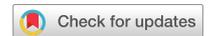




ARTICLE



<https://doi.org/10.1057/s41599-022-01114-7>

OPEN

Changes in high school students' perception of sexual education based on preconception care

Yumiko Tateoka¹ & Fuyuki Itani¹✉

This study examined the effect of sexual education, incorporating preconception care, through a text mining analysis. Between November 2018 and October 2019, we performed a cross-sectional study of 502 high school students in Japan. These two high schools had requested sexual education from midwives associated with Shiga University of Medical Science. The midwives conducted one 60–90-min presentation on sexual education at each school. After the intervention, an anonymous self-administered, paper-based questionnaire survey was administered to the students. Correspondence and cluster analyses were then performed using text mining software. After receiving sexual education taught by midwives, 50.1% of respondents answered that their sexual awareness and thoughts had 'changed' or 'changed somewhat'. It became clear that students who felt that they had changed after taking sexual education also felt that it was important to think seriously about various things such as dating violence, sex, and life. On the other hand, among the students who answered that they did not experience any change in their sexual awareness and thinking, it became clear that this was owing to the content of the sexual education received at junior high school being similar to the current content ($p < 0.05$). The results of the correspondence and cluster analyses indicate that sexual education that includes instruction on preconception care can help raise students' awareness, helping avoid unexpected pregnancies, and could possibly contribute to better reproductive health for both men and women ($p < 0.05$). The findings suggest that teaching preconception care is an important midwifery activity that will help improve the health of the next generation, including supporting the World Health Organization's major goals of reducing perinatal and infant mortality rates.

¹Department of Clinical Nursing Course (Maternity and Midwifery), Shiga University of Medical Science, Otsu, Japan. ✉email: fuyukiy@belle.shiga-med.ac.jp

Introduction

Problems associated with sex during adolescence include teenage pregnancy, unexpected pregnancies, sexually transmitted infections (STIs), abortions, dating violence, weight loss, smoking, and substance abuse (United Nations Educational, Scientific and Cultural Organization, 2018). According to a report by Japan's Ministry of Health, Labour and Welfare (2019), in 2018, 37 children were born to mothers younger than 15, and 8741 children were born to mothers aged between 15 and 19 years. In addition, 161,741 abortions were carried out in 2018, of which 13,588 were performed on girls below the age of 20, for an abortion rate of 4.7 (per 1000 girls of the same age; Ministry of Health, Labour and Welfare, 2018). Each year, the abortion rate remains stagnant. One of the factors behind this trend is sexual violence inflicted by spouses or other close relatives that results in pregnancies. According to a survey by the Gender Equality Bureau Cabinet Office (2017), 21.4% of women and 11.5% of men experienced violence inflicted by their dating partners.

According to data from the 2019 National Institute of Infectious Diseases (NIID, 2019), the number of people infected with STIs in Japan has remained unchanged since 2000, at 27,221 for chlamydia, 6263 for condyloma acuminata, and 9413 for genital herpes. In addition, the number of people infected with syphilis increased sharply from 124 in 2010 to 6642 in 2017 (NIID, 2019). Therefore, the number of people with STIs has not decreased.

Huynh et al. (2020) reported that 46.2% of women in Koshu, Japan, experience unplanned pregnancies and that maternal age, current smoking, a history of three or more pregnancies, and current depressive status are associated with unplanned pregnancies. These results suggest that greater efforts are needed to enhance sexual education among young people and provide comprehensive health care for high-risk women to help reduce unplanned pregnancies (Huynh et al., 2020). For these reasons, it is important to examine and improve the content of adolescent sexual education in Japan.

Sexual education comprises not only education related to reproductive health rights but also preconception care, a concept that has become prevalent since its emergence. Preconception care was formally recommended by the Centers for Disease Control and Prevention (CDC) in 2006 (CDC, 2019) and by the World Health Organization (WHO) in 2013. Preconception care refers to the health care provided to women and couples for future pregnancies. The objective of preconception care is to improve the health of young men and women so that they can have a better quality of life and be healthy in the future. The goal is also to increase the chances of healthier pregnancies and childbirth to improve the health of the next generation of children (Johnson et al., 2006; WHO, 2013; CDC, 2019). For this reason, preconception care is not only targeted at women who are thinking of conceiving in the future along with their partners, but also at men and women who do not wish to conceive (Johnson et al., 2006; WHO, 2013; CDC, 2019). Therefore, the purpose of this study was to have midwives provide high school students with sexual education that incorporates the concept of preconception care so as to allow us to conduct a text mining analysis to determine how sexual education affects students' need for information about preconception care and pregnancy. The analysis also examined their attitudes and behavioral changes regarding independent decision-making.

