



## Nursing Students Knowledge Regarding Innovative Approach of Cord Blood Collection and Stem Cells: Intervention Study

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### *Abstract*

**Background:** Umbilical cord blood (UCB) collection and stem cells researches represent rapidly advancing and widely debated areas in contemporary science and healthcare. UCB is a valuable and rich source of stem cells and is currently used in the treatment of more than 80 medical conditions. **Aim:** To evaluate nursing students' knowledge regarding innovative approach of cord blood collection and stem cells. **Subjects and Methods: Research design:** A quasi-experimental design was utilized. **Setting:** The study was conducted at Faquos Nursing Technical Institute from the first of March 2025 to the end of April 2025. **Sampling:** A systematic random sample was used in the study. **Subjects:** The study involved 50 nursing students. **Tools of data collection:** Data were collected by using two tools. Tool (I) A structured interviewing questionnaire. Tool (II) A knowledge questionnaire to assess nursing students' knowledge toward UCB collection and stem cells. **Results:** The study revealed a significant improvement in the total knowledge of nursing students following the implementation of the educational program, with a highly statistically significant difference at ( $p = <0.01$ ). **Conclusion:** The educational program proved to be effective in enhancing nursing students' knowledge toward the innovative approach of UCB collection and stem cells. **Recommendations:** Continuous health education programs focusing on UCB collection and stem cells should be provided for nursing students to keep pace with emerging concepts and technological advancements in healthcare.

**Keywords:** Cord blood collection, Innovative approach, Knowledge, Stem cell

### Introduction

The UCB collection has emerged as an innovative practice in modern medical science and has attracted increasing interest in recent years. Currently, UCB represents cornerstone of hematopoietic stem cells (HSCs) and is found within the placenta and umbilical cord (UC) of new-borns (Sanchez-Petitto et al., 2023).

The UC acts as the connection between the fetus and the placenta, which develops within the uterus to build the fetus with essential nutrients and oxygen. Following childbirth, the UC is clamped and cut, and discarded from the remaining part and placenta, despite containing a substantial amount of residual blood. UCB is similar to components of peripheral blood, but it distinguished by its high concentration of HSCs (Nakanishi et al., 2022).

The HSCs are multi-potent, immature cells capable of differentiating into all types of blood cells (erythrocytes, leukocytes, and platelets) that are essential for normal physiological functions (Reuther et al., 2022). Clinically, HSCs are widely utilized to reconstitute the hematopoietic system in patients



suffering from both malignant conditions, such as leukaemia and lymphoma, and non-malignant disorders, including sickle cell disease. UCB is considered a valuable and rich source of these stem cells for transplantation purposes, offering several potential advantages for selected patient populations (**Shi et al., 2022**).

Stem cells can be derived from multiple sources, each characterized by different levels of potency. Embryonic, adult, and UCB stem cells each present specific benefits and limitations when applied in clinical settings. Among these sources, UCB provides a practical alternative with notable research and therapeutic advantages. Stem cells are fundamental to normal tissue development, maintenance of tissue homeostasis, and the process of wound healing throughout the human lifespan (**Liu et al., 2022**).

The UCB banking refers to the systematic collection, processing, and long-term storage of UCB for potential future therapeutic use by the donor or compatible family members. This process represents a unique, once-in-a-lifetime opportunity to preserve neonatal stem cells that may be required for life-saving treatments. Stored UCB is readily available for immediate use when needed, making it a valuable medical resource (**Waller-Wise, 2022**).

The procedures involved in UCB collection and processing are relatively simple and not difficult. UCB harvesting is a rapid process, while laboratory processing and preservation typically require a period ranging from several days to weeks. Globally, more than 50,000 successful UCB transplants have been performed for the treatment of various malignancies and haematological disorders. Furthermore, recent advancements in stem cell technology have enabled effective treatment of several life-threatening conditions, such as thalassemia and leukaemia (**Wang & Metheny, 2023**).

In clinical practice, UCB can be collected using either the in-utero or ex-utero method, with the latter being more commonly employed. The in-utero technique involves collecting UCB after the infant's birth but prior to placental delivery, whereas the ex-utero method is performed following the expulsion of the placenta. In both methods, once the new-born is delivered, the UC is clamped and a sterile needle connected to an anticoagulant-coated collection bag is inserted into the umbilical vein to allow blood drainage (**Esmail et al., 2022**).

The UCB is collected with a safe procedure that poses no risk to either the mother or the new-born. In contrast to embryonic stem cells, UCB stem cells are free from ethical controversy. After delivery and separation of the UC, blood can be safely obtained from the portion of the cord still attached to the placenta. Then the stem cells are isolated from the remaining blood within the UC and placental tissues (**Sahoo & Rana, 2020**).

In Egypt, the Ministry of Health and Population has established comprehensive regulations governing UCB banking, drawing upon ethical guidelines and standards adopted in the United States and Europe. Authorization from Al-Azhar University in Cairo is required before any UCB bank can operate within the country. Both public and private UCB banking are permitted, provided that specific regulatory requirements are met to prevent commercial misuse. However, limited awareness and low educational levels remain significant barriers, contributing to inadequate knowledge and reluctance among nurses regarding UCB donation and storage (**Mohammed et al., 2020**).

