

Nurses' Knowledge about Safe and Unsafe Drugs of Patients with Glucose 6 Phosphate Dehydrogenase Deficiency

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Abstract: Background: Nurses play an important role in identifying and preventing precipitating factors that lead to a haemolytic crisis in G6PD deficiency patients by avoiding trigger factors such as specific drugs. **Purpose:** To assess nurses' knowledge about safe and unsafe drugs for patients with G6PD deficiency at Menoufia Governorate. **Methods:** Descriptive research design was utilized. An online survey form was created by using Google Forms. The data were selected from different departments of Menoufia university hospital. **Sampling:** A convenience sample that included 300 nurses, **Instruments:** Instrument one: Nurse's knowledge assessment questionnaire regarding safe and unsafe drugs used for G6PD deficiency patients, Instrument two: Nurses' source of information about safe and safe drugs. **Results:** Approximately half of the nurses (48%) had poor knowledge about safe and unsafe drugs for G6PD patients, 24% had good knowledge, and 20%-70% had average knowledge. Whereas, 49% of nurses gain here knowledge about safe and safe drugs from academic achievement, faculty of nursing, or institution. The educational level had a highly significant correlation with nurses' knowledge regarding safe and unsafe drugs used for G6PD. **Conclusion:** The nurse's knowledge regarding G6PD deficiency was not enough. **Recommendation:** Continuing nursing education and in-services training programs concerning glucose-6- phosphate deficiency should be provided regularly.

Keywords: G6PD Deficiency, nurses, knowledge.

Introduction

Glucose-6-phosphate dehydrogenase deficiency (G6PDD) is one of the greatest genetic enzyme deficiencies in the world. Approximately, 400 million people are affected. It is more common in males than females. It is also more common in people of African, Mediterranean, or Southeast Asian origin. G6PD is a genetic imperfection that leaves erythrocytes susceptible to hemolysis upon certain exposures (Yang et al., 2019). The G6PD gene provides instructions for creating an enzyme called Glucose-6-phosphate dehydrogenase, and this enzyme is involved in the regular release of

carbohydrates. It also protects red blood cells from the effects of possibly harmful molecules named reactive oxygen species. As a result, reactive oxygen species can collect and damage red blood cells. Consequently, increasing the level of reactive oxygen species reasons red blood cells to be destroyed faster than the body can replace them. The subsequent anemia, although usually self-limiting, may be extreme enough to demand exchange transfusion (Abass et al., 2015).

Moreover, numerous medications have been accompanying hemolysis hence, the precipitating factors for G6PD are

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drugs-induced haemolysis including certain sulfonamides, anti-malarial and other drugs or chemicals that are associated with significant haemolysis should be avoided. Persons with G6PD deficiency need to avoid foods, drugs, and chemicals that can precipitate hemolysis. Additionally, the most common medical problem related to glucose-6-phosphate dehydrogenase deficiency is hemolytic anemia. This type of anemia leads to paleness, yellowing of the skin and whites of the eyes (jaundice), dark urine, fatigue, shortness of breath, and a rapid heart rate. In severe anemia, the patient requires a blood transfusion to avoid shock (Lauden et al., 2019).

Nurses work in close contact with the patients and play an important role in identifying and preventing these precipitating factors that lead to hemolytic crises to prevent the development of hemolytic crises by avoiding trigger factors such as fava beans and certain drugs such as Chloramphenicol, chloroquine, primaquine, colchicine, diaminodiphenyl sulfone, dopa, isoniazid, methylene blue, streptomycin, sulfacetamide, sulfapyridine, sulfacytine, acetaminophen, trimethoprim. Also, it can be caused by certain food as fava bean and smoked synthetics cannabinoid, or chemicals such as naphthalene, benzene, aniline dye, and menthol products; to minimize hemolytic crisis and to improve the patient's quality of life should be launched in to reduce the incidence acute hemolytic anemia (Lee et al., 2017).

