

Effect of Educational Intervention on Nursing Students' Performance Regarding Umbilical Cord Blood Collection for Stem Cells

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Abstract

Background: Umbilical cord blood is a readily available source of hematopoietic stem cells that treat a variety of malignant and non-malignant diseases in children and adult. Nurses as frontline health care professionals need to understand umbilical cord stem cells and their application in medicine. **Aim of the study:** To evaluate the effect of educational intervention on nursing students' performance regarding umbilical cord blood collection for stems cells. **Research design:** A quasi-experimental research design was used with pre/posttests. **Setting:** The study was conducted at the faculty of Nursing, Zagazig University. **Subjects:** 100 undergraduate nursing students at the fourth academic year were recruited for the study. **Tools of data collection:** Three tools were used. **Tool (I):** A student nurse self-administered questionnaire which consisted of four parts. **Tool (II):** Nurses student's attitudes towards cord blood collection. **Tool (III):** Observational checklist. **Results:** It was found that 90% of the students had poor knowledge before intervention which decreased to 0% and 1.8% immediately after and three months later of intervention respectively. Also, only 22% of the studied students had a positive attitude before intervention, which changed to 97% and 89% respectively at immediately after and three months later of intervention. In addition, all students(100%) had poor practices toward the collection of cord blood at pretest which changed to 0% and 3.6% at the post and follow up test with a highly statistically significant improvements ($p < 0.001$) which justify the research hypothesis of intervention. **Conclusion:** Educational intervention significantly get out improvements in pre, post-tests and after three months for students' knowledge, attitudes and practices regarding umbilical cord blood collection for stem cells. **Recommendations:** Umbilical cord blood collection and any current technologies must be incorporated into nursing curriculum in order to update the future nurse with this current medical innovation and evidences. **Key words:** Umbilical cord, blood cord collection, stem cells, nursing students.

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I. Introduction

The moment of birth not only means the delivery of new life into the world but also provide a onetime chance to save the life of another person (Amin et al., 2016). The umbilical cord is the direct biolink between mother and fetus. When the mother gives birth, the remaining blood in the placenta and umbilical cord is referred to as cord blood, which contains all the elements in the whole blood of red blood cells, white blood cells, plasma and platelets. In addition, it contains many hematopoietic stem cells that have the ability to differentiate into other cells and the ability to self-renew (Aznar & Sanchez., 2011).

Stem cell therapy is the most advanced technology that has been broadly explored worldwide to enhance human health in medical setting and to repair the body's failing system. It is a new approach in medical science that breaks new ground and stem cells derived from the umbilical cord are proving to be such a boon to stem cells therapy (Kaur., 2016).

Cord blood stem cells are pluripotent which is the ability to differentiate into not only different blood cell types, but potentially into different types of tissue including bone, cartilage, hepatic, pancreatic, neurologic, muscle, epithelial, endothelial, and skin (Gluckman et al., 2011). Furthermore umbilical cord blood is increasingly being used as a source of stem cells and lifesaving treatment for numerous diseases including malignant conditions, immune disorders and certain inherited metabolic diseases (Appelbaum., 2007).

Stem cells taken from umbilical cord blood are much eligible and less likely to be inadmissible in transplants than those derived from the bone marrow or mobilized peripheral blood as a source of hematopoietic stem cells due to their high proliferative potential, increased ability for self-renewal, decrease ability for antigen presentation, lower costs and most importantly, their safety and ethical value (Ikuta., 2008).

Stem cells from cord blood are much easier to get because these cells are readily obtained from the cord and the placenta at the time of delivery. Umbilical cord blood is withdrawn by obstetricians, midwives and nurses who have received training in this field. The withdrawal process is painless as it is performed after cutting the umbilical cord from the newborn (*Wise., 2011*). Cord blood is collected from the umbilical vein in two ways which are in-utero and ex-utero, in-utero method the cord blood is collected after the delivery of the newborn but before the placental delivery. As for the ex-utero method which is the most common method the blood is collected subsequent the placental delivery (*Chandran., 2012*).

Directly after the delivery of newborn, the umbilical cord is double clamped from the newborn and under aseptic technique; the technician prepares the cord vein puncture by a povidine iodine applicator then cannulates the vein with a needle that is connected to a collection bag that precoated with anticoagulant. After that cord blood flows through the needle into the bag by gravity. Total collected volume averages about 75 to 110 mL of cord blood that had been done within 10 minutes of birth (*Stavropoulos & Papassavas ., 2006*). After collection of cord blood it is preserved and stored for use in clinical research, donated to a public cord blood bank, or kept in a private cord blood bank for future medical need (*Fannin., 2011*).

Maternity nurses are part of health care in all life stages. Their role in cord blood collection is concentrated in the preparation, collection, tagging and packing of the blood tube. Nurses have a specified role in patient teaching, as they have a reliable source of health information, so they must be aware of the latest trends in medical diagnosis and treatment. On other hand, continuing education for nurses' equip them with a running developments, preserve their competence and encounter the standards of nursing practices (*Varghese., 2013*). subsequently, the future nurses need to be taught regarding the worth of collecting and preserving umbilical cord blood for future use in curing of illnesses and creating apposite attitude to modulate the holistic care of nursing care (*Abdullah., 2011*).

Significance of the study:

Transplantation of blood forming stem cells to renew the blood and immune system, is still a potentially lifesaving process for patients with malignant and benign hematological diseases in addition to immune disorder as leukemia (*Gratwohl et al., 2013*). Umbilical cord blood had a rich source of haematopoietic stem cells, which has made it as an important tissue source used in the practical field of stem cell transplantation. This medical invention is recent and student nurses are challenged to merge knowledge and attitudes related to newly advanced idea in clinical practice (*Mohammed & Sayed., 2015*). Therefore, these future nurses should be educated about the value of collecting and preserving umbilical cord blood stem cells for future treatment of illness and grasp a proper knowledge, attitudes and good practices concerning it through appropriate teaching. So, this study was conducted to improve fourth year student nurses' knowledge, attitudes and practice related to cord blood collection by applying an educational intervention.