Maternity nurses constitute cornerstone of the healthcare system across all stages of life. Their responsibilities in UCB collection include preparation, sample collection, labelling, and proper packaging of the collected blood. Additionally, nurses play a crucial role in patient education, as they are considered a trusted source of health-related information. Therefore, it is essential that they remain informed about current advances in medical diagnosis and treatment. Continuous professional education enhances nurses' competencies and supports on-going professional development of nursing practice (**Green et al., 2021**).

Consequently, nurses require adequate education regarding the importance of UCB collection and preservation, as well as its future therapeutic potential, in order to foster positive attitudes and improve holistic nursing care. Nurses are involved in multiple aspects of stem cell banking, from understanding UC anatomy to participating in the collection process. Nevertheless, previous studies conducted in Egypt have indicated that a substantial proportion of nurses lack sufficient knowledge about UCB collection,



storage procedures, and medical applications (Mansour, Gouda, & Ibrahim, 2020).

### Significance of the study:

The UCB collection represents an emerging and advanced modality in contemporary medical practice. It is considered one of the most innovative technologies worldwide for restoring impaired body systems; however, awareness of this clinical application remains limited among many clients. Consequently, the practice of UCB collection is primarily carried out by obstetricians, midwives, and nurses who have received specialized training in this area (Mohammed, Khalil, & Mustafa, 2022).

The UCB collection is recognized as a valuable and rich source of stem cells that useful in the management of several diseases in Egypt, including thalassemia, leukaemia, diabetes mellitus, and liver cirrhosis resulting from viral hepatitis (Tomar 2022).

Moreover, a study conducted in Egypt by Hassan et al. (2022) revealed that a considerable proportion of nurses (63.2%) demonstrated inadequate knowledge regarding UCB collection, despite nearly half of them (45.6%) showing a positive attitude toward this practice.

### The aim of the study:

The aim of the study was to evaluate nursing students' knowledge regarding innovative approach of UCB collection and stem cells.

### Research hypothesis :

Knowledge of nursing students regarding innovative approach of UCB collection and stem cells would be suspected to improve after implementation of educational program.

### Subjects and Methods:

#### 1-Technical design:

This design includes description of research design, the study setting, study sample, subjects and tools of data collection.

#### A. Research design:

A quasi-experimental design was used in this study.

#### B. Study Setting:

The present study was conducted at Faquos Nursing Technical Institute- Zagazig University.

#### C. Study sample:

Systematic random sample was used for this study.

#### D. Subjects:

#### Sample Size Calculation

The sample size for this study was determined using statistical power analysis for a one-group pre-test–post-test intervention design. The calculation was based on the following formula (Cohen, 2013):

$$n \approx \left( \frac{Z_{\alpha/2} + Z_{\beta}}{\text{Effect Size}} \right)^2$$

Where  $Z_{\alpha/2}$  represents the Z-value corresponding to the selected confidence level (95%,  $Z = 1.96$ ),  $Z_{\beta}$  represents the Z-value corresponding to the desired study power (95%,  $Z = 1.645$ ), and Effect Size refers to the standardized mean difference expected between pre- and post-intervention measurements.

The expected effect size was estimated based on findings from a previous quasi-experimental educational intervention study conducted among nurses regarding UCB collection and stem cells (Mohammed & El Sayed, 2015), which reported a moderate to large improvement in knowledge and attitude following the intervention. Accordingly, an effect size of approximately 0.6 was assumed. Substituting these values into the formula yielded a minimum required sample size of approximately 50 participants.

#### E. Tools of Data Collection:

Two data collection tools were utilized in the current study.

#### Tool I Structured Interviewing Questionnaire sheet:

This tool was developed by the researcher after an extensive review of the relevant literature. It was



designed to collect baseline demographic characteristics of nursing students, including age, gender, place of residence, educational grade, marital status, family income.

### **Tool II Knowledge Questionnaire:**

This questionnaire was originally developed by **Madhura (2022)** and subsequently modified by the researcher to suit the objectives of the current study. It consisted of 62 items distributed across four main sections:

- **Section I:** General knowledge related to the UC, including anatomy, functions, abnormalities, and the appropriate timing of UC clamping (27 items).
- **Section II:** Knowledge related to UCB collection, covering definition, benefits, indications, contraindications, optimal time for collection, storage facilities, cost, duration of storage, barriers to UCB collection, and personnel responsible for collection (8 items).
- **Section III:** Knowledge regarding the technique of UCB collection, including collection methods, preparation, components of the collection set, infection control precautions, and procedural steps (7 items).
- **Section IV:** Knowledge concerning stem cells, encompassing definition, characteristics, mechanisms of action, sources, types, ESCs (definition and characteristics), benefits, advantages and disadvantages, indications, effectiveness of UCB stem cell transplantation, ethical considerations, and diseases treatable by stem cells (20 items).

### **The scoring system:**

The knowledge questionnaire included 62 items divided into four subscales: general knowledge of UCB (27 items), knowledge related to UCB collection (8 items), knowledge concerning collection techniques (7 items), and knowledge related to stem cells (20 items). Responses were scored using a two-point scale, where a correct answer was given one point and an incorrect or “don’t know” response was given zero. The total score was categorized as follows:

- **Adequate knowledge:**  $\geq 75\%$  (47–62 scores)
- **Average knowledge:** 60% to  $<75\%$  (38–46 scores)
- **Poor knowledge:**  $<60\%$  (0–37 scores)

### **Program Development Phases:**

The educational program was structured and implemented through the following phases:

#### **1) Interviewing and Assessment Phase:**

The program was carried out by the researcher, who works as a clinical instructor at Faquos Nursing Technical Institute. The sessions were conducted in the morning, one day per week on an alternating basis over a period of eight weeks. At the beginning of the program, the researcher introduced herself to the nursing students, welcomed them, and clearly explained the purpose of the study to obtain their informed consent.