In addition, we know protection is better than cure and this rule applies perfectly to this disease. Protection can be achieved by health education about drugs, diet, and chemicals causing the attack and by telling the patient about the severity of the disease and the

importance of lifestyle modifications such as smoking, tobacco, and alcohol cessation. Therefore, nurses should have complete correct knowledge about safe and unsafe drugs for G6PD deficiency. Abass et al. (2015) reported that less than one-third of the studied nurses (26.7%) had complete correct knowledge about safe and unsafe drugs in G6PD deficiency while (73.3%) of them had incorrect knowledge about safe and unsafe drugs in G6PD deficiency.

The frequency of children suffering from the acute hemolytic crisis caused by G6PD deficiency increased in the last three years. Children with G6PD deficiency need special nursing care to minimize complications, such as life-threatening acute episodes of hemolysis. Furthermore, the result of this study could be helpful for nurses in designing and applying standards of nursing care for such a group of patients in the future (Richardson and O'Malley, 2021).

In this respect, this study aimed to evaluate nurses' knowledge about safe and unsafe drugs in patients with G6PD deficiency.

Significance of the study

Glucose-6-phosphate dehydrogenase deficiency (G6PDD) is a very common human genetic abnormality (nearly, 400 million individuals are affected worldwide). The G6PD Deficiency Favism Association maintains lists of medications and other agents that are believed to be safe or unsafe to use in patients with G6PD deficiency (Lee and Malar, 2020). Nurses should have enough knowledge about safe or unsafe drugs to protect patients from any complications. Patients with G6PD deficiency need special nursing care to minimize complications, such as life-threatening acute episodes of hemolysis (Ying et al., 2020). Moreover, the results of this study could be helpful for nurses in

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developing and implementing standards of nursing care for such a group of patients in the future.

Methods

Purpose of the study:

Assess nurses' knowledge about safe and unsafe drugs for patients with G6PD deficiency at Menoufia Governorate.

Research question:

What is the nurses' knowledge about safe and unsafe drugs for patients with glucose 6 phosphate dehydrogenase deficiency at Menoufia Governorate?

Research design:

Descriptive research design was utilized to achieve the purpose of the study. An online survey form was used using Google Forms, and participants were invited to respond to the questionnaire to achieve the aim of the study.

Setting:

This study was conducted using an online self-administered questionnaire. It was delivered to nurses at different departments (pediatric, hematology, outpatient, intensive care unit, general internal medicine department, and Nursery unit) of Menoufia University Hospital because the University hospital has more cases of G6PD deficiency patients.

Subjects:

A consecutive sample of three hundred adult conscious nurses was divided into 42 from the pediatric intensive care unit, 6 from outpatient clinics, 12 from the pediatric clinic, 30 from the internal medicine department, 24 from the nursery unit, and 186 from other places with a total number of nurses of 300 to be willing to participate in the study and able to communicate between March 2021 to the end of May 2021 in the previously mentioned setting.

Sample:

A convenience sample of 300 children was selected from the above-chosen setting. Based on this formula:

$$\text{Unlimited population: } n = \frac{z^2 \times \hat{p}(1-\hat{p})}{\varepsilon^2}$$

$$\text{Finite population: } n' = \frac{n}{1 + \frac{z^2 \times \hat{p}(1-\hat{p})}{\varepsilon^2 N}}$$

where

z is the z score

ε is the margin of error

n is the sample size

̂p is the population proportion

N is the population size

Instruments of data collection

Data were collected using three pretested and validated questionnaires.

Instrument one: It was constructed by the researchers to collect data about nurses' knowledge assessment questionnaire regarding safe and unsafe drugs used for G6PD Deficiency patients. This instrument consisted of two parts;

▪ **Part one:** Contains socio-demographic characteristics of nurses such as nurse's age, educational level, years of experience previous training courses about G6PD Deficiency, marital status, place of work, and residence.

