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Effect of an Educational Program on Perception and Practices of Nursing Students Regarding the Cord Blood Collection Technique and Stem Cells

Rabaa El-Sayed Shaban[1], Entisar Abo Elghite Elhossiny Elkazeh[2], and Neamat Mazloum Mohamed [3],

[1] *Lecturer of Maternity and Gynecological Nursing, Faculty of Nursing, Tanta University,*
[2] *Assistant Professor of Community Health Nursing, Faculty of Nursing, Tanta University,*
[3] *Lecturer of Community Health Nursing, Faculty of Nursing, Tanta University, Egypt*
Corresponding Author: Rabaa El-Sayed Shaban

Abstract:
Background: *Umbilical cord blood collection and stem cells are still an emerging concept, and a lot of people are unaware about this concept, thus nurses are considered by the public as the most credible source of information about cord blood collection and stem cells. Therefore, it is highly desirable to empower the nursing students with knowledge and skills related to this subject.*
The aim of the study was to *evaluate the effect of educational program on perception and practices of the nursing students regarding the cord blood collection technique and stem cells.*
Subjects and Method: Study design: *Quasi-experimental study design was used.*
Study settings: *This study was conducted at the Faculty of Nursing, Tanta University.*
Study subjects: *Convenient sample of 120 students.*
Tools of data collection: *Three tools were used by the researcher to collect the necessary data.*
Tool I: Structured questionnaire sheet: *This tool included two subparts;*
Part one: *Socio-demographic data of the nursing students.*
Part two: *Knowledge of the students regarding the following: a- Knowledge of the nursing students about umbilical cord blood collection sample: b- Knowledge of the students regarding the stem cells.*
Tool II: *Students' attitude towards the cord blood collection sample and stem cells.*
Tool III*: Observational checklist of an umbilical cord blood collection technique.*
Results: *The results of this study showed that there was a statistically significant improvement in the total knowledge level of the students regarding stem cells and umbilical cord blood collection sample as before the program about two fifths (39.2%) of the students had a poor total knowledge level compared with 89.2% and67.5% respectively of them had a good total knowledge level immediately and after three months of the educational program. About two thirds (64.2%) of the nursing students had a negative attitude pre-program, while most of them (91.7%) had a positive attitude immediately post program and become (70.8%) after three months. Also, it was found that 85.8% of the students' pre-program had a poor practice level, while in immediate and three months post program, 97.5%, 93.3% respectively had a good practice level. There was a statistically significant improvement in the total practice score before, immediate and after implementation of the educational program as (P = 0.00).*
Conclusion and Recommendation: *The present study concluded that the educational program was an effective and improved the level of nursing students' knowledge, attitude and practices of an umbilical cord blood collection sample technique and stem cells from pre-program, immediate and after three months of the program. Therefore, the undergraduate nursing curriculum must contain the recent technologies to update the knowledge and practices of the nursing students regarding the umbilical cord blood collection sample technique and stem cells.*

Keywords*: Educational Program- Umbilical Cord Blood Collection - Stem Cells*

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I. Introduction

Cord blood collection and stem cells research are the most important and controversial topics of science and technology today. The frequency of using cord blood has importantly increased since the years 2000. Consequently, the probability of needing stem cells transplants by any of the family members is increasing as well [1, 2].

Umbilical cord blood (UCB) which was through and deemed to be a medical waste material earlier and disposed of the following delivery along with placenta due to the lack of knowledge about its benefits and uses[3]. However, it is considered now a valuable thing. As it is an important source of hematopoietic stem cells, which is a life-saving and used for hematopoietic transplant [4,5]. These stem cells are similar to those found in the bone marrow. Moreover, the stem cells obtained from umbilical cord blood are less likely to be rejected in transplants than bone marrow stem cells. Several other benefits include easy collection and availability of cord blood stem cells, decreased transmission of diseases. Therefore, cord blood can be used for transplantation as an alternative to bone marrow [6, 7, 8]. In addition, according to Center for International Blood & Marrow Transplant Research (CIBMTR) data, there has been a significant decrease in the use of bone marrow and increase in the use of cord blood stem cells transplantation [9].

Stem cells have different types which include embryonic, umbilical cord blood and adult stem cells. Cord blood has been successfully used in transplant medicine for more than twenty years, and it has been used to treat many life-threatening diseases including certain types of cancers, genetic diseases, blood disorders, metabolic disorders and immune diseases [10]. Cord blood stem cells have the ability to develop and transform into other types of cells in the body, so they can help repair tissues, organs, blood vessels and provide the physicians with a way to treat many diseases that require stem cell transplants [11,12].

Umbilical cord blood can be collected without causing any kind of harm to the mother or infant donor. The collection of umbilical cord blood from the placenta is performed immediately within ten to fifteen minutes after the placental delivery through puncturing the umbilical veins with a needle. This is done under sterile technique, and the UCB is collected into a sterile bag containing an anticoagulant to prevent clotting [3].

As stem cells therapy is a new approach in medical science and it is the most advanced technology available globally to repair the body's failing system, most of the clients and their relatives but surprisingly they are unaware about this clinical entity [13]. Also, the health care professionals including staff nurses are lacking adequate knowledge about the umbilical cord blood stem cells therapy which is considered a new innovative approach. Hence, the umbilical cord blood collection is primarily carried out by obstetricians, midwives, and nurses who have received training in this area [14].

