Effect of Educational Empowerment on Student Nurses' Knowledge, Practice, and Attitude toward Genomic Counselling

Amal T. A. Alsharkawy [1], Safaa F. Draz [2], Ghada S. Hassan[3], Mohamed A. Alhofi[4]

[1]Maternity and Gynecological Health Nursing, Faculty of Nursing, Ain Shams University, Egypt.
e-mail: amalsharkawy000@gmail.com
[2]Pediatric Nursing, Faculty of Nursing, Ain Shams University, Egypt.
e-mail: dr.safaa.fouad@nursing.asu.edu.eg
[3]Community Health Nursing, Faculty of Nursing, Ain Shams University, Egypt.
e-mail: ghadaa5000@yahoo.com
[4]Science and Food Technology, Faculty of Agriculture, Ain Shams University, Egypt.
e-mail: Mohamed_elhofi@agr.asu.esu.eg

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ABSTRACT

Context: All over the world, the increased awareness of the importance of early diagnosis of genetic diseases has given them priority in primary health care. However, more recent surveys indicate that genetics content is still lacking in nursing curricula.
Aim: Evaluate the effect of educational empowerment on student nurses' knowledge, practice, and attitude toward genomic counseling.
Methods: Quasi-experimental (pre/posttest) design was utilized to collect the data of this study. The study was conducted at the Faculty of Nursing affiliated to Ain Shams University. The subjects were all available adolescent nursing students who enrolled in the pediatric and obstetric course in the third year. The study sample was composed of 340 nursing students. Researchers used a self-administered questionnaire that includes characteristics of subjects and the assessment of knowledge, attitude, and practice of students.
Results: 47.65% of the studied students had poor knowledge at the pre-educational program phase, while 55.88% had good knowledge at the post educational program, with a highly significant difference at p-value <0.01. There was a highly significant difference between studied students' attitudes toward genetic disease, health history benefits, genetic examination benefits, genomic counseling, follow-up, and decision-making process domains at pre and post-educational program at p-value <0.001. Also, the results reveal that 79.41% of studied students had unsatisfactory practice at the pre-educational program, while 70.59% of them had satisfactory practice at post educational program. There was a highly positive correlation between knowledge, practice, and attitude of studied students about genomic counseling at the pre-educational program.
Conclusion: Educational empowerment positively affected the knowledge, attitude, and practice of adolescent nursing students regarding genomic counseling. The study recommended continuous training for adolescent nursing students about genetic counseling to prepare them for their future roles. Future studies are needed to examine the relationship between knowledge, attitude, and practice of adolescent nursing students regarding genomic counseling.

Keywords: Nursing students, genomic, counseling, empowerment, knowledge, practice, attitude

1. Introduction

Genomic counseling is a communication process, which aims to help individuals and families understand and adapt to the medical, psychological, familial, and reproductive implications of a heritable genetic condition as well as work directly with patients and families offering genetic/genomic information and support, allowing them to make health decisions *(Wevers et al., 2015).* It captures a construct coined "empowerment," defined as a set of beliefs that enable a person from a family affected by a genetic condition to feel that they have some control over and hope for the future *(Ison et al., 2019).*

Moreover, empowerment is considered an intentional, ongoing process centered in the local community, involving mutual respect, critical reflection, caring, and group participation, through which people lacking an equal share of resources gain greater access to and control over those resources *(Zimmerman2000).*

Adolescence is a time of development that encompasses many physical, emotional, and social changes. These changes have been categorized into various 'developmental tasks.' These developmental tasks include separation from family, formation of identity, the establishment of autonomy, and establishment of personal beliefs *(Griswold et al., 2011).*

Adolescents nursing students may present to a genomic counseling clinic for a variety of reasons. They may be seeking information about a familial condition or their genetic status, requesting predictive or pre symptomatic testing for an inherited adult-onset condition, or asking for carrier testing to clarify their risk of having a child with a genetic condition. When providing genetic

counseling to adolescents nursing students, the issue of consent, including assessment of capacity (or competence) to consent, is crucial, as is freedom from coercion. The legal status of adolescents nursing students regarding health decision-making may differ from country to country *(Schupmann et al., 2020).*