▪ **Part two:** Nurse's knowledge assessment questionnaire regarding safe and unsafe drugs used for G6PD Deficiency patients. It was developed by the researchers after revising related literature using factsheets, and information developed by G6PD Deficiency Favism Association maintains lists of medications and other agents that are believed to be safe or unsafe to use in patients with G6PD deficiency (Lee and Malar, 2020). The questionnaire included:

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medications avoided or unsafe for patients with G6PD Deficiency. For example, anti-malarials, Primaquine, Pamaquine, Sulfonamides, Sulfacetamide, Sulfanilamide, Sulfamethoxazole (e.g., Septra, Bactrim), Sulfasalazine, Anti-Bacterials, Nitrofurantoin, Nalidixic Acid, Dapsone, Mafenide Cream (Sulfamylon), Analgesics, Phenacetin, Acetanilid, Phenazopyridine (Pyridium), Miscellaneous, Quinine, Flutamide (Eulexin), Methylene Blue, Rasburicase.

Instrument two: Knowledge of nurses about contradicted medications for G6PD

This instrument was developed by Abass et al., (2015) It contained nurses' knowledge about Analgesics, Acetaminophen, Aspirin, Aurodex, Cardiovascular Agents, Procainamide, Quinidine, Neurologic Agents, Trihexyphenidyl, Levodopa, Phenytoin, Antibiotics, Chloramphenicol, Miscellaneous, Vitamin C, Colchicine and Diphenhydramine ($\alpha = 0.84$).

A scoring system for nurses' knowledge was as follows: - Complete answer was scored (2). An incomplete answer was scored (1). The wrong answer Total scoring system was as follows: From 75-100% were considered a good level of knowledge. - From 65% to less than 75% were considered a fair level of knowledge. - Less than 65% were considered poor level of knowledge.

Source of information (from academic achievement faculty of nursing or institution, from TV or social media, doctors in hospitals, from training courses, and experiences.

Validity:

The validity of this questionnaire was tested by a panel of five professors in different nursing specialties in Medical Surgical Nursing and Community

specialists to ascertain and establish their relevance and completeness.

Ethical consideration

Permission to conduct the study was taken from the ethical committee at the Faculty of Nursing, Menoufia University. Also, the cover page of the questionnaire included a short introduction regarding the purpose of the study, the voluntary nature of participation, announcements of anonymity and confidentiality, and notes for filling in the questionnaire, as well as the link and quick response (QR) code of the online questionnaire. Participants who gave consent to willingly participate in the study were asked to click the 'Continue' button to complete the self-administered questionnaire.

Procedure:

After the development of the instruments, the instruments were assessed for face and content validity assurance by five professors (three professors of internal medicine and two professors in community health nursing). The modifications were done to establish their relevance and fullness. A pilot study was conducted on 30 nurses to test the clarity of the questionnaire. The nurses of the pilot study were excluded from the total sample. The data was collected from the beginning of March 2021 to the end of May 2021. An online survey gateway, Google Form was created, and participants were invited to complete and submit the form. Through the link the participants could view the questions simply by clicking on it and answer the questions and return to the researcher's mail, knowledge about safe and unsafe drugs for patients with G6PD deficiency was collected.

Statistical analysis

Statistical Package of Social Science (SPSS) version 22 (SPSS, Inc,

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Chicago, Illinois, USA) was used to analyze the data, and graphics were done using the Excel program. quantitative data were presented in the form of mean, standard deviation (SD), range, and qualitative data were presented in the form of numbers and percentages. Pearson correlation (r) was used to measure the association between two quantitative variables. The level of significance was set at a P value <0.05 for all significant tests.