Furthermore, nurses are at the forefront of health care delivery and are therefore directly involved in all the processes of blood cord collection and stem cells and also, they play a crucial role in providing first-hand information to general public about umbilical cord blood and stem cells. Therefore, the nurses need to understand this subject, so that they can provide correct information to parents and counsel the pregnant women [15]. In addition, to nurses are the one who has an important role in collecting the umbilical cord blood after the cord has been isolated from the infant and mother. But several misconceptions ignorance and inadequate knowledge regarding the umbilical cord blood and stem cells are prevalent among healthcare providers. Thus, there is a need to improve the knowledge of the nurses as regards to umbilical cord blood stem cells collection, preservation, and utilization [16]. Therefore, the nurses must be knowledgeable and aware of these recent trends in diagnosis and treatment, as these could affect the decision on providing an appropriate stem cells-based treatment for clients with many life-threatening diseases. Consequently, the nurses need to be educated regarding the value of collecting and preserving umbilical cord blood stem cells for future use in treating illnesses, and she also needs to be training on cord blood collection technique [17, 14, 18]. Subsequently; the aim of regarding the cord blood collection technique and stem cells.

The aim of the study

The aim of this study was to: -

Evaluate the effect of educational program on perception and practices of student's regarding the cord blood collection technique and stem cells.

Research Hypothesis:

Nursing students' perception and practices regarding the cord blood collection technique and stem cells expected to be improved after implementing the educational program.

II. Subjects and method

Study design

The quasi-experimental study design was used in this study.

Setting

This study was conducted at the Faculty of Nursing at Tanta University.

Subjects

A convenient sample of 120 students from the third year in the second semester during the academic year (2016- 2017) was included in the study. Those students of the third year were chosen because they have studied most of the clinical nursing courses especially gynecological and obstetrical nursing course.

Tools of data collection:

Three tools were used for data collection:

Tool 1: Structured questionnaire sheet:

After reviewing related literature and previous studies with similar objectives, the questionnaire was developed by the researchers. This tool included two sub-parts;

Part one: Socio-demographic data of the nursing students: It was used to collect the data about; name, age, marital status, telephone number, and email address.

Part two: Knowledge of the students regarding the following:

a-Knowledge of the nursing students about the umbilical cord blood collection sample: it contains 12 questions, such as: definition**,** anatomy**,** function**,** suitable time, risks of stem cells, method of umbilical cord blood storage, banking of umbilical cord blood, cord blood stem cells are essential for life, skills required to collect cord blood, take a sample of the mother's blood on the day of birth to exclude the infected samples, obtaining written consent from the parents, defects of cord blood collection technique.

b- Knowledge of the students regarding the stem cells: it contained 16 questions regarding stem cells, such as definition, characteristics, mechanism of action, forms, definition of embryonic stem cells, characteristics of embryonic stem cells benefits of embryonic stem cells, sites, advantage, disadvantage, indications, efficient of stem cell transplantation of umbilical cord blood, ethical consideration, sources of stem, diseases can be treated by stem cells.

Scoring system:

Each item of knowledge questionnaire was taken a score of (1) for a correct answer, (0) for the wrong answer or don't know. The total score for the knowledge of students was calculated by the addition of the total score of all sections. The mean and standard deviation was calculated. Knowledge score had been classified into three categories as follows:

- A scoring of < 50% of the total score indicated poor knowledge.
- A scoring of 50 - 75% of the total score indicated fair knowledge.
- While a score of > 75% of the total score indicated good knowledge.

Tool II: Students' attitude towards the stem cells and cord blood collection sample: This tool was established by Elazazy et. al., (2016) [19], and was adapted by the researchers after reviewing related literatures to assess students' attitude relating the stem cells and cord blood collection sample, which consisted of (20) items on a 2-point Likert scale agree (1), and disagree (0).

The total scoring system of students' attitude:

- Positive attitude ≥ 60 % of the total attitude score.
- Negative attitude < 60 % of the total attitude score.

Tool III: Observational check list of umbilical cord blood collection technique.

This tool was developed by the researchers based on literatures review to assess the practice of nursing students regarding umbilical cord blood collection sample [20]. The students' practices were observed through using observational performance checklist which composed of eight steps. This checklist had two categories, one category in the form of (done) and another category in the form of (not done).

Scoring system for nursing students' practice was as follows:

Each step regarding the practices was divided into two categorize, zero (0) score for the items which was not done, one (1) score for the items that was done correctly. The total practice level was calculated by submitting of the scores of its items. The mean and standard deviation was calculated. The total practice score had classified into two categories as follows:

- A scoring of <60% of the total score indicated poor practice.
- While a score of ≥ 60% of the total score indicated good practice.

Method

The operation of the study was carried out as follows:

(1)-Administrative approval.

Official permission to conduct the study was obtained from the Dean of Faculty of Nursing, Tanta University.

(2)-Developing the tools:

Study tools were developed by the researcher based on the literatures review. Tools were reviewed by a panel of four experts in the field of Obstetrics and Community Health Nursing to test its content validity. Reliability was tested before the main data analysis and was reported as 0.93for knowledge and 0.85 for attitude.

(3)-The pilot study:

After the development of the tool, a pilot study was carried out on 10% of the nursing students (12 students), who studied gynecological and obstetrical nursing course to test the clarity and applicability of the tools to detect any obstacles that might be encountered during data collection, as well as to determine the length of time needed to collect the data from each student. The necessary modifications were done according to the pilot study. Those students were excluded from the study sample.

(4)-Ethical and legal considerations: -

- All students were informed about the purpose, nature, and benefits of the study at the beginning of data collection and asked to share in the study willingly.
- Informed consent was obtained from the students who agree to participate in the study.
- Confidentiality and privacy were taken into consideration regarding the data collection; the students were assured that all data will be used only for research purpose and the participant's rights to withdraw at any time if desired.

(6)-Developing the educational program: The following steps were followed to develop the educational Program.

A-Assessment Phase:

It was conducted separately for each group using **(Tool I, part, 1)**. The nursing students assessed about their knowledge regarding the stem cells and umbilical cord blood collection sample using **(Tool I parts II; a & b)**. Students' attitude towards the stem cells and cord blood collection sample were assessed using **(Tool II).** Also, an observational checklist of the umbilical cord blood collection technique using **(Tool III)**. **Tool I part 2, tool II, III** were assessed for each nursing student pre, immediate post and three months after the implementation of an educational program.