Each nursing student was interviewed individually for approximately 30 minutes to collect baseline data. A pre-test was conducted using Tool I (Structured Interviewing Questionnaire), Tool II (Knowledge Questionnaire), to assess the nursing students’ initial knowledge toward UCB banking and stem cells. The findings of the pre-test assessment served as a foundation for planning and conducting the educational program sessions.

#### **2) Planning Phase:**

Based on the results obtained from the pre-test assessment during the interviewing and assessment phase, the researcher identified the gaps and educational needs related to nursing students’ knowledge of UCB collection and stem cells. Accordingly, the educational program and an instructional booklet were developed by the researcher in clear and simple Arabic language, taking into consideration the educational level of the nursing students. The booklet was supported with colored illustrations to enhance understanding.

Various teaching strategies were utilized, including lectures, group discussions, demonstrations, and re-demonstrations. Teaching aids consisted of visual materials such as posters, Power Point presentations, and educational videos. The instructional booklet was distributed to students along with stationery



supplies to encourage note-taking and feedback. The educational booklet included up-to-date information related to UCB collection and stem cells.

The general objectives of nursing students' educational sessions were to improve knowledge and attitude in nursing students about UCB collection and stem cells.

**The specific objectives: at the end of the sessions the students should be able to:**

- Describe anatomy of UC.
- Describe physiology of UC.
- Determine congenital anomalies of UC.
- List functions of UC.
- Define UCB.
- Advantage of using UCB to treat disease.
- Disadvantage of using UCB to treat disease.
- Define UCB collection.
- Describe techniques of UCB collection.
- Define stem cells.
- List characteristics of stem cells.
- Determine types of stem cells.
- Determine advantage and disadvantage of stem cells.
- Understand ethical issues concerning stem cells.
- Identify positive attitude about UCB collection and stem cells.

### **3) Implementation Phase:**

The educational program was implemented through six sessions over eight weeks, with each session lasting approximately 30 minutes. These sessions were conducted in the lecture hall at Faquos Nursing Technical Institute. PowerPoint presentations were used and supported by videos, illustrations, and figures, followed by interactive group discussions.

Each session began with a brief revision of the previous content, followed by the introduction of new objectives. The sessions were delivered using simple Arabic and English terminology suitable for the nursing students' educational background. Motivation and feedback techniques were employed to promote students' active participation and engagement throughout the program.

#### **First Session**

At the beginning of the first session, the researcher presented an overview of the educational program and its session outline. Nursing students were encouraged to share their prior knowledge and perceptions regarding UCB collection and stem cells. The general and specific objectives of the session were clarified.

The researcher addressed misconceptions related to UCB collection and stem cells and encouraged students to exchange opinions and discuss the benefits of the acquired knowledge.

At the end of the session, the impact of the session on students' understanding was evaluated. Each nursing student received a printed Arabic educational booklet containing colored images. A brief introduction to UCB and stem cells was provided, including an explanation of the anatomy and physiology of umbilical cord blood.

#### **Second Session**

This session focused on enhancing students' knowledge of UCB, including its definition, functions, diseases treated by UCB cells, as well as the advantages and disadvantages of using UCB.

#### **Third Session**

The third session aimed to improve nursing students' understanding of UCB stem cells, including their definition, characteristics, types, advantages, and disadvantages.

#### **Fourth Session**

This session focused on UCB collection, addressing its definition, indications, and contraindications.

**Fifth Session**

The fifth session concentrated on the techniques of UCB collection and included a discussion of ethical issues related to UCB stem cells.

**Sixth Session**

The final session emphasized the nursing role in UCB collection. Additionally, it served as a comprehensive review of all topics covered in previous sessions and provided an opportunity to discuss and clarify students' questions.

**4) Evaluation Phase:**

During the evaluation phase, a post-test was administered using the same predesigned tools (Tool I and Tool II) to assess nursing students' knowledge and compare pre- and post-test results. The post-test was conducted one week after completion of the educational program to evaluate its effectiveness. The results demonstrated statistically significant improvements in nursing students' knowledge scores following the implementation of the educational program.

**II. Operational Design:**

The operational design included a detailed description of the preparatory phase and encompassed content validity, reliability, pilot study, field work, and ethical considerations.

**Preparatory Phase:**

During this phase, the researcher conducted an extensive review of both local and international literature related to the study topic. This review included text books, scientific journals, articles, and relevant publications. The literature review contributed to enhancing the researcher's understanding of the subject matter and guided the development of the study tools and the educational program booklet.

**Tool validity and reliability:**

To ensure content validity, the study questionnaire was evaluated by a panel of three specialists in obstetric and gynaecological nursing from the Faculty of Nursing, Zagazig University. The experts were asked to review the clarity, relevance, and adequacy of the tool items, and to provide feedback regarding any necessary additions, deletions, or modifications. Based on their comments and recommendations, the researcher revised the questionnaire accordingly, and the finalized version was prepared for implementation.

The reliability of the study tool was assessed using Cronbach's alpha coefficient. The nursing students' knowledge assessment tool demonstrated a Cronbach's alpha value of **0.945**; this value indicated acceptable internal consistency for the used tool.