RESULTS

Table 1 This study was conducted on nurses from different departments (pediatric, hematology, outpatient, intensive care unit, general internal medicine department, and Nursery unit) of Menoufia university hospital at Menoufia governorate, (14 %) were from the pediatric intensive care unit, (10%) were from internal medicine department, (2%) from outpatient clinics, (4%) from the paediatric clinic, (8%) from nursery unit (62%) were from other places with a total number of nurses of 300. Their mean age was 24.66 ± 4.78 and ranged from 20 – 48 years, regarding the experience year, (76%) had less than 5 experience years, (14%) had 5 – 10 experience years, and (10%) had more than 10 experience years. (66%) of nurses only received a diploma education and 28% of nurses had a bachelor's degree. Meanwhile, 88% of nurses attended training courses about G6PD disease.

Table 2 showed the number and percentage distribution of nurses according to their knowledge regarding safe and unsafe drugs used for G6PD deficiency patients. This table revealed that 48% had poor knowledge about safe and unsafe drugs for G6PD patients, and 24% of nurses had good knowledge about safe and unsafe drugs for G6PD patients. About 20%-70% of nurses had average knowledge about safe and unsafe drugs for G6PD patients.

Figure 1 showed the number and percentage distribution of nurses' sources of information about safe and safe drugs. This figure revealed that about half of the studied sample (49%) nurses gain here knowledge about safe and safe drugs from academic achievement faculty of nursing or institution, (22%) of nurses gain here knowledge about safe and safe drugs from here experience, (18%) of nurses' gain knowledge about safe and safe drugs from social media, only (2%) of nurses' gain knowledge about safe and safe drugs from training courses.

Table 3 showed the correlation between social characteristics and total nurses' knowledge regarding safe and unsafe drugs used for G6PD deficiency patients which sex had a highly significant correlation with nurses' knowledge regarding safe and unsafe drugs used for G6PD patients.

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RESULTS

Table 1: Distribution of nurses according to their social

| social characteristics | | No. | % |
|--|------------------------------|------------------|------|
| 1. Age: | Mean \pm SD | 24.66 \pm 4.78 | |
| | Range | 20 – 48 | |
| | <25 years | 186 | 62 |
| | 25-30 years | 96 | 32 |
| 2. Sex | Male | 12 | 4 |
| | Female | 288 | 96 |
| | | | |
| 3. Educational level: | Nursing | 198 | 66 |
| | | 18 | 6 |
| | | 84 | 28 |
| 4. Years of experience: | <5 years | 228 | 76 |
| | 5-10 years | 42 | 14 |
| | >10 years | 30 | 10 |
| 5. Previous training course about G6PD deficiency | Yes | 36 | 12 |
| | No | 264 | 88 |
| 6. Marital status | Married | 174 | 58 |
| | Single | 126 | 42 |
| 7. Place of work | Outpatient | 6 | 2 |
| | Internal medicine department | 30 | 10 |
| | Pediatric | 12 | 4 |
| | Intensive care unit | 42 | 14 |
| | Nursery unit | 24 | 8 |
| | Other | 186 | 62 |
| 8. Residence | Urban | 234 | 78 |
| | Rural | 66 | 22 |
| 9. Attended training courses on G6PD disease | No | 264 | 88.0 |
| | Yes | 36 | 12.0 |

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Table 2: Percentage distributions of nurses according to their knowledge about safe and unsafe drugs used for G6PD patients (N=300).