A- Planning phase:

The educational program developed by the researchers based on students' needs and recent literature review. It included different methods of the educational were used as a lecture, group discussion, posters, power point presentation, pictures, questions, brainstorming and active discussion, videos, brochures, a newborn simulator with umbilical cord attached to the placenta, demonstration and re-demonstration for participants.

a) Formulating objectives: The general objectives of the educational program were to improve the nursing students' knowledge attitude and practice regarding cord blood collection sample and stem cells.

b) Preparing and organizing the program educational methods content. Based on the students' needs which were determined in the pre-assessment and the objectives of the educational program, the researchers reviewed the related literature that covered the various aspect of the educational program.

- The educational program was developed by the researchers based on the results obtained from the interviewing sheet, as well as literature review.
- Organizing content of the educational program to facilitate learning activities to achieve the objectives.
- The content of the educational program was organized in seven sessions to be provided for the nursing students.

c) Selecting educational strategies: **Lecture**: It was presented in a concise manner and simple language. It took 45- 60 minutes for each session. **Group discussion**: It helped the researchers to offer practice in verbal expression, quick thinking and helped the learner to talk freely about their problem and encourage understanding and feedback. In addition, the researchers were able to direct the group by asking stimulating questions, listen to all comments and opinions and from time to time summarizing important points. **Demonstration and re-demonstration**: Demonstration and re-demonstration method were used to illustrate the practice technique of cord blood collection sample, different methods were used as posters, power point presentation, pictures, questions, brainstorming, and active discussion, videos, brochures, a newborn simulator

with umbilical cord attached to placenta was adopted. Enough time was offered for interpretation, re-demonstration and discussion.

B- Implementation phase:

- Meeting with the students in the lecture's classroom and in the Obstetrical and Gynecological lab was done to explain purpose and benefits of the study at the beginning of interview in the Faculty of Nursing at Tanta University.
- After that, questionnaire sheet was distributed for all students to assess their knowledge and attitude about cord blood collection sample and stem cells in pre, immediate and post educational program.
- The students were divided into six groups, 20 students for each group.

The researcher took the students in lectures classroom or in the obstetrical and gynecological Lab from1-3 pm after their clinical area. After that, an observational checklist of umbilical cord blood collection technique was given for each group separately to assess their practice in pre and immediate after practical demonstration as well as re-demonstration and after three months.

Each session ranged from 45-60 minutes. All sessions were administered three times per week to each group.

- The data were collected over a period of four months starting in February and ending in May 2017.
- The average time needed for each student to fill the (questionnaire) ranged from 15-20 minutes.
- The educational program conducted in seven sessions for the students. The sessions were applied separately to each group: These sessions were as follow:

Session (1): Orientation and expectation (theoretical session).

The aim of this session was to orient the students about the importance of the educational program sessions and the expectation of each session.

Session (2): Knowledge regarding the umbilical cord and cord blood collection sample (theoretical session).

The aim of this session was to improve the students 'knowledge about the definition of umbilical cord blood, anatomy, function of umbilical cord, benefits of umbilical cord blood, suitable time for collect umbilical cord blood, risks of stem cells from umbilical cord blood, method of umbilical cord blood storage, banking of umbilical cord blood.

Session (3): Knowledge about steam cells (theoretical session):

The aim of this session was to provide the students with knowledge about definition, characteristics, mechanism of action, forms, sites of blood collection, indications, and sources of stem cells. Definition of embryonic stem cells, characteristics of embryonic stem cells, benefits of embryonic stem cells, advantages of stem cell transplantation, disadvantages of embryonic stem cell transplantation, ethical consideration before using stem cells and the diseases can be treated by stem cells.

Session (4): Demonstration of the cord blood collection sample technique (practical session):

The aim of this session was to clarify for the students how to perform the correct steps of cord blood collection sample technique through demonstration by the researchers.

Sessions (5, 6, 7): Re-demonstration for each student (Practical session).

Re-demonstration for cord blood collection sample technique for each student,

C- Evaluation phase: The aim of this phase was to evaluate the students' knowledge about the stem cells and umbilical cord blood collection sample and its technique.

Evaluation phase was done three times;

1. First time (pretest) before implementation of the educational program by using tools (I, II, III).
2. Second time (immediate posttest): immediately after the implementation of the educational program by using tools (I part 2, II, III).
3. Third time: (posttest) three months after the implementation of the educational program by using tools (I part 2, II, III).

6- Statistical analysis:

The collected data were organized, tabulated and statistically analyzed using SPSS software statistical computer package for version19. For quantitative data, the range, mean and standard deviation were calculated. Test of the significant (qui square and paired t-test) was applied to test the study hypotheses. Correlation between variables was evaluated using Pearson's correlation coefficient (r). Significant was adopted ($p < 0.05$) for interpretation of results of the test of significance.

III. Results

Table (I): Distribution of the studied students according to their sociodemographic data.

Characteristics	The studied students (n=120)	
	N	%
Age in years: ▪ < 20 years ▪ ≥ 20 years	5 115	4.2 95.8
Range **Mean±SD**		**(19-23)** **20.12±0.624**
Marital status ▪ Married ▪ Single	8 112	6.7 93.3

Table (I): Shows the distribution of nursing students according to their socio-demographic data. It was observed that the majority (98.8%) of them were aged from 20 to more than twenty years with a mean of age (20.12 ± 0.624). Also, the majority (93.3%) of them were single.

Table (II): Distribution of the studied students about their knowledge about stem cells throughout periods of study.