**Ethical Considerations:**

Prior to conducting the study, ethical approval was obtained from the Research Ethics Committee (REC) and the Postgraduate Committee of the Faculty of Nursing, Zagazig University (Approval Code: M.D.ZU.NUR\241\9\7\2024). Informed oral consent was obtained from all participating nursing students after providing a clear explanation of the study's purpose.

Participants were informed of their right to decline participation or withdraw from the study at any time without any consequences. Confidentiality and anonymity were ensured by assigning code numbers to each participant, and all collected data were used exclusively for research purposes. Additionally, an official approval letter was issued by the Dean of the Faculty of Nursing, Zagazig University, to the Director of Faqus Nursing Technical Institute, explaining the nature of the study and the role of the researcher.

**Pilot study:**

A pilot study was conducted on 10% of the total study sample, comprising five nursing students, to evaluate the applicability, feasibility, and clarity of the data collection tools. The pilot study also aimed to determine the approximate time required to complete the questionnaire forms. Participants in the pilot study were selected randomly and were excluded from the main study sample. Necessary modifications were made to the tools based on the findings of the pilot study before final data collection.

**Field of work:**

Following the approval of the study, the researcher developed a structured timetable for data collection. The data were collected over a two-month period, extending from the beginning of March 2025 to the end of April 2025. After obtaining the necessary official permissions, a pilot study was conducted to test the research tools, and the results were analysed accordingly. Based on the pilot study findings, the final versions of the data collection tools were prepared.

The finalized questionnaires were distributed by the researcher to nursing students during their free time to obtain their responses. Prior to data collection, the researcher explained the objectives of the study to the students, either individually or through group discussions. Each student was allowed to complete the questionnaire under the researcher's supervision and guidance. Completion of the questionnaire required approximately 15–20 minutes. Upon completion, all questionnaires were reviewed by the researcher to ensure accuracy and completeness of the collected data.

Educational sessions and an instructional booklet were designed in accordance with the identified educational needs of the nursing students, aiming to enhance their knowledge and attitudes toward UCB collection and stem cells. The educational booklet was prepared by the researcher based on an extensive review of relevant literature and previous research studies. It was written in clear and simple Arabic language and included comprehensive information related to cord blood collection and stem cells, such as definitions, advantages, disadvantages, collection techniques, and diseases that can be treated using UCB.

**III-Administrative design:**

An official approval was obtained prior to data collection through submitting a formal letter issued by the Dean of the Faculty of Nursing, Zagazig University, to the Director of Faquos Nursing Technical Institute, requesting permission to conduct the study and collect the required data.

**IV-Statistical design:**

Data were statistically analysed using Microsoft Excel and the Statistical Package for Social Sciences (SPSS) version 25. Descriptive statistics were applied, including frequencies and percentages for categorical variables, and mean ( $\bar{X}$ ) with standard deviation (SD) for quantitative variables. Comparisons between qualitative variables were conducted using the chi-square ( $\chi^2$ ) test, while paired *t*-test was used to compare quantitative variables. Pearson's correlation coefficient (*r*) was utilized to assess the relationship between the studied variables. The reliability of the research instruments was evaluated using Cronbach's alpha coefficient.

**Level of significance:**

The level of statistical significance was interpreted as follows:

- P-value  $\geq 0.05$  Not significant (NS)
- P-value  $< 0.05$  Significant (S)
- P-value  $< 0.01$  Highly Significant (HS).

**Limitation of the study:**

- 1- Nursing students interested in their lectures.
- 2- Most of the nursing students refused to participate in the study despite of they never received counselling about UCB collection and stem cells.

**Results:**

**Table (1):** shows Personal demographic data of studied nursing students. It was found that, 76% of the studied nursing students were female. Also, 42.0% of them were aged 19 years old; the mean SD of age was  $19.22 \pm 0.73$  years. Furthermore, 76.0% of them reside at rural areas. Moreover, 50.2% of them were housewife. Moreover, 54.0% of them were in second grade of nursing institute. In addition, 94.0% of them were single. Likewise, 60.0% of them didn't have sufficient family income.

**Table (2):** displays total nursing students' knowledge regarding innovative approach of UCB collection



and stem cells at pre and post implementation of education program. It clarifies that (12.0% )of the studied nursing students have a good level of knowledge toward the innovative approach of UCB collection and stem cells at pre implementation of education program. While changed to (74.0%) at post implementation of education program.

**Figure (1)** illustrates Percentage distribution of nursing students' knowledge regarding innovative approach of UCB collection and stem cells at pre and post implementation of education program (**n=50**). This figure displays that 12.0% of the studied nursing students have a good level of knowledge regarding the innovative approach of UCB collection and stem cells at pre implementation of education program. While changed to 74.0% at post implementation of education program.

**Figure (2)** clarifies Percentage distribution of the studied nursing students according to their source of nursing background about UCB (**n=50**). This figure displays that 46.0% of the studied nursing students have background about UCB from the internet. Also, 34% of them have information from books. Furthermore, 14% of them have information from public health centers. While, 6% of them have information from their friends.

**Figure (3)** shows Percentage distribution of the studied nursing students according to their attending training courses about UCB collection and stem cells (**n=50**). This figure shows that 78.0% of the studied nursing students do not attend training courses about cord blood collection and stem cells. While, 22.0% of them attend.