Methods

Participants and study period. The participants were 502 first-year students who attended two high schools in Shiga prefecture. These two high schools had requested sexual education from

midwives associated with Shiga University of Medical Science. The survey period was from November 2018 to October 2019 because the class periods differed depending on the school.

Design. This study employed a cross-sectional design.

Sexual education and research method. Midwives conducted one 60–90-min presentation on sexual education at each school. Subsequently, an anonymous questionnaire survey was conducted (Supplementary Data). The session covered weight loss, smoking, dating violence, teenage pregnancy, unexpected pregnancy, STIs, human immunodeficiency virus, substance abuse, menstruation, morals, and ethics regarding sex and the opposite gender. The contents of the questionnaire were as follows: gender, experience of receiving sexual education, dating experience vis-à-vis the opposite gender, and whether their consciousness and thoughts about sex changed (Supplementary Data). The questions were set on a five-point Likert scale. The open-ended portion of the survey asked students to freely explain what they felt and thought about after receiving sexual education in four categories: life plan, self-actualization, relationship of trust, and preconception care (self-care). Further, they were asked to freely describe their thoughts and feelings regarding sex on the whole.

Statistical analysis. Descriptive statistics were calculated for the participants' characteristics. In addition, the freely written text data were analyzed using the text mining software Word Miner[®] to perform cluster analysis and correspondence analysis. The cluster analysis in this study was accomplished using Ward's method, which is one of the cohesive hierarchical classification methods, and the κ -averaging method, which is one of the divided classification methods of the hierarchical classification method. To improve reliability, cluster names, which were represented by component variables that had been categorized into clusters and were found at a significantly high frequency in each cluster, were examined by a researcher with a doctorate in nursing and a researcher who is well versed in sexual education. Following the text mining analysis, the text data were processed by separating the words with spaces; extracting components; removing meaningless components such as symbols, prepositions, punctuation marks, and directives; unifying synonyms; removing repetitions; and creating the components to be analyzed. Afterwards, a cluster analysis was performed with these components, and the components that appeared at a significantly high frequency in each cluster were denoted by quotes, while the cluster names that were derived from these components were denoted by square brackets. A correspondence analysis was conducted on the changes in attitudes and thoughts regarding sex post-sexual education and the reasons for those changes. The significance level for the correspondence analysis was set at 5%.

Text mining refers to the extraction of information from text and performing quantitative analyses on text with qualitative characteristics (Ito, 2013). Although text mining involves the analysis of qualitative data, the analysis method used is quantitative. Hence, text mining incorporates the characteristics of both qualitative and quantitative methods, which allows for text to be analyzed in combination with other qualitative and quantitative studies (mixed method; Ito, 2013). A correspondence analysis is also referred to as a principal component analysis for qualitative data, and it is used to analyze each component of qualitative data. A cluster analysis, on the contrary, is a means of classifying data hierarchically.

Ethical considerations. This study was approved by the nursing research subcommittee of the concerned institution. In addition to explaining the purpose of the study, teachers were asked to clarify that participation was voluntary, that school performance would not be negatively affected by non-cooperation, and that the data would be anonymized and used only for the purpose of this study. The survey was then distributed to the participants along with a note explaining the study. Submitting a completed questionnaire was considered indicative of providing informed consent.

Results

Sample characteristics. Survey responses were collected from 492 (98.0%) participants, and valid responses were received from 417 (83.3%). Hence, 417 responses were included in the analysis.

The demographic characteristics of the participants are shown in Table 1; 211 (50.6%) were men, 204 (48.9%) were women, and two (0.5%) identified as neither. Regarding dating experience, 165 (39.6%) had some and 251 (60.2%) had none. As for their history of sexual education, 206 (49.4%) had received it in elementary school, 206 (49.4%) had not received it in elementary school, and three (0.7%) had forgotten whether they had received it in elementary school. Three hundred and sixty (86.3%) had received sexual education in junior high school, while 56 (13.4%) had not.