Knowledge about steam cells	The studied students (n=120)												χ^2 P
	Pre				Immediate post				After 3 months				
	Incorrect		Correct		Incorrect		Correct		Incorrect		Correct		
	N	%	N	%	N	%	N	%	N	%	N	%	
1- Definition	32	26.7	88	73.3	1	0.8	119	99.2	5	4.2	115	95.8	**50.19 0.00***
2- Characteristics of stem cells	41	34.2	79	65.8	4	3.3	116	96.7	8	6.7	112	93.3	**54.74 0.00***
3- Mechanism of action of stem cells	26	21.7	94	78.3	5	4.2	115	95.8	17	14.2	103	85.8	**16.01 0.00***
4- Forms of stem cells	56	46.7	64	53.3	8	6.7	112	93.3	11	9.2	109	90.8	**73.06 0.00***
5- Definition of Embryonic stem cells	77	64.2	43	35.8	9	7.5	111	92.5	21	17.5	99	82.5	**105.11 0.00***
6- Characteristics of Embryonic stem cells	98	81.7	22	18.3	7	5.8	113	94.2	12	10.0	108	90.0	**198.82 0.00***
7- Benefits of Embryonic stem cells	42	35.0	78	65.0	3	2.5	117	97.5	11	9.2	109	90.8	**53.84 0.00***
8- Sites of stem cells	38	31.7	82	68.3	5	4.2	115	95.8	32	26.7	88	73.3	**31.23 0.00***
9-Advantage of Stem cell transplantation from umbilical cord blood	78	65.0	42	35.0	16	13.3	104	86.7	32	26.7	88	73.3	**75.89 0.00***
10- Indications of stem cells	71	59.2	49	40.8	33	27.5	87	72.5	37	30.8	83	69.2	**30.49 0.00***
11- Disadvantage of embryonic stem cell transplantation	100	83.3	20	16.7	73	60.8	47	39.2	80	66.7	40	33.3	**15.67 0.00***
12- Stem cell transplantation of umbilical cord blood is less efficient compared to stem cell transplantation of bone marrow.	95	79.2	25	20.8	80	66.7	40	33.3	85	70.8	35	29.2	4.85 0.089
13- Ethical consideration before using stem cells	26	21.7	94	78.3	9	7.5	111	92.5	28	23.3	92	76.7	**12.58 0.002***
14- Sources of stem cells	53	44.2	67	55.8	8	6.7	112	93.3	31	25.8	89	74.2	**44.36 0.00***
15- Diseases can be treated by stem cells	74	61.7	46	38.3	9	7.5	111	92.5	38	31.7	82	68.3	**79.19 0.00***
16- Characteristics of the collection of stem cells from the umbilical cord	61	50.8	59	49.2	9	7.5	111	92.5	34	28.3	86	71.7	**54.87 0.00***

* Significant at level P < 0.05.

Table (II): Represents the distribution of the studied students regarding their knowledge about stem cells. It was found that there was statistically significant difference before, immediate and post three months of implementing the educational program regarding all items of the students' knowledge about the stem cells except for stem cells transplantation of umbilical cord blood is less efficient compared to stem cells transplantation of bone marrow as (p < 0.05%).The same table also reveals that the uppermost increase of the correct answer of students were observed in the immediate post educational program as regard definition, characteristics of stem cells, mechanism of action, forms, benefits of embryonic stem cells, sites, transplantation

from umbilical cord blood, indications, efficiency of stem cells, ethical consideration before using stem cells, sources of stem cells when compared to pre-program . On the other hand, a slight decline occurred in scores after three months of the educational program.

Table (III): Distribution of the studied students about their knowledge about umbilical cord and blood collection sample throughout periods of study.

Knowledge items about umbilical cord and blood collection sample	The studied students (n=120)												χ^2 P
	Pre				Immediate post				After 3 months				
	Incorrect		Correct		Incorrect		Correct		Incorrect		Correct		
	N	%	N	%	N	%	N	%	N	%	N	%	
1-Definition of umbilical cord blood.	45	37.5	75	62.5	5	4.2	115	95.8	5	4.2	115	95.8	**68.67 0.00***
2- Anatomy of Umbilical cord	54	45.0	66	55.0	14	11.7	106	88.3	26	21.7	94	78.3	**36.39 0.00***
3- Function of Umbilical cord	26	21.7	94	78.3	8	6.7	112	93.3	27	22.5	93	77.5	**13.54 0.001***
4- Suitable time for collect umbilical cord blood.	63	52.5	57	47.5	15	12.5	105	87.5	19	15.8	101	84.2	**60.06 0.00***
5. Risks of stem cells from umbilical cord blood	86	71.7	34	28.3	70	58.3	50	41.7	74	61.7	46	38.3	5.01 0.082
6- Method of umbilical cord blood storage.	59	49.2	61	50.8	12	10.0	108	90.0	25	20.8	95	79.2	**50.19 0.00***
7- Banking of umbilical cord blood.	54	45.0	66	55.0	14	11.7	106	88.3	26	21.7	94	78.3	**36.39 0.00***
8- Cord blood stem cells are essential for life.	45	37.5	75	62.5	6	5.0	114	95.0	21	17.5	99	82.5	**40.31 0.00***
9- Skills required for collecting cord blood.	26	21.7	94	78.3	8	6.7	112	93.3	27	22.5	93	77.5	**13.54 0.001***
10- It is very important to take a sample of the mother's blood on the day of birth to exclude the infected samples.	29	24.2	91	75.8	5	4.2	115	95.8	17	14.2	103	85.8	**19.74 0.00***
11- Obtaining written consent from the parents before umbilical cord blood collection .	32	26.7	88	73.3	5	4.2	115	95.8	18	15.0	102	85.0	**23.48 0.00***
12-The defects of cord blood collection technique	73	60.8	47	39.2	13	10.8	107	89.2	36	30.0	84	70.0	**68.17 0.00***

* Significant at level P < 0.05.