**Table (3):** clears relations between personal demographic data of the studied nursing students and their total knowledge regarding innovative approach of UCB collection and stem cells at pre and post implementation of education program. it demonstrates that there was highly statistically significant relation between total nursing students' knowledge and their age, educational grade and attending training courses pre and post education program ( $P = < 0.01$ ). Also, there was a statistically significant relation with their sex pre and post education program ( $P = < 0.05$ ). While there was no statistically significant relation with their residence, marital status and family income pre and post education program ( $P = > 0.05$ ).

**Table (1):** Frequency distribution of the studied nursing students according to their Personal demographic data (**n=50**).

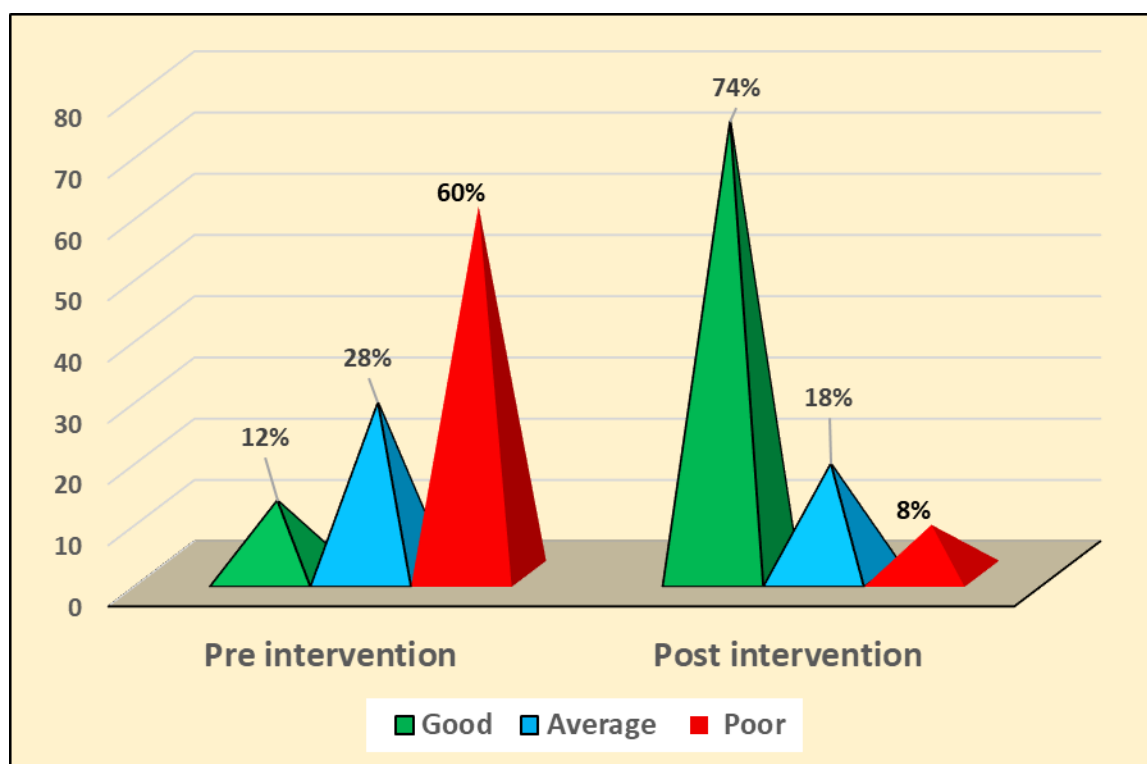
Personal demographic data	No.	%
<b>Sex</b>		
Male	12	24.0
Female	38	76.0
<b>Age</b>		
17 years	0	0.0
18 years	9	18.0
19 years	21	42.0
20 years	20	40.0
<b>Mean ± SD</b>	<b>19.22 ± 0.73</b>	
<b>Residence</b>		
Rural	38	76.0
Urban	12	24.0
<b>Educational grade</b>		
First grade	23	46.0
Second grade	27	54.0
<b>Marital status</b>		
Single	47	94.0
Married	3	6.0
<b>Family income</b>		
Sufficient	20	40.0
Not sufficient	30	60.0



**Table (2):** Comparison between total nursing students’ knowledge regarding innovative approach of UCB collection and stem cells at pre and post implementation of education program (n=50).

Items	Pre program						Post program						X <sup>2</sup>	P-value
	Good		Average		Poor		Good		Average		Poor			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
Umbilical cord blood	4	8.0	13	26.0	33	66.0	38	76.0	8	16.0	4	8.0	51.44	0.000**
Cord blood collection	6	12.0	15	30.0	29	58.0	37	74.0	10	20.0	3	6.0	44.47	0.000**
Technique of cord blood collection	7	14.0	11	22.0	32	64.0	35	70.0	10	20.0	5	10.0	38.41	0.000**
Stem cells	3	6.0	11	22.0	36	72.0	40	80.0	7	14.0	3	6.0	60.64	0.000**
<b>Total knowledge score</b>	<b>6</b>	<b>12.0</b>	<b>14</b>	<b>28.0</b>	<b>30</b>	<b>60.0</b>	<b>37</b>	<b>74.0</b>	<b>9</b>	<b>18.0</b>	<b>4</b>	<b>8.0</b>	<b>43.31</b>	<b>0.000**</b>
<b>Mean SD</b>	<b>23.72±14.87</b>						<b>55.02±8.23</b>						<b>t=19.16</b>	<b>0.000**</b>

X<sup>2</sup>: Chi Square Test.      t= Paired test.      (\*\*) highly Statistically significant at p <0.01.