II. Aim of the study

The aim of the current study was to evaluate effect of educational intervention on nursing students' performance regarding umbilical cord blood collection for stem cells.

This was accomplished through the specific objectives:

1. To assess students nursing knowledge, attitudes and practices related to umbilical cord blood collection for stem cells prior and after the educational intervention.
2. To design, implement, and assess the effectiveness of educational intervention on students' knowledge, attitudes and practices concerning umbilical cord blood collection for stem cells.

Hypothesis.

Nursing students who attend an educational intervention have higher knowledge, acquire positive attitudes and a good practices about cord blood collection than those don't attend the educational intervention.

Subjects and Methods

Study design:

A quasi-experimental interventional design, with pre and post intervention tests was used to conduct this study and to fulfill the aim of the study.

Study setting:

The study was conducted at the Faculty of Nursing, Zagazig University

Sample size:

The sample size was calculated according to the previous studies by *Mohammed and Sayed (2015)*; *Azzazy and Mohamed (2016)*. With the power of test 80% and confidence interval 95% using EPI-Info package the sample size was calculated to be 100 students.

Study subjects

A sample of 100 students from fourth academic year was recruited in addition to 10 students enrolled in the pilot study and excluded from the main study sample. This level was chosen because the students have finished most

of clinical nursing courses especially obstetric and gynecologic nursing courses and in their curriculum this topic wasn't taught. The students were chosen by simple random sampling.

Tools of data collection:

Three tools were developed by the researcher, focused on current related literature were used to collect the necessary data for achieving the study objectives:

Tool (I): Students nurse self-administered questionnaire: this tool developed by the researcher after reviewing the related literatures and previous studies with similar objectives (*Rajab and Sequeira ., 2009 ; Neokleous et al., 2011*), which was written in English language to be understood with a form of close and open ended questions. It encompassed of 4 parts:

- **Part 1:** For gathering data particularizing to demographic characteristics of the students such as; age, gender, student qualifications, previous information regarding cord blood collection and source of their information.
- **Part 2:** This included questions regarding student's knowledge about anatomy and physiology of umbilical cord, it consisted of 4 questions.
- **Part 3:** it entailed questions to assess knowledge pertaining to haematopoietic stem cells, it consisted of 4 questions.
- **Part 4:** it included questions concerning knowledge about umbilical cord blood collection, it consisted of (14) items.

Scoring system for knowledge part:

Every item was scored as 2, 1 and 0 for the responses completely correct answer, incompletely correct answer and wrong or unknown answer respectively. The knowledge score were calculated in the range of (0-44). The total score of each section was calculated by combination of the scores of its items. The total score of student knowledge was calculated by the addition of the total score of all sections. The mean and standard deviation was calculated. In addition, student's total knowledge score was converted into total percent and graded as the following; poor knowledge when total score was < 50%, fair knowledge when the percent total score was 50 - 75% and good knowledge if the percent total score was >75%.

Tool (II): It displays nurse student's attitudes towards cord blood collection for stem cells: This was a self-administered questionnaire developed by the researcher after reviewing related literatures (*Machin et al., 2012; Hatzistilli et al., 2014; Lye et al., 2015*) which was modified by the researcher to assess student's attitudes pertaining to collection of umbilical cord blood for stem cells which composed of (13) items.

Scoring system for attitudes:

The attitudes items were estimated through three point Likert scale (agree, neutral and disagree), which were scored as 1, 2 and 3 respectively. The attitudes score was graded in the range of 13 to 39 points by summing up the scores of the items, the overall score gave total attitudes' score. Students' total attitudes' score was graded as the following; negative attitudes when total score was $\leq 33\%$, neutral when total score was > 33 - 66% and positive when total score was $\geq 67\%$ based on statistical analysis.

Tool (III): Nurse's student observational checklist.

An observational checklist to evaluate student nurse's practices regarding the technique of cord blood collection guided by *Skoric et al , (2007) ; Armson et al , (2015)*, it consisted of (26) items.

Scoring system:

Each correctly done step took one point and zero for the wrong one or if the procedure was incorrectly done. Total score practices was 0-26 marks which were classified as follows: Poor <50 %, Fair 50 -75% and Good >75%.

Content validity and reliability:

The tools and educational intervention booklet were revised for content validity by a jury of five experts (three Prof. from Obstetrics and Gynecologic Nursing from Faculty of Nursing, Zagazig University, and two Prof. expert from obstetric and gynecological medicine from Faculty of Medicine) to revise the developed instruments for clarity, relevance, comprehensiveness, simplicity, and applicability of tools. Minor modifications were done. Reliability of the proposed tools was done using Cronbach's Alpha test, which revealed that each of the three tools consisted of relatively homogenous items as indicated by the moderate to high reliability; which was 0.92 for tool (I) and for tools (II & III) it was 0.87.

Field work:

After formal permission was obtained the researcher begins the collection of data which took a period of seven months from the starting of October 2017 to the end of April 2018. The researcher begins the collection

of data three to four times per week sometimes in the morning or afternoon alternatively according to the students' lectures during the 7 months. The execution of the study was done through four phases: assessment, planning, implementation, and evaluation.

