

Menstrual Blood as Stem Cell Potential: The Turkish Example

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ABSTRACT

Aim: This study aimed at determining the opinions of midwifery students studying at several universities in Turkey regarding menstrual blood donation. **Methods:** The population of this cross-sectional study consisted of midwifery students enrolled in undergraduate programs at several universities in Turkey during the 2023–2024 academic year. Of the 15,689 students, 1346 were reached. Data were collected online using a questionnaire developed by the researchers based on a literature review. The questionnaire comprised two sections: a 10-item questioning Descriptive Information Form assessing sociodemographic characteristics and a 21-item form evaluating participants' knowledge of menstrual blood donation. Data were analyzed using number-percentage distributions and the Chi-square test. **Results:** Among the participating midwifery students, 50% perceived menstruation as a positive process. Only 8.2% were aware that menstrual blood contains stem cells, and 1.2% knew that menstrual blood can be donated for stem cell use. Similarly, awareness of menstrual blood banking was low (2.6%). **Conclusion:** Midwifery students in Turkey have limited awareness and knowledge regarding menstrual blood and its stem cell potential. Improving perceptions of menstruation and promoting positive attitudes may enhance knowledge levels and contribute to raising awareness in society.

KEYWORDS: Blood donation, menstruation, midwifery student, stem cell

INTRODUCTION

The menstrual period is a biological reality for women, and its meaning varies across society.^[1,2] Menstrual blood contains living immune cells and endometrial cells, including both stromal and epithelial components.^[3,4] Compared to other sources of stem cells, menstrual blood offers several advantages. It demonstrates higher proliferative capacity than bone marrow and enables the collection of relatively large number of stem cells without damaging the deoxyribonucleic acid. Furthermore, purified mesenchymal stem cells derived from menstrual blood can be used for various therapeutic purposes.

Mesenchymal stem cells are multipotent progenitor cells capable of differentiating into specialized cell types such as osteoblasts, chondrocytes, and adipocytes. These cells can be obtained from various adult tissues, including bone marrow, peripheral blood, adipose tissue, umbilical cord, placenta, and menstrual blood. Notably, menstrual blood represents a highly expandable and accessible source of stem cells, with strong proliferative and

reparative potential compared to umbilical cord blood and bone marrow.^[5]

The concept of menstrual blood stem cell banking was first introduced in 2007 by the American company, Cryo Cell. This practice gained further attention in India in 2011 following public awareness associated with actress Lisa Ray's cancer survival. Today, stem cell transplantation is increasingly used in countries such as the United States, Japan, and across Europe.^[6-8] In India, menstrual blood banking services have expanded, with numerous collection centers and routine use of menstrual cups for sample collection. Typically, approximately 20 mL of menstrual blood is collected using a silicone cup inserted into the vagina for several hours, after which the sample is transferred into a collection kit and sent to a laboratory facility.

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The collection of menstrual blood is relatively easy, noninvasive, and painless. As the stem cells obtained are autologous, the risk of immune rejection is minimal.^[7,9] These cells may also have potential applications for use in other individuals. Menstrual blood is an easily accessible biological material that can be obtained regularly from women of reproductive age without invasive procedures. However, collection is limited to the menstrual period and is not possible in cases such as amenorrhea. Additionally, due to the private nature of menstruation and its association with cultural taboos in some societies, the use and donation of menstrual blood for therapeutic purposes may be restricted.

Although the number of studies on this topic is limited, existing research suggests that women in countries where menstrual blood banking is more common tend to have more positive attitudes. For example, a study conducted in the United Kingdom reported that 78% of women were willing to donate menstrual blood, while a study in India found that 49% of women had knowledge about menstrual blood donation.^[5,10] Increasing awareness of menstrual blood-derived stem cells may help transform negative perceptions of menstruation and support a more positive understanding of this biological process.

Despite being a cost-effective, convenient, and accessible source of stem cells, menstrual blood remains a poorly understood resource, and public knowledge and perceptions vary widely. To date, no study has investigated this issue in Turkey. Therefore, this study was conducted among midwifery students, who receive education on genetics, reproductive physiology, and women's health, and who are in direct contact with women and the community in their professional roles.

This study aimed to determine the opinions of midwifery students studying at universities in Turkey regarding menstrual blood donation.

PATIENTS AND METHODS

Type of the study

This study is a cross-sectional one.

Place and time of the study

The study conducted online-included midwifery students studying at state/foundation universities in Turkey.