| (I) Name of unsafe drugs | | safe | | unsafe | | I do not know | |
|--|------------------|-----------|----------|-----------|----------|---------------|----------|
| | | No | % | No | % | No | % |
| 1-Antimalarial and Sulfonamides | Primaquine | 84 | 28 | 72 | 24 | 144 | 48 |
| | Pamaquine | 90 | 30 | 78 | 26 | 132 | 44 |
| | Sulfonamides | 84 | 28 | 120 | 40 | 96 | 32 |
| | Sulfacetamides | 42 | 14 | 132 | 44 | 126 | 42 |
| | sulfanilamide | 48 | 16 | 126 | 42 | 126 | 42 |
| | Sulfamethoxazole | 78 | 26 | 102 | 34 | 120 | 40 |
| | Sulfasalazine | 78 | 26 | 90 | 30 | 132 | 44 |
| 2- Antibacterial | Nitrofurantoin | 66 | 22 | 108 | 36 | 126 | 42 |
| | Nalidixic acid | 66 | 22 | 102 | 34 | 132 | 44 |
| | Dapsone | 90 | 30 | 90 | 30 | 120 | 40 |
| | Mafenide cream | 114 | 38 | 60 | 20 | 126 | 42 |
| 3-Analgesics | Phenacetin | 126 | 42 | 60 | 20 | 114 | 38 |
| | Acetanilid | 114 | 38 | 66 | 22 | 120 | 40 |
| | Pyridium | 84 | 28 | 60 | 20 | 156 | 52 |
| 4- Miscellaneous | Quinine | 42 | 14 | 42 | 14 | 186 | 62 |
| | Flutamide | 84 | 28 | 36 | 12 | 180 | 60 |
| | Methylene blue | 54 | 18 | 72 | 24 | 174 | 58 |
| | Rasburicase | 90 | 30 | 54 | 18 | 156 | 52 |
| (II) Name of safe drugs | | No | % | No | % | No | % |
| 1-Antimalarial | Chloramphenicol | 60 | 20 | 108 | 36 | 132 | 44 |
| 2- Antibacterial | Acetaminophen | 108 | 36 | 54 | 18 | 138 | 46 |
| | Aspirin | 120 | 40 | 108 | 36 | 72 | 24 |
| | Aurodex | 78 | 26 | 78 | 26 | 144 | 48 |
| 3- cardiovascular agents | Procainamide | 66 | 22 | 78 | 26 | 156 | 52 |
| | Quinidine | 48 | 16 | 72 | 24 | 180 | 60 |
| 4-Neurologic agents | Trihexyphenidyl | 66 | 22 | 42 | 14 | 192 | 64 |
| | Levodopa | 66 | 22 | 66 | 22 | 168 | 56 |
| | Phenytoin | 108 | 36 | 54 | 18 | 138 | 46 |
| 5-miscellaneous | Vitamin C | 210 | 70 | 18 | 6 | 72 | 24 |
| | Colchicine | 108 | 36 | 96 | 32 | 96 | 32 |
| | Diphenhydramine | 48 | 16 | 90 | 30 | 162 | 54 |

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Figure 1: Percentage Distribution of nurses' sources of information about safe and safe drugs for G6PD patients (N=300).

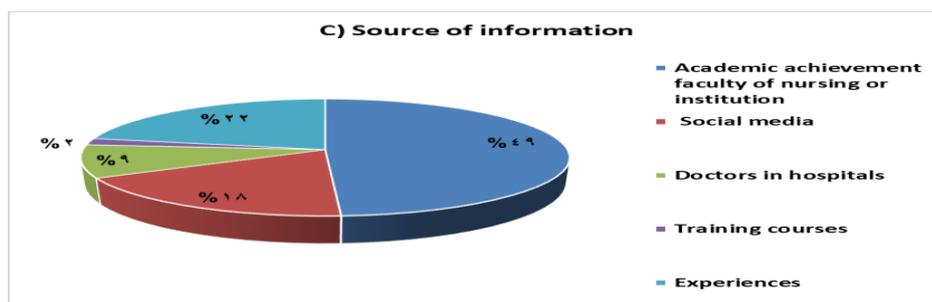


Table 4: Associative relation between social Characteristics and level of nurses' knowledge about safe and unsafe drugs used for G6PD patients (N=300).