[1]*Corresponding author: Amal Talaat Abdelwahed Alsharkawy*

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Adolescent nursing students as genetic counselors may play an important role in helping the individual make an informed decision regarding genetic testing. However, counseling adolescents can provide challenges for healthcare always be suited to the adolescent population due to their unique needs and the challenges of the developmental tasks of adolescence *(Mahjani et al., 2020).*

Genetic counseling can be seen as the health professional role concerned with the impact of genetic disease and genetic information on individuals and families. The roles and activities of nurses in this new era include active participation in genomic research, including the study of the biological, behavioral, family, ethical, legal, and social implications. It also includes the development and integration of genomic technologies in health care and other settings. Besides, the interpretation and use of genomic information and efforts to protect against the misuse of information. In addition to assuring that genomic research, technologies, and information be viewed in the context of other biopsychosocial factors and cultural norms, reinforcement of the concept of genetic determinism is not an unintended by-product of this recent emphasis on genomics *(Sutton et al., 2018).*

2. Significance of the study

*Shawky et al. (2012)***,** in an Egyptian study**,** reported that all patients (from birth up to 18 years) suspected of having a genetic disorder were referred to the genetics clinic in the same hospital. Twenty-eight thousand six hundred eighty-nine patients were proved to have genetic disorders after full investigations among 660,280 children attending the pediatrics hospital, which constituted 4.35% or 43.5/1000. Neurologic disorders were the most common (31.38%) followed by hematologic disorders (18.48%), chromosomal abnormalities (11.51%), fetal, neonatal and infant deaths (6.56%), special senses (5.82%), inborn errors of metabolism (4.24%), endocrine disorders (3.87%), skeletal disorders (3.17%), genito-gonadal anomalies (3.10%), neuromuscular disorders (2.86%), syndromes (2.08%), genodermatoses (1.92%), cardiac disorders (1.47%), gastrointestinal tract anomalies (1.37%), renal anomalies (0.26%), connective tissue disorders (0.26%), respiratory defects (0.22%), vascular anomalies (0.21%), and immunologic disorders were the least common (0.19%).

So, this study is expected to promote nurses' awareness, improve practice, develop positive attitudes toward genomic counseling, together with the recognition that prevention is the hallmark of genetic/genomic health care, that could inform public policymaking groups as they address issues that affect health care practice in the area of genetics/genomics.

3. Aim of the study

Evaluate the effect of educational empowerment on student nurses' knowledge, practice, and attitude toward genomic counseling through:

- Assessing knowledge, attitude, and practice of adolescent nursing students regarding genomic counseling.
- Implementing an educational program for adolescent nursing students about genomic counseling.
- Assess the effect of implementing the educational program on adolescent nursing students' knowledge, attitude, and practice regarding genomic counseling.

3.1. Research hypothesis

There was a positive effect of educational empowerment program on adolescent nursing students' knowledge, attitude, and practice regarding genomic counseling compared to their preintervention level.

3.2. Operational definition

Empowerment is the process of becoming stronger and more confident, especially in controlling one's life and claiming one's rights.

Genomic counseling is the process by which a person gets informed and making decisions about his or her genome.

4. Subjects & Methods

4.1. Research design

A quasi-experimental (pre/posttest) design was utilized to collect the data relevant to this study. A quasi-experiment is an empirical interventional study used to estimate the causal impact of an intervention on a target population without random assignment.

4.2. Research setting

Faculty of Nursing, Ain shams University. The faculty was established in 1980. The first graduates were graduated in 1985. It was the first faculty in Ain shams University accredited for quality in August 2011 from the National Authority of Quality Assurance and Accreditation in Education (NAQAA). The faculty provide a Bachelor's, Master's, and Ph.D. in nursing. The study was conducted in the third-year classroom.