Assessment phase:

This phase involved data collection prior to intervention to assess the baseline. At the first the researcher introduced herself and clarified briefly the purpose of the research subject to the Dean of the Faculty of Nursing and Vice Dean for Education and Students' Affairs. All the target students were met and their written consent for involvement was obtained. The pretest knowledge questionnaire was distributed by the researcher to the student which was self-administered by the students themselves and answers any explanation needed. For the practical part an observational checklist was filled in by the researcher for each student on the simulator at Faculty of Nursing Lab. After that, the same questionnaires and checklist of pretest were used after the intervention implementation for posttest assessment (immediately) and follow up (three months later). The time used for answering the questionnaire was ranged from 45 to 55 minutes. The data were preliminarily tested to provide the basis for the design of the educational intervention.

Planning phase:

Based on literature review, and results obtained from the assessment phase, the researcher designed the content of the educational intervention. An illustrated booklet was prepared by the researcher and after verification of its content by a panel of experts, it was distributed to students for use as a guide for self-learning and to satisfy the shortage in studied students' knowledge, attitudes and practices regarding the collection of cord blood to stem cells. The educational intervention was proceeding in English language to be easily understood.

General objective: The general objective of the students' educational intervention was to promote their knowledge, provide positive attitudes and demonstrate good practices related to cord blood collection as a source of stem cells.

Specific objectives: By the end of the intervention, the students should be able to;

- Describe anatomy and physiology of umbilical cord.
- List abnormalities in umbilical cord.
- Remind umbilical cord functions.
- Identify proper time of cord clamping and cord blood aspiration.
- Define stem cells and hematopoietic stem cells.
- Enumerate characteristics and sites of obtaining stem cells.
- Define cord blood collection.
- List benefits, indications and contraindications of cord blood collection.
- Recognize responsible persons for collecting cord blood.
- Mention places and length time for cord blood storage.
- Enumerate barriers of collecting of cord blood.
- Identify methods of umbilical cord blood collection.
- Recount the components of blood collection set.
- Demonstrate the procedure of aspiration of umbilical cord blood collection.

Implementation phase:

The intervention was performed in the form of educational intervention which was implemented in the Lab of the Faculty of Nursing. The educational intervention was implemented in 4 scheduled sessions (3 sessions for theory, and 1 session for practices). The sessions were scheduled and implemented according to lecturers' circumstances and student's physical and mental readiness. The duration of each session was 45 to 60 minutes for each group according to the student's achievement, progress and feedback. In order to facilitate learning process and allow each student to participate, as well as ensure adequate supervision, the number of students in each session ranged between 15 to 20 students. An orientation to the educational intervention like (the rationale, importance of the subject, contents, time and location) were elaborated in the first session in order to establish good communication with the participant. To ensure that the students understood the content, each session was started by a summary about what was given through the previous session, followed by the objectives of the new one and they all receive the same content using the same training methods. The training methods included lecturers, group discussions and brain storming. Additionally the intervention was aided by using suitable teaching methods as videos, pictures, cord blood collection set and simulation model of placenta

and umbilical cord from the Faculty of Nursing Lab to facilitate and illustrate teaching especially for the practical part.

Evaluation phase:

Evaluation of the health educational intervention was done twice, immediately after its implementation, and a follow-up evaluation after three months through applying the same tools of the pretest.

Pilot study:

Before conducting the main study, a pilot study has been carried out on 10% of the total study sample (10 students) who weren't included in the main study sample. It was done to test the questions for any ambiguity, inapplicability, and feasibility of the tools; it also helped the researcher to estimate the time requested for filling in the forms. Simple necessary modifications were done as revealed from the pilot study results in the form of omissions and rephrasing of certain items.

Administrative and ethical considerations:

Official permissions and consents for data collection were obtained from the Dean of the Faculty of Nursing and Vice Dean for Education and Students' Affairs after explaining the nature of the work. The study research was approved by the Research Ethics Committee of the Faculty of Nursing at Zagazig University and all ethical issues were taken into consideration during all phases of the study. As well, an informed written consent was obtained from each student who agreed to participate in the study. They were informed that participation is voluntary and that they have the right to withdraw from the study at any time without giving any reason and without any interference with their study or grades. They were also assured that the information obtained during the study will be treated confidentially and used for the research purpose only. Confidentiality was confirmed by assigning a number for each student instead of name to protect privacy.

Statistical analysis:

Data entry and statistical analysis were done using the Statistical Package for Social Science (SPSS) version 20.0 for windows SPSS Inc., Chicago, IL, USA). Quantitative data were expressed as the mean \pm SD and median (range). Qualitative data were expressed as number and percentage. Independent samples Student's t-test was used to compare between two groups of normally distributed variables while Mann Whitney U test was used for non- normally distributed variables. Paired $-t$ - test was used to compare between two dependent groups of normally distributed variables. Friedman's test was used to compare between more than two dependent groups of categorical variables. Wilcoxon Signed Ranks Test was used to compare between more than two dependent groups of non-normally distributed variables. All tests were two sided. P-value < 0.05 was considered statistically significant(S), p-value ≥ 0.05 was considered statistically insignificant (NS) and p-value < 0.001 was considered highly statistically significant (HS).

III. Results

Table (1): shows the demographic characteristics of nursing students. The table reveals that the student age was ranged from 21 to 24 years with a mean age of 21 ± 0.57 ; as much as 70 % of the students were females. As for students' qualification 87.0% of them had secondary school. Regarding to students' previous information, about cord blood collection for stem cell therapy, only 13% of the students had information and mass media and internet were the sources of students' information (54.0% & 46.0% respectively).

Table (2): presents knowledge of nursing students regarding umbilical cord. It was noticed that there are highly statistically significant differences between knowledge of the studied students through phases of intervention (pre, immediately post and after three months).

Table (3) : Shows students' knowledge about stem cells; it reveals that only 2% of the studied students had a complete correct answer regarding the definition of stem cells at pretest compared to 87% & 80% at immediately post and follow up respectively. Moreover, considerable improvement were observed between the students' pre, post, and follow up regarding to the correct answer of the unique properties of stem cells (0%, 93% & 87% respectively). Additionally, all the students (100%) identified the source of obtaining blood stem cells at posttest and 94% at follow up. All the differences in knowledge items related to stem cells were observed as highly statistically significant ($p = 0.0001$).