The population and sample of the study

The population of the study consisted of 15,689 students enrolled in the midwifery departments in Turkey during the 2023–2024 academic year. A convenience sampling method was used to select the study sample. The minimum required sample size was calculated as 375 students using the sample size calculation formula for a known population in the Epi Info program (power: 95%,

margin of error: 5%, and assumed prevalence: 50%). However, a larger sample of 1346 midwifery students was ultimately included in the study.

Data collection tools

Data were collected online using the questionnaire developed in GoogleForms. A convenience sampling approach was employed, and participation was voluntary. During the data collection period, the questionnaire was distributed to midwifery students across Turkey via social media platforms (Instagram, Facebook, X/Twitter), women's health-related online forums, and WhatsApp groups.

As the survey invitation was disseminated through open-access channels, the exact number of individuals reached could not be determined; therefore, a conventional response rate could not be calculated. However, this strategy enabled access to a large and geographically diverse sample from different regions of Turkey. Only students who were informed about the study and provided digital informed consent were included.

The questionnaire was developed by the researchers based on a review of the relevant literature, and some items were adapted from previously published studies.^[5,10,11] It consisted of two main sections: a 10-item form assessing sociodemographic characteristics and a 21-item form evaluating knowledge, awareness, and attitudes/intentions regarding menstrual blood donation.

The second section was organized into three conceptual domains: (i) knowledge of menstrual blood and stem cells, (ii) awareness of menstrual blood banking and sources of information, and (iii) attitudes and behavioral intentions toward donation.

The questionnaire items were developed through iterative discussions among the research team, all of whom have academic and/or clinical expertise in women's health and midwifery. This process ensured the relevance, clarity, and alignment of the items with the study objectives.

However, no external expert review was conducted, and formal validity and reliability analyses (e.g., construct validity or internal consistency) were not performed. In addition, as the instrument primarily consisted of single-item and categorical measures, traditional internal consistency analyses were not deemed appropriate for all items.

Data collection

Study data were collected between March 2024 and June 2024 using the online data collection method.

Data availability

The datasets generated and/or analyzed during the current study are available from the corresponding

author on reasonable request. All data were deidentified to ensure participant confidentiality.

Ethical issues

We performed the study in accordance with the Declaration of Helsinki and obtained the approval of the Ege University Medical Research Ethics Committee (Decision No: 24-3.1T/50, Decision date: March 21, 2024). After students to be included in the study were informed about the study, they signed the Informed Consent Form indicating that they volunteered to participate in the study and to fill in the data collection form sent to them online.

Ethical approval was obtained for the study, and at the beginning of the online questionnaire, participants were informed about the purpose and scope of the study, and their digital informed consent was obtained. The questionnaire was administered anonymously, and no personally identifiable information was collected from the participants. To prevent duplicate

responses, participants were instructed to complete the questionnaire only once, and feasible technical measures were implemented where possible.

Table 2: Menstrual blood donation-related opinions of the midwifery students participating in the present study (n=1346)

Variables	n	%
What hygiene product do you use during menstruation?		
Disposable sanitary pads	1325	98.4
Reusable washable pads	5	0.4
Menstrual cups	8	0.6
Tampons	3	0.2
Period panties	3	0.2
Others	2	0.1
Have you ever heard that menstrual blood contains stem cells?		
Yes	110	8.2
No	1236	91.8
If your answer is "yes", what is the source of the information? (n=110)		
Courses in school	20	1.5
Internet/social media	22	1.6
Social circle	13	1.0
Do you know that menstrual blood can be donated for stem cells?		
Yes	16	1.2
No	1330	98.8
Do you know which diseases can be treated with stem cells obtained from menstrual blood?		
Yes	34	2.5
No	1061	78.8
I have no idea	251	18.6
Have you ever heard of menstrual blood banking?		
Yes	35	2.6
No	1311	97.4
Would you agree with the idea that a menstrual blood bank should be established?		
Yes	270	20.1
No	273	20.3
Undecided	803	59.7
Do you think that donating menstrual blood is beneficial for society?		
Yes	327	24.3
No	158	11.7
Undecided	861	64.0
Would you donate your menstrual blood?		
Yes	350	26.0
No	398	29.6
Undecided	598	44.4
Would you accept treatment performed with a sample taken from menstrual blood?		
Yes	689	51.2
No	136	10.1
Undecided	521	38.7
Total	1346	100.0

Table 1: Sociodemographic, obstetric, and health-related characteristics of the midwifery students participating in the present study