Changes in attitudes and thoughts after receiving sexual education

Sex. After receiving sexual education, 209 (50.1%) participants answered that their attitudes and thoughts on sex had either ‘changed’ or had ‘changed somewhat’; 91 (21.8%) answered that they could not say whether they had changed, and 117 (28.1%) answered that they had ‘not changed’ or had ‘not changed much’.

The results of the correspondence analysis are shown in Table 2. For students whose attitudes and thoughts had ‘not changed’, the components that appeared at a significantly frequent rate ($p < 0.05$) were ‘middle school’, ‘class’, ‘originally’, ‘received’, ‘unchanged’, ‘generally’, and ‘freedom’. For students whose attitudes and thoughts had ‘not changed much’, frequent components were ‘middle school’, ‘content’, ‘heard’, ‘similar’, and ‘few’. For students who ‘cannot say whether their attitude and thoughts had changed’, frequent components included ‘don’t know’, ‘learned’, ‘middle school’, and ‘originally’. For students whose attitudes and thoughts had ‘changed somewhat’, these components were ‘dating violence’, ‘could’, ‘various’, and ‘important’. Finally, for students whose attitudes and thoughts had ‘changed’, the components were ‘sex’, ‘life’, ‘oneself’, and ‘serious’.

In addition, 4246 components were extracted, of which 145 appeared at least twice, making them the subject of the analysis. The components that appeared frequently were ‘know’, ‘think’, ‘sex’, ‘myself’, ‘middle school’, ‘originally’, ‘understood’, ‘important’, ‘learn’, and ‘partner’.

When these components were categorized, six clusters were formed (Table 3). Cluster 1, named [understanding of sex and partners], comprised the components ‘think’, ‘myself’, ‘sex’, ‘partner’, ‘person’, ‘various’, ‘important’, and ‘know’. Cluster 2, named [fertility], comprised the components ‘can’, ‘baby’, and ‘low.’ Cluster 3, named [universality of the content of sexual education], comprised the components ‘middle school’, ‘content’, ‘learned’, ‘class’, ‘unchanged’, ‘received’, ‘similar’, ‘most’, ‘before’, ‘same’, ‘heard’, ‘health preservation’, ‘learn’, and ‘lecture’. Cluster 4, named [gender], comprised the components ‘obvious’, ‘gender’, ‘prejudice’, ‘different’, and ‘society’. Cluster 5, named [the miracle of pregnancy], comprised the components ‘ovum’ and ‘low’. Lastly, cluster 6, named [fear], comprised the component ‘scary’.

Life planning. In this category, 3891 components were extracted, of which 118 appeared at least twice, making them the subject of the analysis. The components that appeared frequently were ‘think’, ‘myself’, ‘future’, ‘establish’, ‘important’, ‘properly’, ‘life’, and ‘now’.

In addition, when these components were categorized, eight clusters were formed (Table 4). Cluster 1, named [vision of the future], comprised the components ‘future’ and ‘think’. Cluster 2, named [close relation to sex], comprised the components ‘did not think’, ‘sex’, and ‘familiar’. Cluster 3, named [ruin], comprised the components ‘one’ and ‘fall apart’. Cluster 4, named [healthy life that can also be valued by one’s partner], comprised the components ‘essential’, ‘best’, ‘healthy’, ‘agree’, ‘life’, and ‘partner’. Cluster 5, named [the risk of sexual intercourse], comprised the components ‘pregnancy’, ‘sexual intercourse’, ‘erect’, ‘danger’, ‘talk’, and ‘thought’. Cluster 6, named [step], comprised the component ‘want to go’. Cluster 7, named [create], comprised the components ‘generally’ and ‘make’. Lastly, cluster 8, named [becoming an adult myself], comprised the component ‘adult’.

A correspondence analysis of changes in consciousness and thinking about gender and life plan was conducted. As a result, the components of ‘life’, ‘partner’, ‘waiting’ for men, ‘childbirth’ for women, and ‘protecting’ and ‘person’ for those who are non-binary people appeared significantly frequently.

Self-actualization. In this category, 2422 components were extracted, of which 87 appeared at least twice, making them the subject of the analysis. The components that appeared frequently were ‘myself’, ‘think’, ‘self-actualization’, ‘important’, ‘properly’, ‘partner’, ‘have’, and ‘crucial’.

