consider a critical age because all types of food were under examination for allergic reaction or its reaction on the children so that other ages more than 3 years old considered more safe from this trial regarding food intake specially fava food.

The present findings showed that nearly and more than half of both studied sample fathers and mothers were respectively aged from 20- 30 years, while more than one third and two thirds of both mothers and fathers of the studied sample were respectively illiterate. In relation to parent's

occupation it was found that the majority of the mothers of the studied sample were not working compared with nearly of all of fathers were working. This study was in accordance with the study of **Tullio et al., 2009**, in Italy, who mentioned that most of the studied sample parents aged above 20 years old.

The findings indicated that, the majority of the studied sample have positive family history of G6PD. This study was in agreement with the study of **Wynne, 2011**, who mentioned that all sample have positive history related G6PD.

The study clarified that nearly more than one quarter of the mother and their children blood group was A respectively also, there was high significant statistically difference ( $p < 0.0001$ ) between maternal and their children related to their Blood group. These findings not in agreement with the study of **Tullio, et. al., 2009** who mentioned that nearly half of the studied sample blood group was O, while the study of the present study was supported by the study of **Fathy, 2009**, who mentioned that the most of the studied sample was A the researchers believe that theses deference may be due to the setting of the deferent studies.

**The current study clarified that**, the majority of the studied sample were lived in separate home and have good ventilation, while two thirds of them have 1-2 windows these finding were in accordance of the study of **Frank and Maj, (2005)** who mentioned that, most of the studied sample have good ventilation and enough windows. The investigators believes that good ventilation may causes decrease attack of crisis because it avoid the child from inhalation of substances, namely, antiseptic solution, gases.....etc that causes hemolytic crisis.

**The present study** revealed that about one third of the studied sample acquired hemolytic crisis from falafel and fava beans respectively. In relation to duration of attack, it was found that more than half of them have been hemolytic crisis one day ago. Also, around two thirds of them have history of hospitalization because of hemolytic crisis. This study was in agreement with the study of **Ali, 2008**, in KSA who, mentioned that the majority of the studied sample have hemolytic crisis from eating falafel, and it was the main causes of hospitalization.

This study illustrated that the majority of Mothers' knowledge were unsatisfactory pre program intervention related to G6PD deficiency namely, definition, causes, predisposing factors (what are the forbidden foods which contains fava beans that lead to hemolytic crisis?, what are the common drugs which should be avoid to give for their children suffering from G6PD deficiency? For examples; antibiotics (Sulphonamides, Co-trimoxazole, Bactrim, Septrin, chloramphenicol, Nitrofurantoin, Nalidixic acid), others drugs as; Aspirin, Phenacitin, Sulphasalazine, large doses of vitamin C, Hydralazine, Quinidine. Finally questions about caring for the child when he has hemolytic crisis), heredity factors, family history, signs and symptoms of favism, extreme tiredness, rapid heartbeat, and jaundice, medical diagnosis and medical treatment and methods of prevention of G6PD deficiency. Mean while the knowledge of mothers were improved and were satisfied after program intervention Also, it was obvious that there was a highly significant statistically difference ( $p < 0.0001$ ) between parent's knowledge regarding G6PD Pre and post program intervention. This finding was in agreement with **Hamilton, 2004**, who mentioned in similar study that there was a highly significant statistically difference ( $p < 0.0001$ ) between parent's knowledge regarding G6PD Pre and post program

Also, regarding the mothers' total performance about what the suitable nutrition for their children with favism, forbidden nutrition which should be restricted from their children which lead to hemolytic anemia, actual performance in the critical situations as fever, cough and finally methods of prevention, the

current study indicated that there was a highly improvement in the mothers' performance post program intervention compared with pre program intervention. It was clear from The current study that there was a highly significant statistically difference ( $p < 0.001$ ) between age, gender and residence, family history, children blood group, type of home, ventilation status and parent's knowledge regarding G6PD Pre and post program intervention while, there was no significant statistically difference ( $p > 0.05$ ) between both mothers' and fathers' level of education and occupational state and their knowledge regarding G6PD Pre and post program intervention. These findings were highly supported with the studies of **Monga, et al., 2003, Beutler, 2008, Hassan, et al., 2011 and Gaskin, et al., 2011**, who mentioned that there was significant statistically between the studied sample age, gender and residence, family history and their knowledge in addition to this knowledge increased post program intervention and it was cleared that there was statistically significant pre and post program intervention. Also these findings were support that, there was no significant statistically difference ( $p > 0.05$ ) between both mothers' and fathers' level of education and occupational state and their knowledge regarding G6PD.

The current study revealed that, there was a highly significant statistically difference ( $p < 0.01$ ) between previous hospitalization and its causes and mother's knowledge regarding G6PD Pre and post program intervention. This finding is supported by the study of **Mehta, et al., 2008**, who mentioned that previous hospitalization effect on the mothers knowledge these may be due to increased their experiences related G6PD and its management.

### Conclusion

The current study concluded that the majority of children suffered from Favism acquired hemolytic diseases because of unsatisfactory knowledge and performance of their mothers regarding favism, the predisposing factors and the practices should be done during the attack. Also, an educational program intervention was effective in improving the actual knowledge and practices of mothers regarding G6PD predisposing factors and decreasing of the hemolytic anemia for their children.

### Recommendations

- 1- Initiation and establishment of system for education in the hospitals regarding G6PD from the first time of diagnosis to prevent the complication from hemolysis.
- 2- Awareness programs about predisposing factors should be held periodically for at risk children

- 3- Further studies should be carried out on a large number of G6PD children for evidence of results and generalization.

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