4.3. Subjects

The subject was composed of a convenient sample of all available adolescent nursing students who enrolled in the third year at pediatric and obstetric courses. The study subjects were enrolled during the first semester of 2019-2020; they were composed of 340 nursing students regardless of their age, gender, and parent's education level.

4.4. Tools of the study

The data was collected through:

4.4.1. Self-Administered Questionnaire

It was developed by the researchers based on the recent related literature review, experts' opinions, and researcher experience. This tool was used twice (Pre/post educational program). It included five parts:

Part I: This part included questions related to demographic characteristics of studied students such as age, gender, marital status, family size, rank between family members,

parent's educational level, parent's occupation, and monthly income.

Part II: This part is used to assess the medical history of adolescent nursing students, such as suffering from a genetic disease, positive family history of genetic disease, and conduction of premarital screening for married or engaged students.

Part III: This part is used to assess the knowledge of adolescent nursing students. It was adopted from *Elliott and Friedman (2018)*. It included 13 knowledge items grouped into three main dimensions, namely: Concept of genetic disease (7 questions); genomic nutrition (3 questions); genomic counseling (3 questions).

Scoring system

Responses were measured as correct answers take one score and incorrect answers take zero scores. The overall score was 13 score and categorized as good knowledge (9-13), average knowledge (6-8), and poor knowledge (0-5).

Part VI: This part is used to assess the attitude of adolescent nursing students toward genetic diseases. It adopted from *Barr et al. (2018)*. It included 63 statements grouped into six main dimensions, namely: genetic disease (15 statements); health history benefits (5 statements); genetic examination benefits (13 statements); genomic counseling (17 statements); follow up (6 statements), and decision-making process (7 statements). An example of the statements used, such as genetic diseases, is moving because of relative marriage. Knowing the health history of newcomers helps detect diseases, premarital medical examinations and analyses help identify the health status of the individual and future children. Finally, health awareness helps make the right decision based on the results of premarital medical examination.

Scoring system

Responses were measured on a 5-point Likert scale ranging from (1) strongly disagree to (5) strongly agree for the positive item and vice versa for the negative one. The overall score ranged from (63-315) and be categorized as positive attitude (221-315) and negative (63-220).

Part (V): This part is used to assess the observed practice of adolescent nursing students. It was adopted from *Middleton et al. (2017).* It included nine items as uses active listening and therapeutic communication skills; provides counseling that is anticipatory, therapeutic, facilitative, supportive, and sensitive; provides counseling that is culturally sensitive and consistent with the client's values and preferences; promotes informed decision making that is based on mutually agreed-upon goals.

It also included documentation of counseling interventions in a retrievable format in a way that protects client confidentiality and privacy; respects client autonomy when counseling; provides counseling in a nonjudgmental environment where relevant concerns and emotions can be expressed; provides an environment in which the emotional and psychological impact of the genetic condition or risk can be explored safely; provides genetic counseling and education specific to genetic and genomic issues relevant to care.

Genetic counseling, for example, might include discussing the potential benefits and limitations of genetic testing for disease-associated mutations, alternatives to genetic testing, and the implications of potential genetic test results and integrates current scientific evidence, trends, and research affecting care in the genetic counseling process

The students were observed by conducting a representative session (role play) to practice the role of genomic counselor. The students carried out the counseling session and made an assessment, taken the medical history in a simplified manner, and identified how to manage the counseling session and help in decision-making.

Scoring system

A correct implementation practice of the counseling session was scored as (1) while the incorrect (zero). The total score was categorized as satisfactory = 70-100%, or unsatisfactory = less than 70%. Assessment of students' practices was done before and after the implementation of the educational empowerment program.