In addition, when these components were categorized, six clusters were formed (Table 5). Cluster 1, named [unimaginable], comprised the component ‘none’. Cluster 2, named [life], comprised the component ‘live’. Cluster 3, named [relations], comprised the components ‘people’, ‘associate’, and ‘sex’. Cluster 4, named [step towards the future], comprised the components ‘go forward’, ‘path’, and ‘study’. Cluster 5, named [unrealistic], comprised the components ‘can’t’, ‘come to mind’, and ‘ideal’. Lastly, cluster 6, named [consideration], comprised the component ‘think’.

Mutually trusting relationships with friends and the opposite gender. In this category, 3835 components were extracted, of which 124 appeared at least twice, making them the subject of the analysis. The components that appeared frequently were ‘important’, ‘partner’, ‘think’, ‘myself’, ‘relationship’, ‘friend’, ‘opposite gender’, ‘person’, ‘mutually trusting relationship’, ‘each other’, and ‘feeling’.

Table 1 Participant characteristics (N = 502).

Characteristics	n (%)
<i>Gender</i>	
Men	211 (50.6)
Women	204 (48.9)
Neither	2 (0.5)
<i>History of sexual education in elementary school</i>	
Yes	206 (49.4)
No	206 (49.4)
I don't know	3 (0.7)
<i>History of sexual education in junior school</i>	
Yes	360 (86.3)
No	56 (13.4)
<i>Dating experience</i>	
Yes	165 (39.6)
No	251 (60.2)

Table 2 Correspondence analysis results on the changes in attitudes and thoughts concerning sex and the related reasons ($p < 0.05$)^a.

	No change	Not much change	Cannot say either way	Somewhat changed	Changed
Number of samples ^b	47	49	60	146	31
Number of different components ^c	52	78	75	124	61
Top 1	Middle school	Middle school	Don't know	Dating violence	Sex
Top 2	Class	Content	Learned	Could	Life
Top 3	Originally	Heard	Middle school	Various	Oneself
Top 4	Received	Similar	Originally	Important	Serious
Top 5	Unchanged	Few			
Top 6	Generally				
Top 7	Freedom				

Words that occurred significantly more frequently are listed in descending order.
^aThe significance level was set at 5%.
^bNumber of explanations given for reasons for changes in attitudes and thoughts on sex.
^cNumber of the same components that were counted as 1.

Table 3 Categories of changes in attitudes and thoughts concerning sex.

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
Cluster name	Understanding of sex and partners	Fertility	Universality of the content of sexual education	Gender	The miracle of pregnancy	Fear
Top 1	Think	Can	Middle school	Obvious	Ovum	Scary
Top 2	Myself	Baby	Content	Gender	Low	
Top 3	Sex	Low	Learned	Prejudice		
Top 4	Partner		Class	Different		
Top 5	Person		Unchanged	Society		
Top 6	Various		Received			
Top 7	Important		Similar			
Top 8	Know		Most			
Top 9			Before			
Top 10			Same			
Top 11			Heard			
Top 12			Health preservation			
Top 13			Learn			
Top 14			Lecture			

As a result of cluster analysis with the significance level set at 5%, we obtained six clusters; the above table shows all significant differences in each cluster in descending order. The clusters were named by the author and collaborators because of the components with high significant differences.

Table 4 Categories of changes in attitudes and thoughts on life planning.

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Cluster 7	Cluster 8
Cluster name	Vision of the future	Close relation to sex	Ruin	Healthy life that can also be valued by one's partner	The risk of sexual intercourse	Step	Create	Adult
Top 1	Future	Did not think	One	Essential	Pregnancy	Want to go	Generally	Adult
Top 2	Think	Sex	Fall apart	Best	Sexual intercourse		Make	
Top 3		Familiar	Healthy	Healthy	Erect			
Top 4			Agree	Agree	Danger			
Top 5			Life	Life	Talk			
Top 6			Partner	Partner	Thought			

As a result of cluster analysis with the significance level set at 5%, we obtained eight clusters; the above table shows all significant differences in each cluster in descending order. The clusters were named by the author and collaborators because of the components with high significant differences.

When these components were categorized, many of them fell into a single cluster, and none of them appeared at a significantly high frequency. Therefore, clusters were not established, and no names were given.