Table (III): Illustrates the distribution of the studied students about their knowledge regarding umbilical cord and blood collection sample throughout the periods of the study. It was observed that, pre educational program the students had a correct answer were more than two thirds (62.5%) of them as regard (definition umbilical cord, cord blood stem cells are essential for life) and almost three quarters (78.3%, 78.3%, 75.8%, 73.3%) respectively in relation function of umbilical cord, skills required to collect blood sample from the mothers, take a sample of the mother's blood on the day of the birth to exclude the infected one, obtaining formal consent from the parents. Meanwhile, immediately post educational program there was a high improvement observed in students' knowledge reach to above 90% of them in relation to previous items and slightly decline after three months' post educational program. It also reported that there was a statistically significant difference before, immediate and post educational program regarding all items of students' knowledge about umbilical cord and blood collection sample as P < 0.05%.

Table (IV): Distribution of the studied students regarding their total knowledge level throughout periods of study.

Knowledge domains	The studied students(n=120)						χ^2 P
	Pre		Immediate post		After3 months		
	N	%	N	%	N	%	
a. Knowledge level about stem cells							
▪ Poor	59	49.2	3	2.5	6	5.0	**172.02 0.00***
▪ Average	45	37.5	11	9.2	39	32.5	
▪ Good	16	13.3	106	88.3	75	62.5	
Range Mean ± SD	**(0-16) 7.93±2.709**		**(4-16) 13.68±2.087**		**(4-16) 11.98±2.369**		**F=181.06 P=0.00****
b. Knowledge level about umbilical cord and blood collection sample							
▪ Poor	33	27.5	7	5.8	11	9.2	**132.47 0.00***
▪ Average	66	55.0	6	5.0	30	25.0	
▪ Good	21	17.5	107	89.2	79	65.8	
Range Mean ± SD	**(0-12) 5.73±2.23 3**		**(2-12) 8.73±1.660**		**(1-12) 7.77±2.003**		**F=71.47 P=0.00****

Total knowledge level							
▪ Poor	47	39.2	4	3.3	6	5.0	**155.74 0.00***
▪ Average	55	45.8	9	7.5	33	27.5	
▪ Good	18	15.0	107	89.2	81	67.5	
Range Mean ± SD	**(1-26) 13.67±4.273**		**(7-26) 22.40±3.477**		**(6-26) 19.75±3.937**		**F=157.43 P=0.00****

* Significant at level P < 0.05.

Table (IV): Distribution of the studied students according to their total knowledge score about stem cells throughout the periods of the study. It shows that before an educational program, about half (49.2%) of the students had a poor total knowledge score compared with 37.5% and 13.3% of them had an average and a good knowledge score respectively with a mean + SD (7.93 ± 2.709). While, immediate and three months after an educational program, 88.3 and 62.5% of them had a good score and mean ± SD (13.68 ± 2.087) and (11.98 ± 2.369) respectively. Regarding the knowledge score of umbilical cord and blood collection sample, more than quarter (27.5%) of the students had a poor score compared with 55.8% and 17.5% had an average and a good score of knowledge respectively. While immediate and three months after an educational program, 89.2%, 65.8%, of them had a good score with a mean ± SD 8.73±1.660 and 7.77 ± 2.003 respectively. As regards to the all total score of knowledge, about two fifths (39.3%) of the students had a poor score of the knowledge before an educational program, compared to 45.8% and 15% of them had an average and a good score with a mean ± SD 13.67 ± 4.273. while immediate and post 3 months, 89.2% and 67.5 % had a good score with a mean ± SD 22.40 ± 3.477 and 19.75 ± 3.937 respectively. There was a statistically significant improvement in the total knowledge score of the studied students before, immediate and three months after an educational program as (P = 0.00).

Table (V): Distribution of the studied students regarding their attitude items throughout periods of study.

Attitude	The studied students (n=120)												χ^2 P
	Pre				Immediate post				After 3 months				
	Disagree		Agree		Disagree		Agree		Disagree		Agree		
	N	%	N	%	N	%	N	%	N	%	N	%	
1-Feeling of restlessness that stem cell transplantation influences on the benefit of others.	55	45.8	65	54.2	47	39.2	73	60.8	50	41.7	70	58.3	1.12 0.572
2-All researches about an embryonic stem cells from embryo or aborted fetus must be prevented by the government.	95	79.2	25	20.8	74	61.7	46	38.3	77	64.2	43	35.8	**9.93 0.007***
3- **Life begins at conception, thus an embryonic stem cell research that involves the destruction of embryo is unethical, illegal and unimportant**	41	34.2	79	65.8	29	24.2	91	75.8	34	28.3	86	71.7	2.94 0.229
4-To live as a human adult, a blastocyst must be given the sameappreciation and right.	17	14.2	103	85.8	12	10.0	108	90.0	21	17.5	99	82.5	2.83 0.242
5-Stem cell transplantation must be openly practiced.	37	30.8	83	69.2	15	12.5	105	87.5	31	25.8	89	74.2	**12.15 0.002***
6-Pregnant mothers should be counseled to store their umbilical cord blood stem cells for future intent.	36	30.0	84	70.0	14	11.7	106	88.3	22	18.3	98	81.7	**12.91 0.002***
7-It is important that health care provider should be Competency knowledgeable in stem cells	22	18.3	98	81.7	6	5.0	114	95.0	25	20.8	95	79.2	**13.85 0.001***
8-Awareness of the potency advantage, uses, and potential harms of stem cells research.	59	49.2	61	50.8	12	10.0	108	90.0	24	20.0	96	80.0	**51.16 0.00***
9-There are urgent needs for extra awareness program about stem cells.	20	16.7	100	83.3	9	7.5	111	92.5	20	16.7	100	83.3	5.72 0.057
10-The future of universe is becoming shining if the research of stem cells can be implemented successfully.	21	17.5	99	82.5	7	5.8	113	94.2	22	18.3	98	81.7	**9.80 0.007***
11-It is necessary that umbilical cord blood stem cells collection to be approved by Islamic religious.	47	39.2	73	60.8	18	15.0	102	85.0	30	25.0	90	75.0	**18.21 0.00***
12-It is important to collect the umbilical cord blood stem cells after delivery.	42	35.0	78	65.0	23	19.2	97	80.8	36	30.0	84	70.0	**7.78 0.02***