4.5. Procedures

Ethical Considerations: The research approval was obtained from the Faculty of Nursing, Ain Shams University Ethical Committee before starting the study. The researchers clarified the study's objectives and aim to the students included in the study before starting. Verbal approval was obtained from the students before inclusion in the study. The researchers were assuring maintaining anonymity and confidentiality of the subjects' data. The nursing students were informed that they could choose to participate or not in the study, and they have the right to withdraw from the study at any time.

The pilot study was carried out on 34 nursing student those represent 10% of the sample at the previously mentioned setting to test the applicability and the clarity of the included tools and the feasibility of the research process. The pilot has also served to estimate the time needed for each subject to fill in the questionnaires.

Content validity was ascertained by a group of five experts from the Pediatric Nursing Department (two experts), one expert of Community Health Nursing, one expert of Maternity and Gynecological Health Nursing, and one expert from Genetic Department affiliated to Faculty of Medicine, Ain Shams University. Their opinions were elicited regarding the format, layout, consistency, accuracy, and relevancy of the tools' content. Test-retest reliability was carried out to test the reliability of the tool. Cronbach's Alpha for the tool was 0.832.

Delivery of educational training program was done through the following phases:

Assessment phase: The researchers started with a needs assessment of nursing students regarding genomic counseling. In the first session, the researchers explained the aim of the study and the components of the tools. The self-administered questionnaire was distributed to nurses students before assessing their knowledge, attitude, and practice. The educational program is prepared and designed

according to the nurse students' knowledge, attitude, and practice.

Intervention phase: Studied subjects were divided into ten groups. Each group consisted of 34 nursing students. The program sessions were held in the Faculty of Nursing lecture hall, Ain Shams University, over six continuous weeks. These two-hour sessions were held every week for the same group (8-10 a.m) for five consecutive weeks.

The sessions were arranged as follows:

First session: The students were introduced to each other and were notified about the method and structure of the sessions. The subjects' expectations from the education program were identified, and the studied group completed the questionnaires.

The second session covered the concept of genetics, different definitions, and a brief introduction to it. These were explained and discussed with the subjects, and the students' questions were allowed at the end of the session.

Third session: The subjects were acquainted with the concept of genomic counseling, benefits, aims, and counseling principles.

Fourth session: Genomic nutrition concept and principle, nurse role related to genetic counseling were taught to the participants.

Fifth session: The subjects were educated on follow-up and how to make decisions; at the closing of the educational program, subjects were asked to fill in the questionnaires (posttest). The sessions ended after responding to the subjects' questions. Researchers used illustrative methods during the session as an educational booklet, papers, PowerPoint, videos using a laptop, simulation-based training, a guiding Arabic booklet, and charts were presented to the participants for practice and learning. The time needed to collect data was six months, from Jan 2020 to June 2020. All infection control procedures regarding COVID 19 were considered during the data collection process.

Program evaluation phase: It was applied through pre and posttest using the same study questionnaires in order to appraise differences, similarities, and areas of improvement, as well as defects. It also estimated the effect of the educational program on nurses' students regarding genomic counseling.

4.6. Data analysis

Data collected from the studied sample was revised, coded, and entered into Personal Computer (PC). Computerized data entry and Statistical analysis were fulfilled using the Statistical Package for Social Sciences (SPSS) version 22. Data were presented using descriptive statistics in the form of number/percent, mean, and SD. T-test used to compare means pre and post-intervention. Pearson's correlation coefficient is the statistical test that measures the statistical relationship, or association, between two continuous variables. The significance level was considered at $p < 0.05$, and at $p < 0.01$ was considered highly significant.

5. Results

Table 1 shows that mean of nursing students' age was 21.41±0.75 years, 82.4% were females, and 88.2% were singles. Related ranking between family members 39.1% of students was the first child. According to the educational level of parents, 44.1% of their fathers and 49.4% of their mothers had secondary education. Regarding parents' occupation, 88% of their fathers were employees, and 57.4% of their mothers were an employee. According to their monthly income, 51.8% of them had reported enough income.