Preconception self-care. In this category, 2495 components were extracted, of which 92 appeared at least twice, making them the subject of the analysis. The components that appeared frequently were 'important', 'myself', 'properly', 'crucial', 'know', 'think', 'children', 'pregnancy', 'care', and 'self-care'.

In addition, when these components were categorized, eight clusters were formed (Table 6). Cluster 1, named [valuing myself], comprised the components 'important' and 'myself'. Cluster 2, named [understanding], comprised the components 'didn't know', 'understood', 'glad', and 'meaning'. Cluster 3, named [luxury grocery items], comprised the components 'cigarettes', 'drugs', and 'drinking alcohol'. Cluster 4, named [difficulties of women], comprised the components 'difficulties' and 'women'. Cluster 5, named [understanding the menstrual cycle], comprised the components 'app', 'insert', and 'menstrual cycle'. Cluster 6,

Table 5 Categories of changes in attitudes and thoughts on self-actualization.

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
Cluster name	Unimaginable	Life	Relations	Step towards the future	Unrealistic	Consideration
Top 1	None	Live	People	Go forward	Can't	Think
Top 2			Associate	Path	Come to mind	
Top 3			Sex	Study	Ideal	

As a result of cluster analysis with the significance level set at 5%, we obtained six clusters; the above table shows all significant difference in each cluster in descending order. The clusters were named by the author and collaborators because of the components with high significant differences.

Table 6 Categories of changes in attitudes and thoughts on preconception self-care.

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Cluster 7	Cluster 8
Cluster name	Valuing myself	Understanding	Luxury grocery items	Difficulties of women	Understanding the menstrual cycle	Method	Stress	Contraceptive method
Top 1	Important	Didn't know	Cigarettes	Difficulties	App	Method	Stress	Condom
Top 2	Myself	Understood	Drugs	Women	Insert			Wear
Top 3		Glad	Drinking alcohol		Menstrual cycle			
Top 4		Meaning						

As a result of cluster analysis with the significance level set at 5%, we obtained eight clusters; the above table shows all significant differences in each cluster in descending order. The clusters were named by the author and collaborators because of the components with high significant differences.

named [method], comprised the component 'method'. Cluster 7, named [stress], comprised the component 'stress'. Lastly, cluster 8, named [contraceptive method], comprised the components 'condom' and 'wear'.

Discussion

Changes in attitudes and thoughts regarding sex. In this study, about half of the students experienced changes in their sexual awareness and thoughts. In this regard, the cluster analysis showed that students were able to think about sexuality, understanding the other person, the miracle of pregnancy, and gender. Based on the concept of preconception care, the content of the sexual education was related not only to the impact on one's own body but also to the fact that the pregnancy would give rise to the next generation and impact one's life plan, encouraging thoughts about self-determination from adolescence to the future. As a result, high school students appeared to have changed their consciousness not only about sexual activity between men and women, the physical and psychological danger of abortion to women, and sexual ethics, but also about building relationships with others based on mutual respect. In previous studies, it was reported that those who received sexual education had higher knowledge about sex and a higher rate of contraceptive use (Li et al., 2017). It is speculated that sexual education changes sexual awareness and thinking, leading to the development of knowledge about sexuality and reproduction and the transformation of contraceptive behavior (Li et al., 2017). From the above, the present study is consistent with earlier research.

Twenty-eight percent of the participants did not experience any change. The results of the correspondence analysis suggest that as the content of the sexual education received in junior high school and the content of this sexual education intervention overlapped, their thoughts turned to what they had already understood.

A white paper from the 8th National Survey Report on Youth Sexual Behavior found that more than half of the students cited 'differences in mind between men and women' and 'gender equality' as the content of sex education in junior high school

(Nishioka, 2018). This was followed by 'love', 'contraceptive methods', and 'sexual intercourse' (Nishioka, 2018). At the age in question, students have not yet come to understand the necessity of consent during sexual activity, which was the focus of the content in this study, and the importance of building a relationship of trust that does not lead to dating violence. Therefore, it is probable that students' understanding was limited to the same topics as those covered in junior high school, such as contraception and abortion. In the future, it is necessary to incorporate the concept of preconception care in sexual education for junior high school students.