**Figure (1):** Percentage distribution of nursing students’ knowledge regarding innovative approach of UCB collection and stem cells pre and post implementation of education program (n=50).

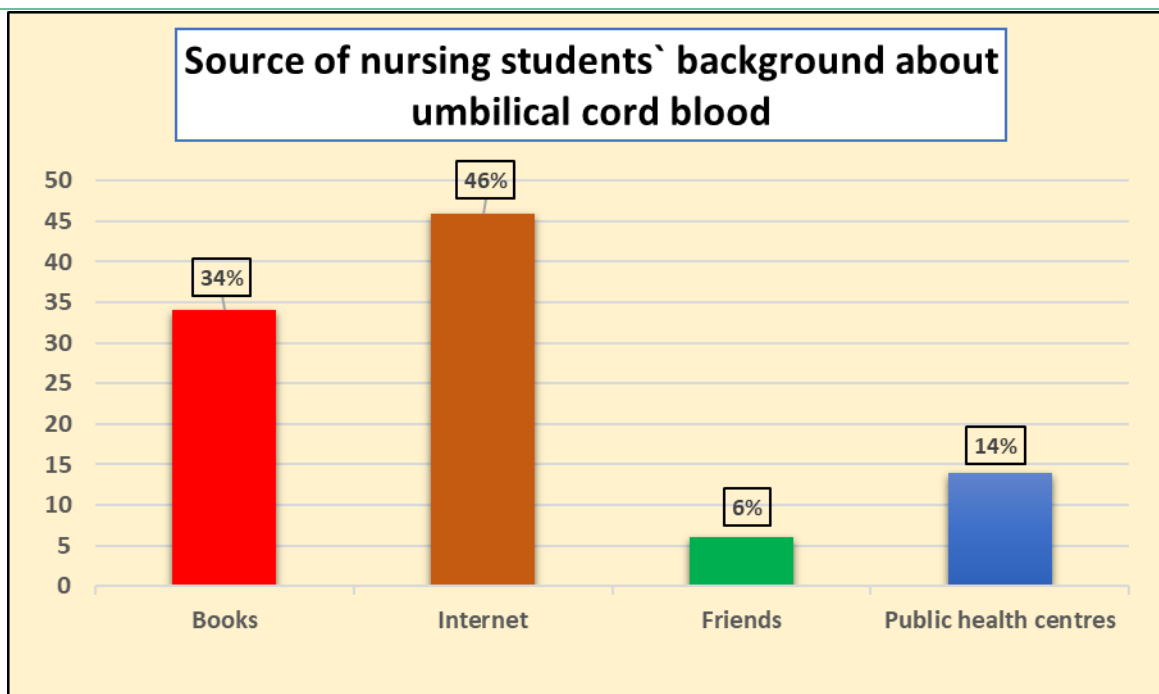


Figure (2): Percentage distribution of the studied nursing students according to their source of nursing background about UCB (n=50).

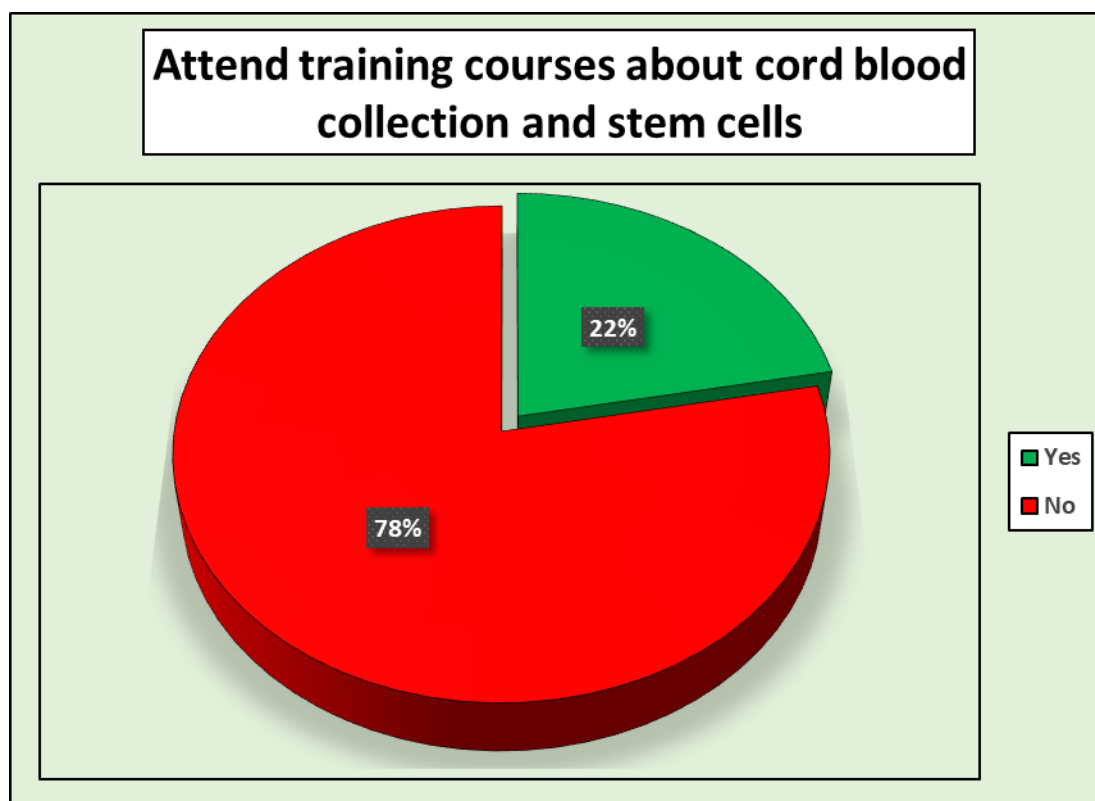


Figure (3): Percentage distribution of the studied nursing students according to their attending training courses about UCB collection and stem cells (n=50).