Sociodemographic characteristics	n	%
Year at school		
1	393	29.2
2	292	21.7
3	363	27.0
4	298	22.1
Place of residence stayed longest		
City	763	56.6
District	406	30.2
Town-Village	177	13.2
Region of residence in Turkey		
Aegean Region	341	25.4
Mediterranean Region	210	15.6
Central Anatolia Region	204	15.2
Marmara Region	193	14.3
Southeast Anatolia Region	181	13.4
Black Sea Region	132	9.8
Eastern Anatolia Region	85	6.3
Religion		
Islam	1284	95.4
Christianity	6	0.4
No religious faith	50	3.7
Others	6	0.4
Having been pregnant		
Yes	35	2.6
No	1311	97.4
Presence of a diagnosed disease		
Yes	363	27.0
No	983	73.0
Total	1346	100.0

Table 3: Comparison of the views of midwifery students participating in the study on menstrual blood donation in terms of some variables

Variables	Willing to donate menstrual blood						χ^{2*}	P
	Yes		No		No idea			
	n	%	n	%	n	%		
Year at school								
1	97	24.7	116	29.5	180	45.8	4.129	0.659
2	67	22.9	89	30.5	136	46.6		
3	98	27.0	109	30.0	156	43.0		
4	88	29.5	84	28.2	126	42.3		
Religion								
Islam	321	25.0	385	30.0	578	45.0	15.414	0.017
Christianity	2	33.3	2	33.3	2	33.3		
No religious faith	24	48.0	10	20.0	16	32.0		
Others	3	50.0	1	16.7	2	33.3		
Presence of a diagnosed disease								
Yes	87	24.0	141	38.8	135	37.2	21.110	0.000
No	263	26.8	257	26.1	463	47.1		
Perceptions of menstruation								
Positive	204	28.7	221	31.0	287	40.3	11.772	0.019
Neither positive nor negative	92	23.2	106	26.7	199	50.1		
Negative	54	22.8	71	30.0	112	47.3		
Hygiene product used during menstruation								
Disposable sanitary pads	347	25.8	387	29.2	596	45.0	20.116	0.028
Reusable washable pads	1	20.0	4	80.0	-	-		
Menstrual cups	5	62.5	3	37.5	-	-		
Tampons	-	-	1	33.3	2	66.7		
Period panties	1	33.3	2	66.7	-	-		
Others	1	50.0	1	50.0	-	-		
Having heard of menstrual blood banking								
Yes	17	48.6	10	28.6	8	22.9	13.540	0.009
No	338	25.1	388	28.8	590	43.8		
Agreeing with the idea that a menstrual blood bank should be established								
Yes	171	63.3	28	10.4	71	26.3	423.952	0.000
No	27	9.9	179	65.6	67	24.5		
Undecided	152	18.9	191	23.8	460	57.3		
Thinking that donating menstrual blood is beneficial for society								
Yes	191	58.4	38	11.6	98	30.0	408.036	0.000
No	14	8.9	122	77.2	22	13.9		
Undecided	145	16.8	238	27.6	478	55.5		
Accepting treatment performed with a sample taken from menstrual blood								
Yes	292	42.4	124	18.0	273	39.6	285.604	0.000
No	12	8.8	93	68.4	31	22.8		
Undecided	46	8.8	181	34.7	294	56.4		

*Chi-square

The planning and writing of the study were conducted in accordance with the principles of scientific publication ethics and the Declaration of Helsinki.

Statistical analysis

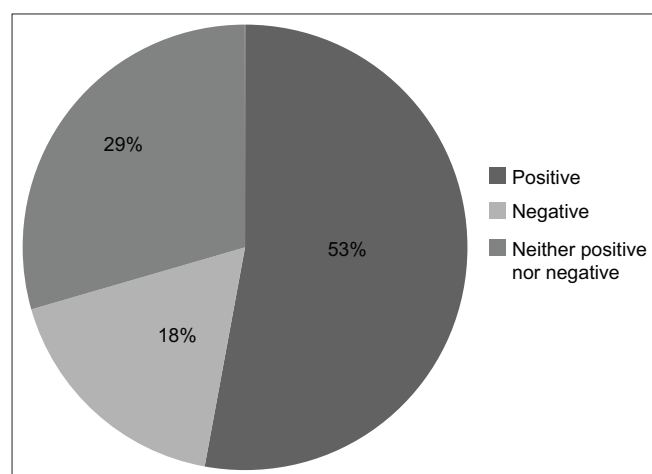
Data were analyzed using the IBM SPSS Statistics version 16.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were presented as frequencies (*n*), percentages (%), means, and standard deviations. The Chi-square test

was used to examine associations between categorical variables. A $P < 0.05$ was considered statistically significant. The final sample size ($n = 1346$) exceeded the minimum required sample ($n = 375$), thereby increasing the statistical power and precision of the estimates. Furthermore, the number of outcome events ($n = 350$) was sufficient for multivariable logistic regression, meeting the recommended events-per-variable criteria.