Table (4): Displays that there were highly statistically significant differences between pre, immediately, and after three months after the implementation of the educational intervention in relation the knowledge of nursing students regarding the collection of umbilical cord blood as (definition, appropriate time of collection, benefits). Additionally, the same table reflects that, there was a general improvement in all items of knowledge regarding collection of cord blood (number of collected cells, number of transplant cells, places for storing, duration of storage and barrier of collection) of the studied students immediately and after three

months of implementing educational intervention as compared to before educational intervention with highly statistically significant differences at p-values < .0001

Figure (1): Illustrates that, most of the students (90%) had poor knowledge level before intervention. Meanwhile, the most of them (95%) got good knowledge level of knowledge immediately after intervention that declined to 86.2% after three months of intervention.

Attitudes of nursing students regarding umbilical cord blood for stem cell therapy are portrayed in **table (5)** which revealed that there were highly statistically significant improvements were detected among the students after the educational program implementation (p=0.0001).

Level of total attitudes of studied students regarding umbilical cord blood for stem cell therapy through intervention phases **figure (2)** reveals that, there were highly statistically significant differences between students' and total attitudes score towards cord blood collection throughout intervention phases pre, post & follow up (P<0.001), where the total score of their positive attitudes increased from 22% in pre intervention to 97% and 89% at immediately post and follow up respectively.

Figure (3): Demonstrates that all the students (100%) had poor practices regarding umbilical cord blood collection at pre intervention which changed to 0% and 3.8% at post and after three months respectively of intervention. Meanwhile the total practices level of the studied students were scored as good by 0% in pre intervention which improved to 92% and 84.6% at immediately post and follow up intervention respectively.

Table (6): Shows the relations between demographic characteristics of studied students and their total score of knowledge, attitudes and practices it was observed that there was statistically significant relation between total knowledge score at posttest in relation to student gender, while there were no statistically significant differences between total knowledge, attitudes and practices score and nursing students' qualification or previous information through the intervention phases.

IV. Discussion

Blood from umbilical cord which collected immediately after birth is rich in blood forming stem cells that genetically identified to the newborn. This collected blood generates the cells of blood and cells of the immune system which currently used to treat blood disorders and immune system diseases like leukaemia, where cells from cord blood are similar to those of adult bone marrow (*Bindu & Srilatha , 2011*).

As regards the studied students' demographic characteristics, the current study explored that their age ranged from 21 to 24 years with a mean age of 21 ± 0.57 and less than three quarter of them were females. As for students' qualification, the current study result found that more than three quarter of the participant students had secondary education. This finding is in partial agreement with that of a study done in Saudi Arabia by *Azzazy & Mohamed, (2016)* who found that the mean age of their students was 21 ± 0.62 . Additionally, *Iye et al, (2015)* in Malaysia stated that the majority of their nurse students were females (93.2%) and 81.8% of them had secondary education.

Concerning students' previous information toward umbilical cord blood collection and the source of their information, the present study result demonstrated that, the majority of the studied subjects' didn't have any previous information and more than tenth had information, where mass media(TV) was the most common source followed by internet. This finding is in congruence with that of *Amin et al, (2016)* who found that 89% of their studied sample had no previous information regarding umbilical cord stem cell therapy and media was considered a main source of information. Similarly, *Hatzistilli et al, (2014)* in Greek mentioned that the main source of information on umbilical cord blood and banking among their student sample was clinic brochures and media.

In contrast with the result of the current study which seems to be different from the results of a previous study done by *Moustafa & Youness, (2015)* in Egypt, who studied "nurses' knowledge about umbilical cord banking and its barriers", the study revealed that books and magazines were the most common source of nurses' knowledge followed by seminars and conferences.

The present study objectives were to examine the effectiveness of educational intervention on the knowledge, attitudes and practices of nursing students towards collecting umbilical cord blood for stem cells therapy. The results of the present study showed that the level of knowledge of the participants was poor with extremely negative attitudes and poor practices. The implementation of educational intervention has proven to meet their needs in enhancing their knowledge, improving their attitudes and maintaining good practices, which led to acceptance of the research hypothesis and its objectives. The results of the educational intervention and its independent positive influence on the knowledge, attitudes and practices of the student nurses regarding the cord blood collection of stem cells were results.

Respecting the evaluation of the students' knowledge regarding the collection of umbilical cord blood for stem cells, the results of the present study revealed that most of the participant students had a weak level of knowledge regarding umbilical cord, stem cells and withdrawal of blood from the umbilical cord before educational intervention. These low scores in the level of knowledge may be due to the fact that the using of

collected umbilical cord blood as source of stem cell therapy is a new advanced trend and nursing curricula are still lacking in this issue. Likewise, the students ignore reading to update their professional knowledge besides lack of motivation.

Meanwhile, in the immediately post-test and after three months of implementing the educational intervention, there were statistically significant improvements for knowledge scores in relation to umbilical cord, stem cells and cord blood collection, as the majority of students under study, had good knowledge. Such improvements might be accounted on students' interest to learn and acquire knowledge about the study topics as well as the illustrated booklet which was distributed to students to be used as an ongoing reference, was helpful in students' acquisition of knowledge. In addition, the application of adult learning rules throughout the educational sessions with encouragement of raising questions, participation, and interactions along the intervention were behind these improvements.