**Table (3):** Relations between personal demographic data of the studied nursing students and their total knowledge regarding innovative approach of UCB collection and stem cells at pre and post implementation of education program (n=50).

Personal demographic data	Total knowledge at pre-program						χ <sup>2</sup>	P-Value	Total knowledge at post-program						χ <sup>2</sup>	P-Value
	Good (n=6)		Average (n=14)		Poor (n=30)				Good (n=37)		Average (n=9)		Poor (n=4)			
	No.	%	No.	%	No.	%			No.	%	No.	%	No.	%		
<b>Sex</b>																
Male	0	0.0	1	7.1	11	36.7	.715	0.035*	2	5.4	6	66.7	4	100.0	28.66	0.000**
Female	6	100.0	13	92.9	19	63.3			35	94.6	3	33.3	0	0.0		
<b>Age (years)</b>																
18	0	0.0	3	21.4	6	20.0	1.11	0.000**	6	16.2	2	22.2	1	25.0	12.39	0.015*
19	0	0.0	2	14.3	19	63.3			11	29.7	7	77.8	3	75.0		
20	6	100.0	9	64.3	5	16.7			20	54.1	0	0.0	0	0.0		
<b>Residence</b>																
Rural	4	66.7	8	57.1	26	86.7	.887	0.087	25	67.6	9	100.0	4	100.0	5.548	0.062
Urban	2	33.3	6	42.9	4	13.3			12	32.4	0	0.0	0	0.0		
<b>Educational grade</b>																
First	0	0.0	1	7.1	22	73.3	2.64	0.000**	10	27.0	9	100.0	4	100.0	20.62	0.000**
Second	6	100.0	13	92.9	8	26.7			27	73.0	0	0.0	0	0.0		
<b>Marital status</b>																
Single	6	100.0	14	100.0	27	90.0	.128	0.345	35	94.6	8	88.9	4	100.0	0.695	0.706
Married	0	0.0	0	0.0	3	10.0			2	5.4	1	11.1	0	0.0		
<b>Family income</b>																
Sufficient	3	50.0	4	28.6	14	46.7	.462	0.481	13	35.1	6	66.7	2	50.0	3.069	0.216
Insufficient	3	50.0	10	71.4	16	53.3			24	64.9	3	33.3	2	50.0		
<b>Attending training courses about UCB collection and stem cells</b>																
Yes	6	100.0	5	35.7	0	0.0	1.26	0.000**	11	29.7	0	0.0	0	0.0	4.955	0.084
No	0	0.0	9	64.3	30	100.0			26	70.3	9	100.0	4	100.0		

χ<sup>2</sup> = Chi square test. No significant at p > 0.05. \*Significant at p < 0.05. \*\*highly significant at p < 0.01.

**Discussion**

The UC represents the essential biological link between the fetus and the placenta. Despite its critical role during pregnancy, it is commonly regarded as biological waste and routinely discarded after childbirth (Arafat, 2021). However, UCB is now recognized as a valuable source of stem cells, particularly HSCs, which have proven life-saving potential and wide applications in stem cell therapy and transplantation (Mazlan et al., 2021).

Regarding the personal demographic characteristics of the studied nursing students, the findings of the current study indicated that females constituted nearly two thirds of the study sample. Almost half of the students were 19 years old, with a mean age of 19.22 ± 0.73 years. More than half of the students were enrolled in the second grade of the nursing institute. In addition, the results showed that about three fifths of the students reported having insufficient family income.

These findings differ from those reported in a study conducted at Benha University by Elmarakby et al. (2022), which assessed the effect of an educational program on maternity nurses’ knowledge and attitudes toward UCB banking. That study revealed that the majority of participants were aged between 25 and 30 years, with a higher mean age. This discrepancy may be attributed to differences in the study population, as the latter study focused on maternity nurses rather than nursing students.



With regard to marital status, the present study demonstrated that more than three quarters of the nursing students were single. This finding is consistent with the results of a study carried out at Tanta University by **Shaban et al. (2019)**, which reported that the majority of nursing students were unmarried.

In contrast, this finding disagrees with that of **Tork et al. (2018)**, who found that most nurses in their study were married, which could be explained by differences in age, professional status, and life stage between nurses and students.

Concerning the residence of the studied students, the results revealed that more than half of them lived in rural areas. This finding is supported by **Mansour et al. (2020)**, who reported a high proportion of rural residents among nurses participating in an educational program related to UCB stem cell preservation in Egypt.

Concerning the total knowledge of nursing students regarding UCB collection and stem cells, the present study demonstrated a marked improvement following the implementation of the educational program. A highly statistically significant difference was observed between pre- and post-intervention knowledge scores ( $p \leq 0.01$ ), indicating the effectiveness of the educational intervention.

Before the educational program, only a small proportion (more than tenth) of the nursing students exhibited a good level of knowledge about UCB collection and stem cells. In contrast, after the program, nearly three quarters achieved a good knowledge level. This notable improvement highlights the crucial role of structured educational programs in enhancing students' understanding. The inadequate baseline knowledge may be attributed to the fact that many students had not yet graduated and had limited exposure to this specialized topic.