Changes in attitudes and thoughts on life planning. In this study, it became clear that the students were able to think about themselves, their future, and their life; this was considered important for future plans. The study revealed that students can find it important to think about their future life plans. An awareness survey on life plans revealed that among unmarried women, life plan holders had significantly higher average reproductive knowledge, and life plan thinking also led to interest in reproduction (Japan Family Planning Association, 2019). It has been reported that having a future outlook with a vision for higher education and employment may contribute to delayed sexual activity (Japan Family Planning Association, 2019). In addition, a systematic review reported that comprehensive interventions that incorporated preconception care reduced first-time pregnancies by 15% and recurrent pregnancies by 37% (Hirose et al., 2009). Based on the cluster analysis results, having a life plan appears to be a consideration when thinking about closeness to sex and the risk of sexual activity. Further, it is important to convey the importance of creating a life plan in relation to sex.

In addition, in the 7th Survey Report on the Life and Awareness of Men and Women, 78.9% of female and 71.5% of male participants answered that they wanted children, which was significantly higher than males. From the results of this study, it became clear that females are more positive about childbirth in their life plans.

Changes in attitudes and thoughts on self-actualization. Self-actualization is positioned at the top of Maslow's hierarchy of needs and is defined as a desire for growth (Dean et al., 2014b). In the first year of high school, basic needs are satisfied, and it is time to start thinking about the future, such as going on to university and getting a job, and to be greatly involved in self-actualization. In sexual education conducted at this stage, realizing the necessity of thinking about self-actualization together with a life plan will be an opportunity for students to look at themselves and to consider what kind of adults they want to be. It can be said that they are able to feel the importance of imagining their own future image and working towards that dream. From the results of the cluster analysis, it became clear that some participants were thinking about relationships and life, including the future, whereas others were not. Previous research has reported that while self-actualization education has the effect of increasing 'self-usefulness' and 'feelings for social self-actualization', it increases anxiety in terms of awareness of choosing a course (Shirai, 2007). Some people feel more strongly about self-usefulness and social self-actualization, while others become anxious and unable to think about self-actualization. The results suggest that it is necessary to consider how the content and methods could be more generalized in consideration of varying developmental tasks, the growth environment, and personality.

Changes in attitudes and thoughts on mutually trusting relationships. It has been reported that many women in Japan 'cannot speak about contraception', and that contraception is mainly practiced by men (Yoshizawa, 2019). Additionally, gender awareness plays a major role in the root of problems associated with sex, such as pregnancy, contraception, and STIs. Yoshizawa also notes that, 'It is important to understand what kind of attitudes and behaviors constitute dating violence, and to learn how to create an equal relationship where you respect your partner' (2019, p. 305). Hence, solving problems associated with sex requires building a mutually trusting relationship. In addition, there are reports that teaching healthy relationships as part of required health education reduces physical dating violence (Wolfe et al., 2009). In this study, the students were taught that building a relationship with their partner affects the onset of problems associated with sex, which allowed them to once again recognize the importance of thinking about each other's feelings and valuing themselves and their partner.

Furthermore, providing sexual education that incorporates the topic of relationships, including dating violence, which is something familiar to high school students, appears to affect how they view the importance of having and building mutually trusting relationships with friends and the opposite gender.

In addition, incorporating the topic of sexual minorities into sexual education helped the students comprehend and develop an interest in these groups, and it deepened their understanding of the importance of respecting their partner, without simply binding them to the idea of homosexuality or heterosexuality.

Changes in attitudes and thoughts on preconception self-care. Studies on domestic 'pre-pregnancy management' have affirmed its importance (Nagusa, 2019). Previous studies have also reported that pre-pregnancy self-care is important because pre-pregnancy issues, such as smoking, alcohol, being overweight or underweight, poor nutrition, and STIs, affect pregnancy, delivery, puerperium, and new-borns (Dean et al., 2014a; Lassi et al., 2014a, 2014b). As a result of the cluster analysis, it became clear that the students understood the significance of their physical health and the difficulties faced by women, as they were thinking about luxury grocery items such

as cigarettes, drugs, and alcohol as well as the menstrual cycle, stress, and contraceptive methods that were discussed in the lecture on fertility. Changes in consciousness and thoughts were seen for each item of self-care, suggesting that the students understood the importance of self-care before pregnancy after being informed that the choices they made in adolescence would affect future pregnancy.