Meanwhile statistically significant improvements for knowledge scores among the participant students in relation to umbilical cord, stem cells and cord blood collection were found at the immediately post-test and after three months of intervention, where the majority of them had a good level of knowledge. These improvements might be accounted on the attention of the students to learn and achieve knowledge about the study topics as well as the illustrated booklet which was distributed to students to be used as an ongoing reference was helpful in students' acquisition of knowledge. In addition, the application of adult learning principals' throughout the educational sessions with the motivation of asking questions, participation, and interactions along the intervention were behind these improvements.

The present study findings are in agreement with those of *Mohamed & Sayed, (2015)*, who reported that maternity nurses in their study had poor knowledge about cord blood collection and stem cells before the educational intervention which conveyed to statistically significant improvement at post and after three month of intervention. Similarly, *Akshatha, (2012)*, who reported a significant difference between the pre and posttests level of knowledge among the studied subjects and concluded that the structured teaching program was effective in improving knowledge of their staff nurses. On the same line, these findings are supported by *Armson, (2005)* who emphasized that health care provider including nurses should be informed and taught about the promising clinical potential of hematopoietic stem cells from umbilical cord blood and about current indications for its collection, storage and use based on sound scientific evidence.

The present study findings are in congruence with *Lovis, (2010)* which revealed that the majority of their participants had poor knowledge regarding cord blood collection and its utilization for stem cells in the pre-test, while in the post-test, most of them had good knowledge. On the same line, these results are consistent with those of *Kumaraswamy & Muthulakshmi, (2010)* who concluded that the structured teaching program was effective in enhancing and improving the knowledge of health professionals especially staff nurses regarding umbilical cord blood stem cells collection and preservation where the post-test mean score (39.6 ± 2.57) was higher than that of pre-test score (13.23 ± 3.88). By educating the health care professionals especially nurses, misconceptions can be removed and adequate knowledge can be provided to them.

Concerning nurse students' attitudes for cord blood collection and stem cells, the findings of the current study revealed that about nearly one quarter of the studied students had positive attitudes toward the current study topic before intervention, which changed to the majority in posttest and more than three quarter after three month of intervention and the differences observed were statistically significant. This higher change in attitudes may be due to the effect of information received from the educational intervention with high adherence with the educational sessions and the maturation of the fourth grade students who consequently acquired more knowledge which lead to positive attitudes.

Such findings are similar to, *Azzazy & Mohamed, (2016)* in Egypt, who assess the effect of educational intervention on knowledge and attitude of nursing students regarding stem cell therapy, they found that 56% of their students had positive attitude toward stem cell therapy before the intervention which changed to 94% post intervention. Similarly, *Mohamed & Sayed, (2015)* mentioned that nearly two thirds of their studied nurses had negative attitudes toward cord blood collection and stem cells before intervention and this percentage was changed to more than two thirds had positive attitude at posttest and after 3 months. Muslims are willing to accept new medical innovations that would create a cure for diseases or provide promises to human being; such belief affects positively on the view of students regarding stem cells therapy.

On the contrary of the present study results *Leng et al, (2016)* who carried out a study in Malaysia found that 86.6% of their nursing students showed good attitudes toward stem cells therapy. Additionally, *Bombas et al, (2011)* reported a least significant improvement in their nurses' attitudes and added there were difficulties in changing attitudes.

Concerning the assessment of the students' practices regarding the technique of cord blood collection, the current study demonstrated that all students had poor practices regarding the technique of cord blood collection before the intervention, which conveyed to good practices in the majority of them at post and follow up tests. This finding clarifies that cord blood collection for stem cells is a new approach in medical field and

most nurses were unaware about this clinical entity. The current study results are partially in agreement with **Mohamed & Sayed, (2015)**, who revealed that the mean score of the technique of cord blood collection was 1.32 ± 1.22 at pre intervention and changed to 8.92 ± 1.21 and 7.81 ± 1.49 at immediately post and three months later of intervention.

As regards the relations between total knowledge, attitudes and practices score to the students' demographic characteristics, the current study results showed that, there were statistically significant relations between total knowledge score and some of demographic variables as gender. Meanwhile there were no statistically significant relations between total knowledge, attitudes and practices score and the students' qualification and source of information. These findings are in disagreement with **Amin et al, (2016)** in Mangalore and **Moustafa & Youness, (2015)** in Egypt who found no association detected between knowledge score of their participants and their demographic characteristics as age, gender and qualification. Meanwhile, there were relations between knowledge and previous information and source of information.

The mean scores of students' knowledge, attitudes and practices after three months of intervention were declined; this decent is normal and expected finding. This is recognized as retention of knowledge gained decreases with time, which reveals the need for refreshment courses. However, these scores remained higher, compared to before intervention. These findings are consistent with those of **Emery et al, (2013)**, who noticed a direct relation between memory exhaustion and length of time that elapsed after exposure to certain educational events.

V. Conclusion

In the light of the findings of the present study,, it can be concluded that the educational intervention was effective in improving the level of nursing students' knowledge, attitudes as well as practices toward cord blood collection for stem cells, where there were highly statistically significant improvements in their knowledge and attitudes mean score immediately after and three months later of intervention. As well, there was a statistically significant difference in students' practices score before, immediately after and three months post intervention. So, the previously mentioned findings justified the current research hypothesis.

VI. Recommendations

In the light of the findings of the present study the following recommendations were suggested:

- After graduation, regular planned in-service training programs on cord blood collection and stem cells should be established to develop nurses' knowledge, attitudes, and practices so as to fit recently advanced concepts in healthcare.
- Umbilical cord blood collection and any current technologies must be incorporated into nursing curriculum in order to update the future nurse with this current medical innovation and evidences.
- Further research with larger sample is recommended to identify the needed curriculum content and to generalize the findings.