| | | poor | | average | | good | | X ² | p. value |
|---|----------------------|------|-------|---------|--------|------|-----------|----------------|----------|
| | | No | % | No | % | No | % | | |
| Age | <25 years | 65 | 57.0% | 101 | 64.3% | 18 | 100.0% | 17.56 | 0.002 |
| | 25-30 years | 37 | 32.5% | 51 | 32.5% | 0 | 0.0% | | |
| | >30 years | 12 | 10.5% | 5 | 3.2% | 0 | 0.0% | | |
| Nursing | Male | 11 | 9.6% | 0 | 0.0% | 0 | 0.0% | 17.55 | 0.001 |
| | Female | 103 | 90.4% | 157 | 100.0% | 18 | 100.0% | | |
| Educational level: | Nursing diploma | 11 | 9.6% | 5 | 3.2% | 0 | 0.0% | 24.29 | 0.001 |
| | Nursing institution | 20 | 17.5% | 57 | 36.3% | 0 | 0.0% | | |
| | Bachelor of nursing | 83 | 72.8% | 95 | 60.5% | 18 | 100.0% | | |
| Nursing | <5 years | 81 | 71.1% | 123 | 78.3% | 18 | 100.0% | 10.53 | 0.032 |
| | 5-10 years | 16 | 14.0% | 23 | 14.6% | 0 | 0.0% | | |
| | >10 years | 17 | 14.9% | 11 | 7.0% | 0 | 0.0% | | |
| Previous training course about G6PD deficiency | No | 103 | 90.4% | 139 | 88.5% | 12 | 66.7% | 8.32 | 0.016 |
| | Yes | 11 | 9.6% | 18 | 11.5% | 6 | 33.3% | | |
| Marital status | Married | 38 | 33.3% | 79 | 50.3% | 0 | 0.0% | 20.96 | 0.001 |
| | Single | 76 | 66.7% | 78 | 49.7% | 18 | 100.0% | | |
| Place of work | Outpatient | 6 | 5.3% | 0 | 0.0% | 0 | 0.0% | 75.17 | 0.001 |
| | Internal medicine | 0 | 0.0% | 22 | 14.0% | 6 | 33.3% | | |
| | Pediatric department | 0 | 0.0% | 12 | 7.6% | 0 | 0.0% | | |
| | Intensive care unit | 6 | 5.3% | 34 | 21.7% | 0 | 0.0% | | |
| | Nursery unit | 16 | 14.0% | 6 | 3.8% | 0 | 0.0% | | |
| | other | 86 | 75.4% | 83 | 52.9% | 12 | 66.7% | | |
| Residence | Urban | 35 | 30.7% | 30 | 19.1% | 0 | 0.0% | 10.66 | 0.005 |
| | Rural | 79 | 69.3% | 127 | 80.9% | 18 | 100.0% | | |
| Attended training courses on G6PD disease | No | 103 | 90.4% | 139 | 88.5% | 12 | hemolysis | 8.32 | 0.016 |
| | Yes | 11 | 9.6% | 18 | 11.5% | 6 | 33.3% | | |

DISCUSSION

G6PD deficiency is one of the most common genetic enzyme insufficiencies in the world. Persons with G6PD deficiency need to avoid drugs that can precipitate haemolysis. The risk posed by those drugs is determined in part by the person's G6PD variant and thus the grade of enzyme deficiency. Nurses work in close contact with the patients and play an important role in identifying and preventing these precipitating factors that lead to haemolytic crises prevent the development of haemolytic crises by avoiding unsafe drugs (Lee et al., 2017).

Regarding nurses' knowledge regarding safe and unsafe drugs used for G6PD patients, the current study results showed 48% do not know unsafe drugs for G6PD patients, and only 24% know safe drugs for G6PD patients. About 20%-70% know safe drugs for G6PD patients, (18%-36%) do not know unsafe drugs for G6PD patients. Similarly, a study by Abass et al. (2019) about nurses' knowledge and performance related to the care of children with glucose -6-phosphate dehydrogenase deficiency at Assiut university children's hospital concluded that the percentage total score of nurses' knowledge about safe and unsafe drugs of patients with G6PD. It was found that the majority of nurses (93.3 %) had incomplete knowledge about safe and unsafe drugs while (6.7) % of them had incorrect or poor knowledge about safe and unsafe drugs of G6PD deficiency. From the researchers' point of view, nurses had decreased knowledge about safe and unsafe drugs for G6Pd deficiency due to irregular attending training courses about G6PD disease and couldn't be improved by educational program but require more structural planning for attended training courses on G6PD disease.