Table 4: Multivariable logistic regression analysis of factors associated with willingness to donate menstrual blood

Variables	B	OR (Exp (B))	95% CI	P
Region	0.046	1.047	0.968–1.133	0.250
Year of study	0.149	1.161	1.023–1.318	0.021*
Religion	0.494	1.638	1.218–2.204	0.001*
Hygiene product use	0.068	1.070	0.743–1.540	0.716
Menstrual perception	−0.039	0.961	0.797–1.160	0.681
Awareness of menstrual blood banking	−0.349	0.705	0.440–1.130	0.147
Presence of diagnosed disease	0.105	1.110	0.803–1.535	0.527
Perceived benefit for society	−0.805	0.447	0.383–0.522	<0.001*
Acceptance of treatment	−0.956	0.384	0.320–0.461	<0.001*

* $P < 0.05$. OR=Odds ratio; CI=Confidence interval

**Graph 1: Midwifery students' perceptions of menstruation**

RESULTS

In the study, 1346 midwifery students were included. Their mean age was 21.18 ± 2.6 (minimum: 18.0; maximum: 45.0) years.

Sociodemographic, obstetric, and health-related characteristics of the midwifery students participating in the present study are presented in Table 1.

The menstrual blood donation-related opinions of the midwifery students participating in the present study about are presented in Table 2.

Participating midwifery students' opinions regarding menstrual blood donation were analyzed according to selected variables [Table 3]. A statistically significant association was found between the students' perception of menstruation and their willingness to donate menstrual blood' ($P = 0.019$). Among the participants, 28.7% of those with a positive perception menstruation, 23.2% of

those with a neutral perception, and 22.8% of those with a negative perception expressed willingness to donate menstrual blood [Graph 1]. A significant association was also observed between the use of menstrual hygiene products and willingness to donate menstrual blood ($P = 0.028$). In addition, 48.6% of students who had heard about menstrual blood banking and 25.1% of those who had not heard about it reported willingness to donate. Knowledge about menstrual blood banking was significantly associated with increased willingness to donate ($P = 0.009$).

Furthermore, 63.3% of students who supported the establishment of menstrual blood banking and 9.9% of those who did not support it expressed willingness to donate menstrual blood. Supporting the establishment of menstrual blood banking was significantly associated with willingness to donate ($P < 0.001$) [Table 3].

Among the participating midwifery students, 58.4% of those who believed that menstrual blood would be beneficial for the society and 8.9% of those who did not share this belief expressed willingness to donate menstrual blood ($P < 0.001$). This finding indicates that perceiving menstrual blood as beneficial for society significantly associated with increased willingness to donate. Similarly, 42.4% of students who were willing to receive treatment using products derived from menstrual blood, and 8.8% of those who were not willing expressed willingness to donate menstrual blood ($P < 0.001$). Belief in the therapeutic potential of menstrual blood was significantly associated with willingness to donate [Table 3].

The results of the multivariable logistic regression analysis are presented in Table 4. Multivariable logistic regression analysis was performed to identify independent predictors of willingness to donate menstrual blood. The overall model was statistically significant ($\chi^2 = 329.521$, $P < 0.001$) and explained 31.8% of the variance (Nagelkerke $R^2 = 0.318$). The model correctly classified 79.8% of cases. Year of study (odds ratio [OR] = 1.16, 95% confidence interval [CI]: 1.02–1.31, $P = 0.021$) and religious affiliation (OR = 1.63, 95% CI: 1.21–2.20, $P = 0.001$) were significant predictors of willingness to donate. The strongest predictors were perceiving menstrual blood donation as beneficial for society (OR = 0.447, 95% CI: 0.383–0.522, $P < 0.001$) and willingness to accept treatment derived from menstrual blood (OR = 0.384, 95% CI: 0.320–0.461, $P < 0.001$). Other variables, including region, hygiene product use, menstrual perception, prior awareness of menstrual blood banking, and presence of diagnosed disease, were not significantly associated with willingness to donate ($P > 0.05$).