These findings are consistent with those reported by **Abdel Salam et al. (2025)**, who assessed the impact of a designed educational program on pregnant women's knowledge and attitudes toward stem cells and cord blood banking. Their results revealed that the majority of participants had insufficient knowledge prior to the intervention, which significantly improved immediately after the program.

Similarly, **Mousa (2024)** found that more than half of maternity nurses at Helwan University had unsatisfactory knowledge levels regarding cord blood banking. Comparable results were reported by **Madhura (2022)** in India, where maternity nurses demonstrated poor knowledge before receiving an educational intervention.

From the researcher's point of view, these results can be explained by the relatively recent introduction of UCB collection and banking as advanced practices in maternity care. In Egypt, nursing curricula often provide limited coverage of this topic. Furthermore, post-graduation nurses may not actively pursue continuous professional development due to heavy workloads and low motivation, which negatively affects their knowledge updating.

The current findings are also in agreement with **Ibrahim et al. (2021)**, who reported that more than three quarters of antenatal mothers achieved satisfactory knowledge scores regarding UC stem cell banking after program implementation, with a statistically significant increase compared to pre-intervention results.

Conversely, these findings contradict those of **Roshdi et al. (2021)**, who found that less than half of their study participants demonstrated good knowledge. This discrepancy may be attributed to differences in educational levels among study samples.

Regarding attendance at training courses related to UCB collection and stem cells, the findings of the current study revealed that more than three-quarters of the nursing students had not attended any training courses in this field, whereas less than one-quarter reported prior attendance. This finding may be attributed to the greater focus of most nursing students on their academic lectures, in addition to the limited participation of students in extracurricular training programs.

These findings are consistent with a study conducted at Benha University, Egypt, by **Elmarakby et al. (2022)**, which examined the effect of an educational program on maternity nurses' knowledge and attitudes toward UCB banking and its barriers. The authors reported that none of the participants had attended specialized scientific courses related to UCB banking. This lack of participation was explained



by reduced motivation among maternity nurses after graduation, as well as increased workload, which negatively affected their efforts to update their knowledge regarding UC-related issues.

Similarly, **Abo-Baker and Masoud (2021)** conducted a study in Egypt entitled “Stem Cell Therapy: Health Care Providers’ Knowledge and Attitude” involving 104 participants, and found that the majority of the studied subjects had not attended training courses related to stem cell therapy. This could be attributed to the limited availability of specialized training programs within educational institutions and professional development settings, in addition to the heavy workload faced by health care providers.

Concerning the sources of nursing students’ background knowledge about UCB and stem cells, the current study demonstrated that nearly half of the students obtained their information from the internet. From the researchers’ point of view, this may be explained by the ease of access and rapid availability of online information.

This finding is supported by a study conducted by **Franklin (2022)** in the Kingdom of Saudi Arabia entitled “Stem Cells: Knowledge and Attitude before and after the Summer Training Program among Nursing Students in Al-Namas”, which reported that social media platforms were the primary source of information for approximately half of the studied nursing students.

The present study also demonstrated a highly statistically significant relationship between nursing students’ total knowledge scores and demographic variables such as age, educational grade, and attendance of training courses, both before and after the intervention ( $p \leq 0.01$ ). This may be explained by younger students’ stronger learning abilities, motivation, and exposure to modern teaching strategies supported by technology.

These findings are consistent with **Chauhan (2021)**, **Esmail et al. (2022)**, and **Armstrong et al. (2018)**, all of whom reported significant associations between knowledge levels and demographic characteristics such as age, education, and experience.

In contrast, **Samuel (2019)** found no such relationship, which may be attributed to consistent educational exposure and individual learning motivation.

### **Conclusion**

Based on the results of the present study, it can be concluded that the implemented educational program was effective in enhancing the overall knowledge of nursing students regarding the innovative approach to UCB collection and stem cells. This improvement was evidenced by a highly statistically significant difference between pre- and post-program implementation. Moreover, a highly statistically significant association was identified between the total knowledge scores of nursing students and certain personal demographic characteristics (Educational grade), particularly the educational grade, both before and after the implementation of the educational program.

### **Recommendations**

Based on the results of the current study, the following recommendations are proposed:

#### **At the educational level:**

- The undergraduate nursing curriculum should be updated to incorporate recent advances and emerging technologies related to UCB collection techniques and stem cells in order to enhance nursing students’ knowledge, attitudes, and practices.
- Educational booklets addressing UCB collection and stem cells should be made available in Obstetrics and Gynaecological laboratories within nursing technical institutes to ensure easy access for all nursing students.

#### **At the practical level:**

- Continuous and periodic nursing training programs and workshops should be organized for both undergraduate and postgraduate nursing students, with emphasis on UCB collection sample techniques and stem cells.

#### **At the research level (Further studies):**

- On-going research and continuous follow-up studies are recommended to assess and improve nursing students’ knowledge, attitudes, practices, and perceptions regarding UCB collection and stem cells.



- Health education programs and mass media strategies should be implemented to raise awareness among nursing students about UCB collection and stem cells, highlighting the advantages of UCB and the benefits of its storage in UCB banks.
- Further studies should explore the extensive utilization of banked stem cells and UCB in the management of chronic diseases and congenital fetal anomalies during intrauterine life.
- Replication of the current study on a larger probability sample across different settings is recommended to enhance the generalizability of the findings.

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