13-The baby and his mother should only use their own umbilical cord blood stem cells after delivery.	45	37.5	75	62.5	57	47.5	63	52.5	65	54.2	55	45.8	**6.79 0.034***
14- After taking the umbilical cord blood the baby will be in danger.	44	36.7	76	63.3	48	40.0	72	60.0	56	46.7	64	53.3	2.57 0.277
15-The time is wasting when obtaining umbilical cord blood.	51	42.5	69	57.5	63	52.5	57	47.5	70	58.3	50	41.7	**6.15 0.046***
16- Stem cells give benefit for everyone	41	34.2	79	65.8	13	10.8	107	89.2	25	20.8	95	79.2	**19.20**
17-The delivery room should include umbilical cord blood collection as routine care.	30	25.0	90	75.0	11	9.2	109	90.8	22	18.3	98	81.7	**10.51 0.005***
18- It is important that baby cord blood stored should be available.	27	22.5	93	77.5	5	4.2	115	95.8	12	10.0	108	90.0	**19.62 0.00***
19- It is necessary to attend workshops about stem cells	19	15.8	101	84.2	7	5.8	113	94.2	18	15.0	102	85.0	**6.89 0.032***
20- The nursing curriculum should include a lecture about stem cells.	23	19.2	97	80.8	4	3.3	115	95.8	16	13.3	103	85.8	**14.47 0.001***

* Significant at level P < 0.05.

Table (V): Presents that disagree responses of the students regarding the stem cells and umbilical cord blood collection was low compared with agree on responses in the pre-educational program. However, immediately post educational program, their agree responses increase, while post 3 months of educational program, their agree responses slightly decline. Also, there was a statistically significant differences regarding all positive statements throughout three phases of the educational program as (P = < 0.05%) expect five statements of the attitude which include feeling restlessness that stem cells transplantation influence the benefit of others, life begins at conception thus the embryonic stem cells research that involves the destruction of embryo is unethically, illegal and unimportant, to live as a human adult, blastocyst, must be given the same appreciation and right, there are an urgent needs for extra awareness program and after taking the umbilical cord blood the baby will be in danger.

Table (VI): Distribution of the studied students regarding their total attitude level throughout periods of study.

Total attitude level	**The studied students(n=120)**						**χ^2 P**
	Pre		**Immediate post**		**After3 months**		
	N	**%**	**N**	**%**	**N**	**%**	
▪ Positive attitude	43	35.8	110	91.7	85	70.8	**23.66**
▪ Negative attitude	77	64.2	10	8.3	35	29.2	**0.00***
Range Mean ± SD	**(7-19) 13.57±2.807**		**(8-19) 16.04±2.213**		**(4-19) 14.36±3.395**		**t=57.51 P=0.00***

* Significant at level P < 0.05.

Table (VI): Represents the distribution of the studied students regarding their total attitude level throughout periods of study. The table showed that about two thirds (64.2%) of the nursing students had a negative attitude pre-program, while most of them (91.7%) had a positive attitude immediately post program and become (70-8%) after three months post educational program. It also found that there was a statistically significant difference throughout the three periods of the educational program as (P = 0.00).

Table (VII): Percent distribution of the studied students regarding their practice items throughout periods of study.

Blood cord collection technique	**The studied students (n=120)**												**χ2 P**
	Pre				**Immediate post**				**After 3 months**				
	Not done		**Done**		**Not done**		**Done**		**Not done**		**Done**		
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	
1-Preparation of the blood collection kit.	44	36.7	76	63.3	1	0.8	119	99.2	2	1.7	118	98.3	**88.44 0.00***
2-After the delivery of the infant, double clamp the umbilical cord and cut the umbilical cord asusual.	44	36.7	76	63.3	0	0.0	120	100.0	0	0.0	120	100.0	**100.25 0.00***
3-Cleanse the area of the umbilical cord with alcohol followed by butadiene to remove maternal blood and contaminants.	53	44.2	67	55.8	1	0.8	119	99.2	3	2.5	117	97.5	**108.55 0.00***

4-Stabilize the cord and insert butterfly needle intothe umbilical vein. Gently milk the cord towards the needle.	93	77.5	27	22.5	3	2.5	117	97.5	11	9.2	109	90.8	**197.98 0.00***
5-Fill half of bag with100-150 ml of blood and 35 ml of anticoagulant.	91	75.8	29	24.2	9	7.5	111	92.5	8	6.7	112	93.3	**180.07 0.00***
6-After the blood is collected, allow the blood in the tubing to run into the bag, remove the needle and discard it into a sharp's container.	92	76.7	28	23.3	17	14.2	103	85.8	25	20.8	95	79.2	**120.99 0.00***
7-Turn the bag over gently several times to mix the blood and anticoagulant.	82	68.3	38	31.7	7	5.8	113	94.2	14	11.7	106	88.3	**140.05 0.00***
8-Ensure all samples are labeled with the patient's ID, also contain the time, date of collection and delivery	72	60.0	48	40.0	17	14.2	103	85.8	26	21.7	94	78.3	**66.72 0.00***

* Significant at level P < 0.05.