DISCUSSION

Mesenchymal stem cells can be obtained from various adult tissues, including bone marrow, peripheral blood, adipose tissue, umbilical cord, placenta, and menstrual blood. Among these sources, menstrual blood offers several advantages due to its noninvasive accessibility and high properties may contribute to a shift in societal perceptions of menstruation.^[11] In this context, the present study aimed to evaluate the opinions of midwifery students studying at universities in Turkey regarding menstrual blood donation.

Although menstruation is a natural component of women's reproductive health, it has been shaped by various cultural and social perceptions throughout history. Education level and professional knowledge play significant roles in shaping these perceptions.^[12] In this context, students in the health sciences may differ from the general population in their understanding and attitudes toward menstruation. In the present study, approximately half of the participating midwifery students reported positive perceptions of menstruation. Similarly, Aker *et al.* found that nursing students tended to perceive menstruation as a natural phenomenon.^[13] In contrast, Rembeck *et al.* reported that postmenarcheal girls had less positive perceptions of menstruation compared to premenarcheal girls.^[14] Furthermore, Botello-Hermosa *et al.* observed that participants perceived menstruation as a normal process, which was attributed to the inclusion of health sciences students in the sample.^[15] Overall, these findings suggest that the results of the present study are largely consistent with the existing literature.

Various hygiene products are used by women during menstruation. Disposable sanitary pads are most commonly preferred option due to their practicality and ease of access. In recent years, menstrual cups have gained increasing attention because of their potential to reduce environmental impact and to provide long-term economic benefits.^[16] In the present study, almost all participating midwifery students (98.4%) reported using disposable sanitary pads, likely due to their convenience and widespread availability. Similarly, studies by Botello-Hermosa *et al.* and García-Egeave *et al.* have shown that disposable sanitary pads and menstrual cups are most commonly used menstrual product.^[15,17] Despite this high prevalence of disposable product use, interest in reusable menstrual products is increasing, as reflected by the growing number of scientific publications on the subject.^[15] With regard to menstrual blood donation, previous studies have suggested that the use of menstrual cups—or willingness to use them—may be a predictive factor for willingness to donate menstrual blood.^[5] In the

present study, however, the use of menstrual cups and tampons was considerably lower compared to disposable sanitary pads. Although a statistically significant association was observed between hygiene product used and willingness to donate menstrual blood, this finding should be interpreted with caution due to the limited number of participants using alternative menstrual products. Nevertheless, existing evidence indicates that familiarity with menstrual blood collection methods, such as menstrual cups, may positively influence willingness to donate.

Although menstrual blood has considerable potential as a source of stem cells and offers promising opportunities in stem cell therapies and regenerative medicine, limited awareness and knowledge at the societal level may negatively influence donation rates and intentions. In the present study, awareness levels were notably low: only 8.2% of participants knew that menstrual blood contains stem cells, and an even smaller proportion (1.2%) were aware that menstrual blood can be donate for stem cell use. Furthermore, only 1.5% reported receiving information on this topic during their formal education. Previous studies have reported varying levels of knowledge and awareness. In Podder's study, although 65% of nursing students were aware of menstrual blood banks in India, only 14% of them knew that menstrual blood contains stem cells.^[8] Similarly, Jomon *et al.* reported that 13% of women were knowledgeable about this topic, while Manley *et al.* found a rate of 16% among women working at universities.^[10,18] Kaur *et al.* reported that 24% of female healthcare workers in India had knowledge of menstrual blood banking.^[11]

In contrast, other studies have reported substantially higher levels of awareness. For instance, Hans and Kaur found that 93% of nursing students were knowledgeable about menstrual blood banking, and Alqersh *et al.* reported generally good knowledge levels among nursing students.^[6,19] Similarly, studies by Singh *et al.*, and Meena and Manimegalai indicated that nursing students had adequate knowledge on this topic.^[20-22] In comparison, only 2.6% of midwifery students in the present study were aware of menstrual blood banking, suggesting that awareness levels in Turkey are considerably lower than those reported in many other countries.