Table 2 reveals that only 2.4% of students suffered from a genetic disease, and 75% had diabetes. 94.4% of studied students had not positive family history of genetic disease. Concerning premarital screening, 60% of married/engaged students conducted a premarital screening.

Table 3 demonstrates highly significant differences between students' knowledge about the concept of genetic disease, genomic nutrition, and genomic counseling at pre and post-educational programs at p-value <0.01. Also, 47.7% of studied students had poor knowledge pre-educational program, while 55.88% had good knowledge post educational program.

Table 4 reveals a highly significant difference between studied students' attitudes toward genetic disease, health history benefits, genomic examination benefits, genomic counseling, follow-up, and decision-making domains at pre and post-educational program at p-value <0.001. Total attitude indicates that 22.6% of studied students had a positive attitude at the pre-educational program, while 83.8% had a positive attitude at the post educational program with a p-value <0.01.

Table 5 indicates a highly statistically significant difference between the total student practice regarding genomic counseling pre and post-educational program at $p < 0.01$. Also, 79.41% of studied students had unsatisfactory practice at the pre-educational program, while 70.59% had satisfactory practice at the post-educational program.

Table 6 shows a highly statistically significant positive correlation between knowledge, practice, and attitude of studied students about genomic counseling at the pre-educational program at a p-value <0.01.

Table (1): Frequency and percentage distribution of the studied nursing students according to their demographic characteristics (n=340).

Variables	N	%
Age (year)		
21-	200	58.8
22-	140	41.2
Mean SD	21.41±0.75	
Gender		
Male	60	17.6
Female	280	82.4
Marital status		
Single	300	88.2
Engagement	37	10.9
Married	3	0.9
Family size		
3-4	142	41.8
5-6	160	47.1
7-8	38	11.1
Rank between family member		
1	133	39.1
2	95	27.9
3	52	15.3
4	60	17.7
The educational level of the father		
Cannot read and write	10	2.9
Read and write	34	10
Primary	59	17.4
Secondary	150	44.1
Bachelor	87	25.6
The educational level of the mother		
Cannot read and write	13	3.8
Read and write	39	11.5
Primary	63	18.5
Secondary	168	49.4
Bachelor	57	16.8
Father occupation		
Employee	302	88.8
Unemployed	38	11.2
Mother occupation		
Employee	195	57.4
Unemployed	145	42.6
Monthly income		
Enough	176	51.8
Not enough	164	48.2

Table (2): Frequency and percentage distribution of the studied nursing students according to their medical history (n=340).

Variables	N	%
Suffering from genetic disease		
Yes	8	2.4
No	332	97.6
If yes, what is it? (N=8)		
Thalassemia	0	0
G6PD	2	25
Diabetes	6	75
Cystic Fibrosis	0	0
Sickle cell anemia	0	0
PKU	0	0
Family history about genetic disease		
Yes	19	5.6
No	321	94.4
If yes, previously admitted to hospital-related this disease (N=19)		
Yes	19	100
Conduction of premarital screening if you married or engaged (n=40)		
Yes	24	60
No	16	40
If yes, the type of premarital screening is (n=24) *more than one answer		
General physical examination	24	100
Counseling	10	41.7
ABO	24	100
Thalassemia screening	4	16.7
G6PD screening	5	20.8
PKU screening	7	29.2

Table (3): Comparison of the studied nurses' students according to their knowledge level at pre and post-educational program (n=340).

	Pre						Post						t-test	P-value
	Good		Average		Poor		Good		Average		Poor			
	N	%	N	%	N	%	N	%	N	%	N	%		
Concept of genetic disease	48	14.1	150	44.1	142	41.8	188	55.3	117	34.4	35	10.3	13.564	0.000
Genomic nutrition	45	13.2	160	47.1	135	39.7	194	57.1	113	33.2	33	9.7	14.198	0.000
Genomic counseling	50	14.7	128	37.6	162	47.65	200	58.8	118	34.7	22	6.5	12.667	0.000
Total knowledge	43	12.65	135	39.70	162	47.65	190	55.88	120	35.3	30	8.82	16.025	<0.01

Table (4): Comparison of the nursing students' attitude at pre and post-educational program (n=340).