Table (VII): Distribution of the studied students regarding their practice of blood cord collection technique. The table shows that there was a statistically significant difference in the practice items of the blood cord collection of the students before, immediate and after the educational program as (P= 0.00).

Table (VIII): Percent distribution of the studied students regarding their total practice level throughout periods of study.

Total practice level	The studied students(n=120)						χ^2 P
	Pre		Immediate post		After3months		
	N	%	N	%	N	%	
▪ Poor practice	103	85.8	3	2.5	8	6.7	**244.54**
▪ Good practice	17	14.2	117	97.5	112	93.3	**0.00***
Range	**(0-8)**		**(5-8)**		**(4-8)**		**t=362.91**
Mean ± SD	**3.24±2.037**		**7.54±0.766**		**7.26±1.00**		**P=0.00***

* Significant at level P < 0.05.

Table (VIII): Distribution of the studied students regarding their total practice score throughout the periods of the study. It was found that 85.8% of the students in pre-educational program had a poor score of the practice with a mean ± SD 3.24 ± 2.037 while in immediate and after three months, 97.5%, 93.3% had a good score with a mean ± SD 7.54 ± 0.766 and 7.26 ±1.00 respectively. There was a statistically significant improvement in the total practice score before, immediate and after the educational program as (P = 0.00).

Table (IX): Correlation between total knowledge level, total attitude level and total practice level of the studied students throughout the periods of study.

Total knowledge level and total attitude level	Total practice score					
	Pre		Immediate post		After3 months	
	r	P	r	P	r	P
▪ **Total knowledge level about stem cells**	-0.111	0.226	0.127	0.167	-0.005	0.955
▪ **Total knowledge level about umbilical cord and blood collection sample**	0.121	0.187	0.151	0.099	0.118	0.198
▪ **Total knowledge level**	-0.007	0.939	0.148	0.106	0.057	0.536
▪ **Total attitude level**	0.129	0.161	0.036	0.695	0.104	0.260

Table (IX): Correction between the total knowledge score, total attitude and total practice scores of the studied students throughout periods of the study. The table illustrates that there was no a statistically significant difference with a negative correlation between the total knowledge score with the total score of the practice pre-program as (r = -007 and P = 0.939). On the other hand, there was no significant differences with a positive correction between the total knowledge score, total attitude score and the total practice throughout the periods of the study as (r = 0.148 and P = 0.106), (r= 0.057 and p=0.536), (r=0.129 and 0.161), (r=0.036 and 0.695) and (r = 0.104 and P = 0.260) respectively.

IV. Discussion

Knowledge of blood cord collection and stem cells are deemed important in nursing care, particularly for undergraduate nursing students who are the future nurses and soon have the responsibility of an advocator and teacher, and as a health care provider. There is a need to promote cord blood collection and stem cell knowledge and its application in the medical field to create awareness and update information among undergraduate nursing students [21]. Therefore, this study was conducted to evaluate the effect of an educational program on the perception and practice of nursing student's regarding the cord blood collection and stem cells.

As regards to socio-demographic characteristics of the nursing students **(Table I)**, it was revealed that the majority of the students were aged from 20 and more with a mean of age 20.12 + 0.624 years. This is in the same line with **Pinto and Pushapaveni (2017)** [22], who reported that the majority of the participants fall between the ages of 21-30 years. Regarding the marital status, the results of the present study reported that most of the students were single. This result is contradicted with **Tork et. al., (2018)** [23], who found that most nurses were married.

Concerning the students' knowledge items about stem cells **(Table II)**, the present study stated that a significant improvement was observed in all student's knowledge items from pre to immediately after the program and it was decline slightly after three months post-program except one item, was not significant: (stems cell transplantation of umbilical cord blood is less efficient compared to bone marrow). This improvement was due to the effect of the intervention program which was given to those students by the researchers. This result is contradicted with a study done by **Varghese, (2015)** [17], who showed that there was poor knowledge among the nursing students regarding the various aspects of the cord blood collection and stem cells.

As regards the nursing students' knowledge about the umbilical cord and blood collection sample **(Table III)**. The findings of the current study illustrated that the studied nursing students had a poor and average level of knowledge before receiving an educational program. Meantime, immediately post-test and after three months from implementing the educational program, there was a statistically significant improvement for all knowledge items in relation to the umbilical cord and cord blood collection sample except the item linked to risks of stem cells from umbilical cord blood.

Similarly, to the findings of the present study **Lovis, (2010)** [24], mentioned that the nurses had poor knowledge about the cord blood collection and the stem cells before the educational program. Also, this result was supported by **Leng et.al., (2016)** [25], who reported that the nurses had a moderate level of knowledge. This result can be justified from the researcher point of view to the fact that, cord blood collection and stem cells are recent progress direction and the nursing curriculum is still deficient in this issue. In addition to that, the students are more concise on the content that has been educational in the nursing college curriculum, while they neglect to update their knowledge via self-learning.

Regarding the knowledge level about the stem cells during the three phases of the study **(Table IV)**, the present study showed that half of the nursing students had poor knowledge in pre-program and it was improved immediately and after three months of an educational program. While in relation to the students' knowledge level about the umbilical cord and blood collection sample, it was found that less than half of them had an average knowledge in pre-program and it was improved in immediate and after three months of the educational program.

Concerning the total knowledge of the nursing students as regards to their knowledge about the stem cells and umbilical cord blood collection, the present study revealed that, there was a statistically significant improvement in the total knowledge score of the nursing students during the three phases of the study in pre, immediately and three months after educational program. On the other hand, this result was agreed with **El-Sayed et. al.,(2018)** [26]**,** who presented that about three-quarters of the participants had adequate knowledge after receiving an educational program and there was a significant difference between the level of knowledge in the pre and post educational program. In addition to **Mary, (2015)** [27], found that the nurses had inadequate knowledge regarding placental stem cells. Therefore, it is necessary to update the nurses on the latest trends and development about knowledge and technology, so that they are able to give correct information to the clients. Also, there are great needs for updating the knowledge of developing nurses and the general public.