Table (1): Distribution of the Studied Students According to their General characteristics (n=100)

Demographic characteristics		
Age of students:		
• Mean \pm SD	21 \pm 0.57	
• Median(Range)	21(21-24)	
Gender:	No	%
• Female	70	70.0
• Male	30	30.0
Student qualification:		
• Technical institute	13	13.0
• Secondary school	87	87.0
Previous information regarding cord blood collection:		
• Yes	13	13.0
• No	87	87.0
Source of information (n=13)		
• Mass media(TV)	7	54
• Internet	6	46

Table 2: Distribution of the Studied Students According to their Knowledge Regarding Umbilical Cord through the Intervention Phases (n=100)

Knowledge regarding Umbilical cord	Pre	Post immediately	After 3 months	Freidman test	'p-value
	No (%)	No (%)	No (%)		
Anatomy and physiology of Umbilical cord:					
• Wrong answer	35	0	0	175.02	*0.0001
• Correctly incomplete	57	3	6		
• Correctly complete	8	97	94		
Functions of umbilical cord:					
• Wrong answer	29	0	0	161.1	*0.0001
• Correctly incomplete	62	6	13		
• Correctly complete	9	94	87		
Abnormalities of umbilical cord:					
• Wrong answer				175.04	*0.0001
• Correctly incomplete	55	0	5		
• Correctly complete	45	11	12		
	0	89	83		
Appropriate time of cord clamping:					
• Wrong answer				194.2	*0.0001
• Correctly incomplete	40	0	2		
• Correctly complete	46	3	6		
	4	97	92		

¹P value based on Friedman test

* Highly significant

Table (3): Distribution of the Studied Students According to their Knowledge Regarding Stem Cells at Time Trend of Assessment (n=100)

Knowledge regarding stem cells	pre	Post immediately	After 3 months	Freidman test	'p-value
	No (%)	No (%)	No (%)		
Definition of stem cells:					
• Wrong answer	90	0	5	177.23	*0.0001
• Correctly incomplete	8	13	15		
• Correctly complete	2	87	80		
Unique properties of stem cells:					
• Wrong answer	96	0	2	190.05	*0.0001
• Correctly incomplete	4	7	11		
• Correctly complete	0	93	87		
Haematopoietic stem cells:					
• Wrong answer	98	0	0	194.03	*0.0001
• Correctly incomplete	2	8	11		
• Correctly complete	0	92	89		
Source of obtaining blood stem cells:					
• Wrong answer				185.04	*0.0001
• Correctly incomplete	86	0	0		
• Correctly complete	10	0	6		
	4	100	94		

¹P value based on Friedman test

* Highly significant

Table (4): Distribution of the Studied Students According to their Knowledge Regarding Umbilical Cord Blood Collection Through the Intervention phases (n=100)

Knowledge about umbilical cord blood collection	pre	Post immediately	After 3 months	Freidman test	'p-value
	No (%)	No (%)	No (%)		
Definition of cord blood:					
• Wrong answer	74	0	0	174	*0.0001
• Correctly incomplete	23	5	11		
• Correctly complete	3	95	89		
Appropriate time of cord blood collection:					
• Wrong answer	92	0	4		

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• Correctly incomplete	8	4	5	188.01	*0.0001
• Complete	0	96	91		
Benefits of using umbilical cord blood for stem cells:					
• Wrong answer	94	0	4	180.05	*0.0001
• Correctly incomplete	6	3	9		
• Correctly complete	0	97	87		
Types of diseases that can be treated with cord blood:					
• Wrong answer	91	0	3	187.08	*0.0001
• Correctly incomplete	9	6	9		
• Correctly complete	0	94	88		
Contraindications of cord blood collection:					
• Wrong answer	96	1	4	189.03	*0.0001
• Correctly incomplete	4	3	9		
• Correctly complete	0	96	87		
Responsible person for collecting cord blood:					
• Wrong answer					
• Correctly incomplete	30	0	0	192	*0.0001
• Correctly complete	68	3	5		
	2	97	95		
Types of techniques used for collection of cord blood:					
• Wrong answer	82	0	3	184.04	*0.0001
• Correctly incomplete	18	3	6		
• Correctly complete	0	97	91		
Duration of cord blood collection:					
• Wrong answer	69	0	0	194	*0.0001
• Correctly incomplete	31	2	7		
• Correctly complete	0	98	93		
Equipment's that used for collection cord blood:					
• Wrong answer					
• Correctly incomplete	85	0	2	191	*0.0001
• Correctly complete	15	3	5		
	0	97	93		
Number of cells collected from cord blood:					
• Wrong answer					
• Correctly incomplete	92	0	0	195	*0.0001
• Correctly complete	8	4	6		
	0	96	94		
Number of cells needed in a stem cell transplant:					
• Wrong answer					
• Correctly incomplete	92	2	5	186.01	*0.0001
• Correctly complete	8	5	9		
	0	91	89		
Places used for storing umbilical cord blood:					
• Wrong answer					
• Correctly incomplete	25	0	0	196.06	*0.0001
• Correctly complete	75	0	3		
	0	100	97		
How long can cord blood be stored:					
• Wrong answer	89	0	3	193.5	*0.0001
• Correctly incomplete	9	2	5		
• Correctly complete	2	98	92		
Barrier of collecting cord blood:					
• Wrong answer	69	0	3	183.04	*0.0001
• Correctly incomplete	31	9	11		
• Correctly complete	0	91	86		