Faramarzi *et al.* reported that menstrual blood is an easily accessible sources of stem cells and that the stem cells it contains share characteristics with other types of stem cells.^[23] In the present study, only 24.3% of participating midwifery students believed that stem cells derived from menstrual blood would be beneficial for society. In contrast, Kaur *et al.* found that 73% of female healthcare workers considered menstrual

blood-derived stem cells to be beneficial for society.^[11] Similarly, Manley *et al.* reported that a large proportion of participants held positive views regarding the societal benefits of these stem cells.^[10] These findings suggest that midwifery students in Turkey have comparatively lower awareness and less positive perceptions regarding the benefits of menstrual blood-derived stem cells than healthcare professionals in other countries. This gap may indicate that the potential of menstrual blood as a stem cell source is not sufficiently recognized in Turkey. Therefore, there is a need for increased educational initiatives and awareness-raising programs targeting this topic. Consistent with this interpretation, the proportion of midwifery students who had heard of stem cell banking in Turkey was relatively low (43.3%), further supporting the limited level of awareness observed in this study.

Although menstrual blood has great potential for stem cell therapy, awareness and acceptance levels considerably vary from one society to another. In the present study, the rate of the participants who accepted to be treated with stem cells obtained from menstrual blood was 51.2%. In Leng *et al.*'s study conducted with midwives and nurses (2016),^[24] 31% of the participants supported the view that stem cells obtained from menstrual blood could be used in therapies in medicine. In Manley *et al.*'s study conducted with women working at universities (2019),^[10] this rate was quite high (91%). In Kaur *et al.* study (2023),^[11] 56.3% of the participating women displayed a positive attitude towards treatment with stem cells. These results indicate that in Turkey, attitudes displayed towards stem cell therapy by midwifery students differed from attitudes displayed by healthcare professionals in other countries. This difference indicates that health professionals lack sufficient knowledge and awareness about stem cell therapy and the potential use of menstrual blood in stem cell therapy in Turkey. The fact that the rate of the midwifery students participating in the present study who were aware of stem cell banking was very low (2.6%) indicates that their knowledge of menstrual blood banking is rather inadequate, which supports the difference between Turkey and other countries. However, these comparisons should be interpreted cautiously, as differences in cultural context, sampling methods, and measurement tools across studies may influence the findings.

The multivariable analysis revealed that perceived benefit of menstrual blood donation and willingness to accept treatment derived from menstrual blood were the strongest predictors of donation intention. This suggests that attitudes and beliefs may play a more decisive role

than knowledge alone in shaping donation behavior. These findings are consistent with previous studies indicating that positive perceptions and perceived utility are key determinants of health-related behavioral intentions.

The findings of this study should be interpreted with caution due to its cross-sectional design and the use of convenience sampling. These methodological characteristics limit the ability to draw causal inferences and may affect the generalizability of the results. Therefore, the relationships identified in this study should be interpreted as associations rather than causal effects.

One limitation of this study is that the questionnaire used was not subjected to formal validity and reliability analyses. However, due to the absence of a standardized measurement tool addressing menstrual blood donation in the Turkish context, a literature-based questionnaire developed through research team consensus was used in this study. In addition, the fact that the instrument largely consisted of single-item and categorical questions limited the applicability of comprehensive psychometric analyses. Therefore, the findings should be interpreted with caution, and future studies are recommended to focus on developing valid and reliable measurement tools in this area.

CONCLUSION AND RECOMMENDATIONS

Midwifery students represent a professional group that is closely engaged with society and maintains continuous contact with women. Therefore, increasing their awareness of menstrual blood donation and stem cell-related applications is of critical importance in enabling them to provide informed and effective guidance to the community.

The findings of the present study indicate that midwifery students in Turkey, have relatively low levels of awareness and knowledge regarding menstrual blood and its stem cell potential compared to of healthcare professionals in other countries. This may be attributed to the novelty of the topic, insufficient educational coverage, and limited practical information regarding menstrual blood collection and donation procedures. Based on these findings, it is recommended that educational curricula in midwifery programs be enriched with up-to-date content on menstrual blood stem cells and donation processes. In addition, awareness-raising initiatives, workshops, and training programs should be developed to improve both knowledge and attitudes toward this emerging field. Future studies are also recommended to explore this topic in different populations and to evaluate the effectiveness of educational interventions.

These findings may contribute to the development of educational strategies and awareness initiatives aimed at improving knowledge and attitudes toward menstrual blood donation. The dissemination of education and awareness programs will allow the potential of menstrual blood for stem cell therapy to be fully understood and evaluated in Turkey. Within this context, increasing the knowledge and awareness levels of midwifery students in this area will contribute to positive changes in social perceptions and attitudes.

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Conflicts of interest

There are no conflicts of interest.

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