Limitations

One limitation of this study is that we were unable to conduct a survey before the sexual education intervention. As a result, the effect of the intervention could not be verified through a before-and-after comparison. In addition, we did not track long-term changes or actual behaviors.

In the future, it will be necessary to conduct a survey using the same questionnaire before and after the intervention, and to investigate behavior and outcomes, such as pregnancy and STIs, in the long term to clarify the effect of the intervention.

Conclusion

Based on the concept of preconception care, we conducted a sexual education intervention with a focus on the impact that pregnancy will have on the next generation and the importance of self-determination and one's life plan right from adolescence. As a result, not only did knowledge about sexuality take root but awareness of building relationships based on mutual respect grew. In addition, students were able to understand the importance of self-care before pregnancy and realized the importance of having a life plan and imagining the future. These lessons are expected to lead to a reduction in the damage caused by sexual violence and improvements in students' latent consciousness regarding issues such as avoidance of unexpected pregnancy. The findings suggest that such an approach could contribute to better reproductive health in Japan among both women and men. Furthermore, the results indicate that this sort of intervention is an important midwifery activity that can help improve the health of the next generation, including helping reach the WHO's preconception care goals of reducing perinatal and infant mortality rates. In future, it is necessary to carry out quantitative and mixed methods research to further develop the literature on health education in adolescence.

Data availability

The datasets generated during and/or analyzed during the current study are not publicly available due to part of the result and a huge amount of data but are available from the corresponding author on reasonable request.

Received: 12 July 2021; Accepted: 28 February 2022;

Published online: 04 April 2022

References

- Centers for Disease Control and Prevention (2019). Before pregnancy: overview. <https://www.cdc.gov/preconception/index.html>. Accessed 24 Dec 2019.
- Dean SV, Lassi ZS, Imam AM, Bhutta Z, A (2014a) Preconception care: nutritional risks and interventions. *Reprod Health* 11:S3. <https://doi.org/10.1186/1742-4755-11-s3-s3>
- Dean SV, Lassi ZS, Imam AM, Bhutta Z, A (2014b) Preconception care: promoting reproductive planning. *Reprod Health* 11:S2. <https://doi.org/10.1186/1742-4755-11-s3-s2>
- Gender Equality Bureau Cabinet Office (2017) Results of the number of consultations made regarding spousal violence at spousal violence counselling and support centres (for 2016): data on spousal violence in 2017 [in Japanese]. http://www.gender.go.jp/policy/no_violence/e-vaw/data/pdf/2017soudan.pdf. <https://doi.org/10.1016/b978-0-12-803533-7.00002-8>. Accessed 11 Oct 2020.