¹P value based on Friedman test

*Highly significant

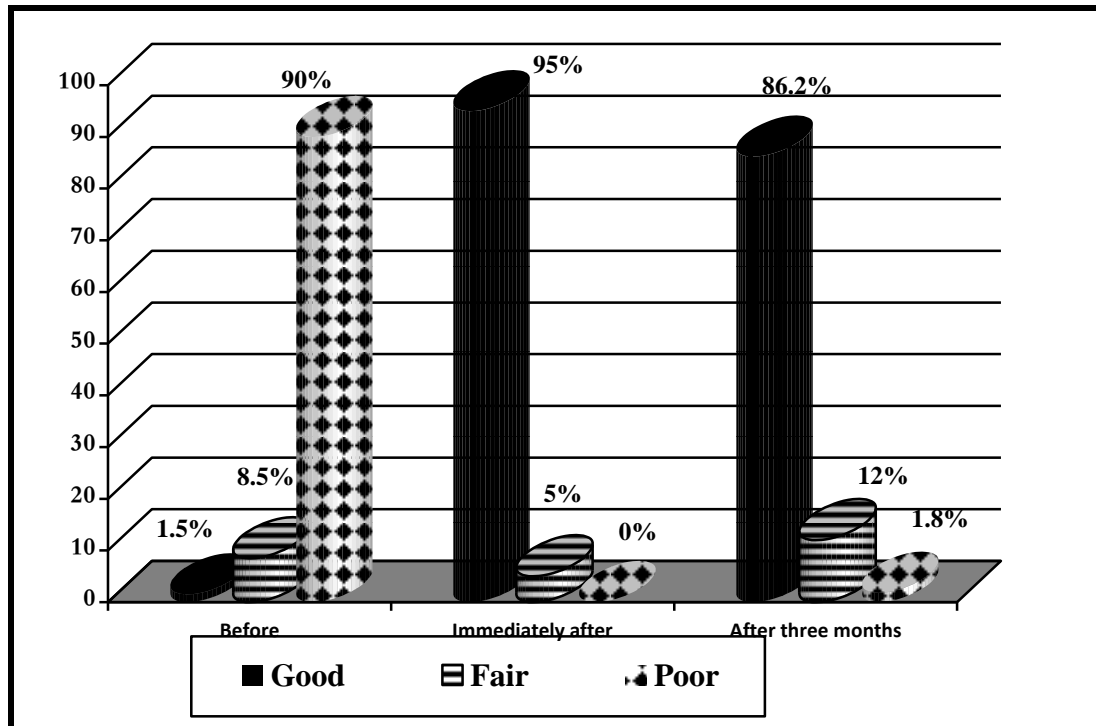


Figure (1): Distribution of the Studied Students According to their Total Score of Knowledge at Different Time of Assessment (n=100)

Table (5): Distribution of the Studied Students According to their Attitudes Regarding Umbilical Cord Blood for Stem Cells Therapy at Time Trend of Assessment (n=100)

Time assessment attitudes	pre	Post immediately	After 3 months	Freidman test	'p-value
	No (%)	No (%)	No (%)		
Collecting umbilical cord blood immediately after delivery is necessary:					
• Agree					
• Neutral	18	97	89	153.3	*0.0001
• Disagree	46	3	11		
	36	0	0		
Obtaining cord blood collection is wasting time:					
• Agree	50	2	4	153.9	*0.0001
• Neutral	40	0	5		
• Disagree	10	98	94		
Umbilical cord blood should only be used for baby and his own family:					
• Agree	83	6	9	122.9	*0.0001
• Neutral	0	3	3		
• Disagree	17	91	88		
When cord blood is taken, the baby is not harmed					
• Agree	15	96	87	146	*0.0001
• Neutral	60	4	13		
• disagree	25	0	0		
The collection of cord blood affects the care of mother or her newborn:					
• Agree	78	3	8	145.7	*0.0001
• Neutral	11	2	3		
• Disagree	11	95	89		
Umbilical cord blood collection should be a routine care in delivery rooms and widely practiced:					
• Agree					
• Neutral	11	97	89		

<ul style="list-style-type: none"> Disagree 	50 39	3 0	11 0	157.4	*0.0001
Experiences and proficiency in umbilical cord blood collection for stem cell is required for nursing students as a health care provider: <ul style="list-style-type: none"> Agree Neutral Disagree 	15 21 64	97 3 0	95 3 2	158	*0.0001
Every pregnant woman should be advised to store her umbilical cord blood for future purposes: <ul style="list-style-type: none"> Agree Neutral Disagree 	0 29 71	98 2 0	89 11 0	179.07	*0.0001
It is necessary to introduce cord blood collection and stem cells in nursing courses: <ul style="list-style-type: none"> Agree Neutral Disagree 	10 55 35	100 0 0	94 6 0	171	*0.0001
It is necessary to cord blood banking for storage of stem cells: <ul style="list-style-type: none"> Agree Neutral Disagree 	46 27 27	100 0 0	97 3 0	100	*0.0001
I accept to attend workshops about umbilical cord blood collection and stem cells: <ul style="list-style-type: none"> Agree Neutral Disagree 	55 9 36	96 4 0	90 8 2	63.02	*0.0001
Collecting umbilical cord blood and stem cells is approved by religious: <ul style="list-style-type: none"> Agree Neutral Disagree 	0 34 66	97 3 0	89 11 0	192.06	*0.0001