On the other hand, a study by Bubp et al. (2015) about caring for glucose-6-phosphate dehydrogenase deficient patients, contradicted these results and concluded that the majority of the health care team had correct knowledge about safe and unsafe drugs for G6PD deficiency. This may be owed to the improved knowledge of the health care team because of training they received as a part of hospital training strategies. Furthermore, a study by Elgammal et al. (2015) about the effect of nursing intervention programs about are provided for children suffering from favism on nurses' performance, contradicted these results and concluded that the total scores of nurses' knowledge and practice for the majority of the studied nurses showed poor knowledge and unsatisfactory practice before applying the study intervention program related to favism, which found (70 %) of nurses had incorrect knowledge about safe and unsafe drugs while (30%) of them had correct knowledge about safe and unsafe drugs of G6PD deficiency. This may be due to a lack of in-service training programs which should be conducted periodically to refresh nurses' knowledge. While Rawajfah and Tubaishat, (2015). they assessed " Nursing students' knowledge and practices of standard precautions. They reported that the mean total knowledge score was 13.8 (SD=3.3) out of 18. On average, 79.9% of the knowledge questions were answered correctly.

Concerning nurses' source of information about safe and safe drugs for G6PD deficiency, the current study showed that about half of the studied sample (49%) nurses gain here knowledge about safe and safe drugs from academic achievement faculty of nursing or institution, (22%) of nurses' gain knowledge about safe and safe

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drugs from here experience, (18%) of nurses' gain knowledge about safe and safe drugs from social media, only (2%) of nurses' gain knowledge about safe and safe drugs from training courses. This point of view is consistent with research done by Abass et al. 2019 who indicated that only (3.0%) of nurses gain here knowledge about safe and safe drugs from training courses. This result was inconsistent with results obtained by El-Sayed et al. (2012) who investigated " Prevention of Haemolytic Crisis among G6PD Children: Effect of Educational Program Intervention", they showed that nurses gain here knowledge mainly from training courses. The differences in the current study might be related to the difference in the time of data collection and sample of the study.

The finding of the current research reflected that there was a significant positive correlation between socio-demographic characteristics and total nurses' knowledge regarding safe and unsafe drugs used for G6PD deficiency patients which sex had a highly significant correlation with nurses' knowledge regarding safe and unsafe drugs used for G6PD patients, also, the educational level had highly significant correlation with nurses knowledge, additionally, place of work had highly significant correlation with nurses knowledge regarding safe and unsafe drugs used for G6PD. This result was in the same line as Glader and Tirnauer, (2018) who evaluated " diagnosis and management of glucose-6-phosphate dehydrogenase (G6PD) deficiency.", they reported that there was a significant positive correlation between socio-demographic characteristics and total nurses' knowledge regarding safe and unsafe drugs used for G6PD deficiency patients.

Conclusion:

Based on the results of the current study it can be concluded that the total score of nurses' knowledge about safe and unsafe drugs related to patients with Glucose -6- Phosphate dehydrogenase deficiency at Menoufia University Hospital was incomplete and had poor knowledge and required more in-services training program to promote and enhance their knowledge. Statistically, a significant difference was found between nurses' knowledge & their age, years of experience, and level of education.

Study implications:

Nurses' knowledge about safe and unsafe drugs for G6PD deficiency should be improved by continued nursing education and in-services training programs in general, special units, and emergency units about safe and unsafe drugs for G6PD deficiency patients. Hospitals should be equipped with the necessary educational facilities and materials necessary to upgrade the nurse's knowledge. Nurses should always be encouraged to attend scientific meetings and conferences to rapidly growing scientific knowledge. And periodic monitoring of nurses' knowledge and evaluate their level.

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