- Hirose K, Michiko H, Keiko (2009) Abraham Maslow's hierarchy of needs pyramid: a reexamination from the perspective of his original work. *Bull St. Luke's College Nurs* 35:28–36. <https://doi.org/10.1186/s12884-020-03088-3>
- Huynh S, Trung, Yokomichi H, Akiyama Y, Kojima R, Horiguchi S, Ooka T, Shinohara R, Yamagata Z (2020) Prevalence of and factors associated with unplanned pregnancy among women in Koshu, Japan: cross-sectional evidence from Project Koshu, 2011–2016. *BMC Pregnancy Childbirth* 10(1):1–10. <https://doi.org/10.1186/s12884-020-03088-3>
- Ito T (2013) Text mining as a tool for nursing studies [in Japanese]. *Jpn J Nurs Res* 46(5):475–484
- Japan Family Planning Association (2019) The sexuality of young people. White paper from the 8th National Investigation Report on the sexual behaviour of youths. Shogakukan, Tokyo, pp. 91–94
- Johnson K, Posner SF, Biermann J, Cordero JF, Atrash AK, Parker CS, Boulet S, Curtis MG (2006) Recommendations to improve preconception health and health care—United States: a report of the CDC/ATSDR Preconception Care Work Group and the Select Panel on Preconception Care. *Morb Mortal Wkly Rep* 55(6):1–13. <https://doi.org/10.1037/e506902006-001>. CE-1–CE-4
- Lassi ZS, Imam AM, Dean SV, Bhutta ZA (2014a) Preconception care: caffeine, smoking, alcohol, drugs and other environmental chemical/radiation exposure. *Reprod Health* 11:S6. <https://doi.org/10.1186/1742-4755-11-s3-s6>
- Lassi ZS, Imam AM, Dean SV, Bhutta ZA (2014b) Preconception care: preventing and treating infections. *Reprod Health* 11:S4. <https://doi.org/10.1186/1742-4755-11-s3-s4>
- Li C, Cheng Z, Wu T, Liang X, Gaoshan J, Li L, Hong P, Tang K (2017) The relationships of school-based sexuality education, sexual knowledge and sexual behaviors—a study of 18,000 Chinese college students. *Reprod Health* 14(1):103. <https://doi.org/10.1186/s12978-017-0368-4>
- Ministry of Health, Labour and Welfare (2019) Number of births according to the mothers' age (5-year age groups) and birth order: overview of demographic statistics (fixed values) in 2018 [in Japanese]. https://www.mhlw.go.jp/toukei/saikin/hw/jinkou/kakutei18/dl/08_h4.pdf. Accessed 24 Dec 2019.
- Ministry of Health, Labour and Welfare (2018) Effects of protecting a mother's body: Overview of the 2018 health administration report [in Japanese]. https://www.mhlw.go.jp/toukei/saikin/hw/eisei_houkoku/18/dl/kekka6.pdf. Accessed 24 Dec 2019
- Nagusa M (2019) Review of literature on the preconception care of mature women [in Japanese]. *Jpn Soc Hum Care Res* 10(1):9–17
- National Institute of Infectious Diseases (2019) Annual report of infectious disease outbreak trend survey [in Japanese]. <https://www.niid.go.jp/niid/ja/allarticles/surveillance/2270-idwr/nenpo/10115-idwr-nenpo2019.html?tmpl=component>. Accessed 2 Feb 2021.
- Nishioka E (2018) Trends in research on adolescent sexuality education, fertility awareness, and the possibility of life planning based on reproductive health education. *Jpn J Hyg* 73(2):185–199. <https://doi.org/10.1001/archpediatrics.2009.69>
- Shirai M (2007) Jikojitsugenkyōiku no fu no kōka [Negative effects of self-actualisation education]. In Benesse Center for Education, Research and Development: Benesse Educational Research and Development Institute's survey report on the life, behaviour, and attitudes of metropolitan high school students. Benesse Corporation, Tokyo
- United Nations Educational, Scientific and Cultural Organization (2018) Children's and young people's sexual and reproductive health needs. Chap. 3.1 in International technical guidance on sexuality education. An evidence-informed approach, revised edn. https://www.unaids.org/sites/default/files/media_asset/ITGSE_en.pdf. Accessed 2 Feb 2021.
- World Health Organization (2013) Policy brief: Preconception care: maximizing the gains for maternal and child health. https://www.who.int/maternal_child_adolescent/documents/preconception_care_policy_brief.pdf. Accessed 24 Dec 2019.
- Wolfe DA, Crooks C, Jaffe P, Chiodo D, Hughes R, Ellis W, Stitt L, Donner A (2009) A school-based program to prevent adolescent dating violence. *Arch Pediatr Adolesc Med* 163(8):692–699. <https://doi.org/10.1001/archpediatrics.2009.69>
- Yoshizawa T ed. (2019) Textbook on the basics of midwifery: introduction to midwifery, vol 2 [in Japanese]. Japanese Nursing Association, Tokyo

Acknowledgements

We would like to express our deep gratitude to the high school directors and teachers for their understanding of sex education in this study and for their cooperation in sexual education and the implementation of the questionnaire in this study. We would also like to express our deep gratitude to all the high school students who cooperated in filling out and submitting the questionnaire.

Competing interests

The authors declare no competing interests.

Ethical approval

The questionnaire and methodology for this study was approved by the nursing research subcommittee of Shiga University of Medical Science (Approval number: K30-018, Approval date: 7 November 2018). We confirm that all research was performed in accordance with the relevant guidelines and regulations.

Informed consent

The survey was distributed to the participants along with a note explaining the study. Submitting a completed questionnaire was considered indicative of providing informed consent.

Additional information

Supplementary information The online version contains supplementary material available at <https://doi.org/10.1057/s41599-022-01114-7>.

Correspondence and requests for materials should be addressed to Fuyuki Itani.

Reprints and permission information is available at <http://www.nature.com/reprints>

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this license, visit <http://creativecommons.org/licenses/by/4.0/>.

© The Author(s) 2022