	Pre				Post				t-test	P-value
	Positive		Negative		Positive		Negative			
	N	%	N	%	N	%	N	%		
Genetic disease	100	29.4	240	70.6	305	89.7	35	10.3	10.688	<0.001
Health history benefits	90	26.5	250	73.5	262	77.1	78	22.9	9.867	<0.001
Genetic examination benefits	68	20	272	80	295	86.8	45	13.2	13.002	<0.001
Genomic counseling	70	20.6	270	79.4	302	88.8	38	11.2	11.874	<0.001
Follow up	84	24.7	256	75.3	293	86.2	47	13.8	12.077	<0.001
Decision-making process	61	17.9	279	82.1	301	88.5	39	11.5	14.646	<0.001
Total	77	22.6	263	77.4	285	83.8	55	16.2	16.745	<0.001

Table (5): Comparison of total nursing students' practice pre and post-educational program (n=340).

Practice level	Pre		Post		t-test	p-value
	No.	%	No.	%		
Satisfactory	70	20.6	240	70.59	13.586	<0.01
Unsatisfactory	270	79.41	100	29.41		

Table (6): Correlation between nursing students' knowledge, attitude, and practice pre-educational program.

	Knowledge	Practice
Practice	r. 0.711	
	p 0.000	
Attitude	r. 0.568	r. 0.609
	p 0.000	p 0.000

6. Discussion

Education is required for student nurses, staff nurses, and all health professionals to assure that the revolutionary advances in genetics and genomics reach the patients and families for whom they were developed. Nurses, other health care professionals, and their employers will ultimately face significant liability for failing to incorporate genetic/genomic discoveries into practice *(Murakami et al., 2020).* So, the current study aimed to evaluate the effect of educational empowerment on student nurses' knowledge, practice, and attitude toward genomic counseling.

The current results reveal that mean of students' age was 21.41±0.75 years. Most of them were females and singles. Related ranking between family members reveals that more than one-third of students was the first. According to the educational level of parents, less than half of their fathers and about half of their mothers had secondary education. Regarding parents' occupation, the majority of their fathers were employees, and more than half of their mothers were employees. According to their monthly income, more than half of them had enough income.

These results are supported by the study conducted by *Abozeid et al. (2020)* in Egypt with a sample size of 282 students, who detected a mean age of student nurses is 20.8±2.3 years; more than two-thirds of them were females and singles. Less than two-thirds of them had sufficient monthly income. The results also consistent with the study by *Hwang and Oh (2020)* in Iran with a sample size of 304 student nurses and reported that most of the students were females, and their mean age was 20.4 years.

According to the student's medical history, the present study results mention that most studied students had no family history of genetic disease, and only eight out of three hundred forty students suffered from a genetic disease, six of them had diabetes, and the remaining two had G6PD. The students' premarital screening shows that more than half of married/engaged students have done premarital screening. These findings reflected an average knowledge of the students' preprogram implementation as more than one-tenth, and more than one-third had good and average knowledge regarding the genomic disease preprogram.

These results are similar to a study performed by *Polat et al. (2020)* in Turkey on a sample size of 245 students and reported that only two students suffered from diabetes mellitus due to genetic causes.

Regarding nursing students' knowledge related to genomic counseling, the current study reveals a highly statistically significant difference between students' knowledge about the concept of genetic disease, genomic nutrition, and genomic counseling at pre and post-intervention. Less than half of the studied students had poor total knowledge regarding genomic counseling at pre-intervention, while more than half of them had good knowledge at post-intervention, with a highly significant difference at p-value <0.001. These results explained as the researcher prepared the educational program material dependent on the knowledge level of nursing students and using suitable language for them.