[†]P value based on Friedman test

*Highly significant

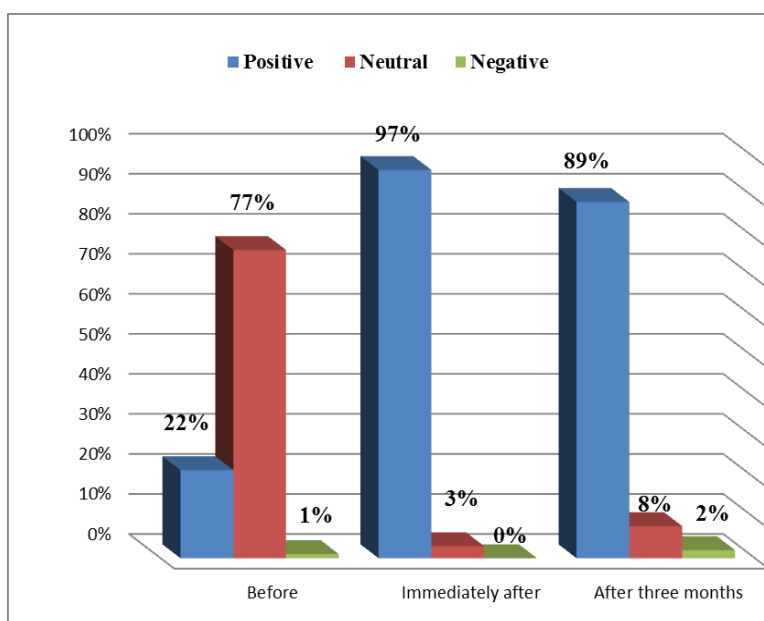


Figure (2): Level of Total Attitudes of Studied Students Regarding Umbilical Cord Blood for Stem Cells Therapy Through Intervention Phases (n=100)

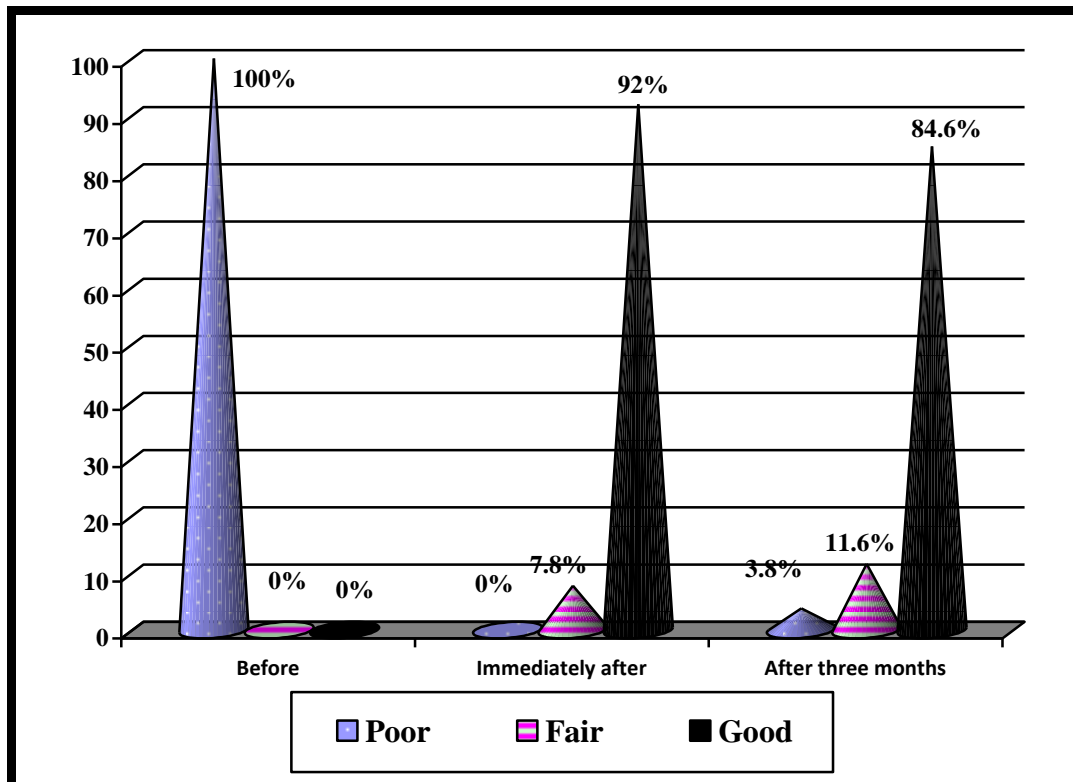


Figure (3): Distribution of the Studied Students According to their Total Score of Practices at Different Stages of Assessment (n=100)

Table (6): Relations Between Demographic Characteristics of Studied Students' and their Knowledge, Attitudes and Practices Through the Intervention Phases (n=100)

Variables	Knowledge			Attitudes			Practices		
	pre	Post immediately	After 3 months	pre	Post immediately	After 3 months	pre	Post immediately	After 3 months
Gender									
Male (n=30)	6.4±3.7	43.6±0.7	42.5±1.7	26.4±4	33±2	32±3	2.8±1.3	24.6±1.8	20.6±1.8
Female(n=70)	6.5±3.5	42.5±3	41 ± 5	25 ± 4	22±1.2	32.6±1.7	3 ±1.8	24.7±1.5	20±1.7
T	*0.8	2.6	2	1.6	0.6	0.9	*0.3	0.3	1.08
p		**0.009	0.04	0.09	0.5	0.3		0.7	0.3
Qualification									
Technical institute(n=13)	6±3.8	43±1.8	40.7±4.5	25±4	33.2±1.2	33.2±2	3.2±1.5	24.7±1.5	20±1.8
Secondary school (n=87)	6.5±3.5	42.8±2.9	41.6±4.6	25.4±4	32.9±1.5	32.4±2.1	2.9±1.7	24.7±1.4	20.3±1.8
t	*0.8	0.3	0.6	0.2	0.5	1.3	*0.5	0.02	0.09
p		0.7	0.5	0.8	0.6	0.2		0.98	0.9
Previous information									
Yes (n=13)	7±3.2	43±1.5	42.6±2	26.5±3	32.4±1.7	31.6±2.7	3.4±1.5	24.7±1.6	20.6±2
No (n=87)	6.4±3.6	42.8±3	41.3±4.8	25±4	33±1.4	32.6±2	3±1.7	24.6±1.4	20.3±1.7
t	*0.4	0.07	0.9	1.03	1.5	1.6	*0.3	0.13	0.5
p		0.9	0.3	0.3	0.13	0.1		0.9	0.6

*Mann-Whitney test

** Statistically significant

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