As regards to the attitude of nursing students during the study period **(Table V)**, the current study stated that the disagree responses of the students related to the stem cells and umbilical cord blood collection was low compared with agree responses in pre-program, while their agree responses was improved immediately post educational program, but after three months of the program their agree responses slightly decline.

Furthermore, it was found that there was a statistically significant differences regarding all positive statements during the three phases of intervention except five statements of the attitude as: (feeling restlessness that stem cells transportation influence the benefit of others, life begins at conception thus the embryonic stem cells research involves the destruction of embryo is unethical, illegal and unimportant, to live as a human adult, blastocysts must be given the same appreciation and right, there are an urgent needs for extra awareness program and after taking the umbilical cord blood the baby will be in danger).

Regarding the total attitude level of the nursing students **(Table VI)**, the present study showed that about two-thirds of the students had a negative attitude related to the cord blood collection and stem cells in the pre-educational program, while it was improved immediately post implementation of educational program and it was slightly declined after three months. This current result was correspondence with a study done by **Mohamed (2015)** [14], who stated that about two thirds of the students had a negative attitude related to the cord blood collection and stem cells in pre-intervention and it was changed to a positive attitude after intervention in

immediate and after three months. These results can be attributed to the educational intervention which improved the students' knowledge as well as its impacts on the students' attitude.

Moreover, a study was done by **Fadell et. al., (2018)** [28], reported that the nurses had a negative attitude towards cord blood collection and stem cells. After receiving information from the educational program and high adherence with educational sessions and their active participation improving nurses' knowledge and lead to a positive attitude.

Concerning the nursing students practice regarding the cord blood collection technique **(Table VII)**, the current study revealed that in pre-program phase the following two steps were done by half of the nursing students: (preparation of blood collection kit, clamp and cut the cord to collect blood), and only one step was done by more than one third of the students. Furthermore, the steps of: (swab the insertion site stabilize the cord and insert the needle into the umbilical vein and ensure all sample are labeled with patient's ID, all sample labels should contain the time and date of collection) was done by more than one-third of the students. While the step of: (turn the bag over gently several times to mix blood with anticoagulant) was done by more than one quarter of the students. Additionally, three steps were done by less than one-quarter of the students: (gently milk the cord toward the needle, clamp the tubing, remove the needle and discard it into sharps container). After the educational program, the present study showed that there was a significant improvement in all practice items of the blood cord collection in immediate and after three months post educational program.

On the other hand, after three months from the educational program, students' knowledge and practice was slightly declining due to lack of practice or forgetting. This stresses that the educational program should be repeated after a certain interval to upgrade their knowledge and maintain their achievement. Therefore, follow up education is most essential to continuously upgrade the students' knowledge and practice. This could be in the form of equipping them with booklet and brochures boosting their knowledge and practices regularly.

Concerning the total score of the practice level relate to cord blood collection technique among nursing students **(Table VIII)**. The present study illuminated that the majority of the students had poor practice level in the pre-educational program, while after the educational program the majority of the students showed a good practice level. Also, there was a statistically significant improvement was found between pre-educational program, immediate and three months post educational program in the scores of students practices.

This finding agrees with a study done by **Petti, (2013)** [29], who reported that the improvement of the students' performance as a result of using face to face educational method. These findings could be explained by the researcher that as the result of existence of direct feedback, supervision and interaction with the students in the demonstration and re-demonstration methods which is considered effective method as existence of, group discussion, posters, power point presentation, pictures, questions, brainstorming and active discussion, brochures, newborn simulator with umbilical cord attached to placenta videos. It was obvious that there are no researches were done related to cord blood sampling technique. Therefore, further research was required to identify and investigate the nurse's concerns regarding the practice of cord blood collection. Also, furthers assessment and efforts should be undertaken for improving the undergraduate nursing curricula to impart knowledge and attitude for these students about cord blood collection sample and stems cells.

Regarding the correlation between the total knowledge score, total attitude and total practice scores (**Table IX**), it was found that there were no significant differences with a positive correction between the total knowledge score, total attitude score and the total practice throughout the periods of the study. This finding is agreement with a study done by **Leng et.al., (2017)** [25], who mentioned that there was a poor association between the undergraduate nursing students' knowledge and attitude score. Also, this finding is Incomparable to a study conducted by **Habib et.al., (2017)** [30], who found that there was a strong statistically significant differences positive correlation between the total knowledge score and the total attitude score of the study sample.

V. Conclusions

Based on the findings of the present study, it can be concluded from this study that nurses' knowledge toward cord blood collection technique and stem cells was poor and average in the pre-educational program and they have a negative attitude. Furthermore, the study revealed that the training program was effective and improved the level of nursing students' knowledge and practices of blood cord collection technique and stem cells from pre-program, Immediate and three months post educational program.

VI. Recommendations

Based on the results of the presents study, the following recommendations are suggested:

1- The undergraduate nursing curriculum must contain the recent technologies to update the knowledge and practice of nursing students regarding cord blood collection sample technique and stem cells.
2- There was a need for contentious follow up for nursing students related to cord blood collection technique and stem cells to improve and develop their knowledge, attitude, and practice.

3- Further research should focus on understanding the attitude and opinions of nursing students, and how their practices may be influenced by cord blood collection, as this may positively or negatively affect the information that will be provided in the future to expected parents.
4- Extra studies and survey are required to identify and investigate the nursing student's concerns regarding their practice of cord blood collection sample technique.
5- The current study stressed the importance of regularly conducting wide nursing training programs and workshops for under and postgraduate nursing students as regards to cord blood collection sample technique and stem cells.

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