These results are consistent with the study performed by *Mohamed and Elhadary (2017)* in Egypt with a sample size of 194 students and detected that the majority of the study participants did not know genetic terms and genetic disorders. Also, it agreed with *Wright et al. (2019),* who conducted a study in Australia with a sample size of 253 nurses and revealed that more than three quarters of registered nurses and midwives believed their knowledge of genetics was poor or average and need an educational program. The results also matched with a study conducted by *Dewell et al. (2020)* at Western Canada with a sample size of 207 nursing students and detected that educational program positively affected students' knowledge with a p-value <0.05.

Concerning nursing students' attitudes about genomic counseling, the current results report a highly significant difference between student nurses' attitudes toward genetic disease, health history benefits, genetic examination benefits, genomic counseling, follow-up, and decision-making process domains at pre and post-educational program at p-value <0.01. Regarding total attitude, the study indicates that more than three-quarters of studied students had a negative attitude at the pre-educational program, while most of them had a positive attitude at post educational program with a p-value <0.01. These results may be due to effective teaching methods during the educational program as PowerPoint slides with illustrative pictures.

These results are consistent with the study performed by *Ward et al. (2016*) in the United States with a sample size of 1002 baccalaureate nursing students and stated that students' attitudes related to genetic disease improved post educational program. Also, Lopes-*Júnior et al. (2017)* conducted a study in Brazil with a sample size of 54 nurses and physicians. The study reported a highly statistically significant difference between nurses' attitudes at pre and post-educational program with a p-value of 0.009. Also, similar findings were revealed by *Čargonja et al. (2021),* who conducted a study in Croatia with a sample size of 179 medical students using the Kruskal–Wallis test, a statistically significant difference was found between the fifth-year students' attitudes before and after education and between the fifth year before education and the sixth year for their total knowledge, total attitudes ($P < 0.001$) and

personal assessment of knowledge in medical genetics ($P < 0.001$).

According to nursing students' practice about genomic counseling, the present study presents that more than three-quarters of studied students had unsatisfactory practice pre-intervention, while more than two-thirds of them had satisfactory practice about genomic counseling post-intervention. These improvements in students' practice explained as the researcher used simulation-based training during educational program implementation and used easy medical terms to allow nursing students to acquire new knowledge. These findings are supporting the current study hypothesis.

These findings are like a study done by *De Jesus and Mitchel (2016),* who revealed that genetic education increases nurses' perception and improves genetic counseling practice. Also, consistent with the study done by *Seven et al. (2015)* in Turkey with a sample size of 175 nurses and detected that nurses are not sufficiently knowledgeable about applying genetics in practice, they are willing to have more education to support their patients' care.

According to the correlation between studied variables, the present results reported highly positive correlations between knowledge, practice, and attitude of studied students about genomic counseling at the pre-educational program at p-value <0.01. These results explained as improving the subjects' attitude results in acquire high knowledge and competent practice.

These results are consistent with *Čargonja et al. (2021)* study that is conducted in Croatia with a sample size of 179 medical students and demonstrated that positive attitudes were associated with higher levels of knowledge. Also, it agree with the study made by *Aiello (2017),* who stated that improving in nurses' knowledge caused improving in their practice.

7. Conclusion

Educational program had a positive effect on adolescent nursing students' knowledge, attitude, and practice regarding genomic counseling. There was a statistically significant positive correlation between knowledge, practice, and attitude of studied nursing students about genomic counseling at the pre-educational program.

8. Recommendations

- Continuous training for adolescent nursing students about genetic counseling to prepare them for their future roles.
- Inclusion of genomic concepts, related nursing role in the undergraduate curricula.
- Future studies are needed to examine the relationship between knowledge, attitude, and practice of adolescent nursing students regarding genomic counseling.
- Further studies are needed to assess predictive factors affecting adolescent nursing students' knowledge and practice regarding genetic counseling.

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