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ORIGINAL RESEARCH

Using warm compresses to reduce IL-1β levels in dysmenorrhea: An evaluation of a quasi-experimental study

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Abstract

Primary dysmenorrhea is a gynecological problem that occurs among adolescents and women of reproductive age. Theoretically, primary dysmenorrhea increases pro-inflammatory cytokine IL-1β levels. However, studies using warm compresses to reduce pain management in dysmenorrhea are limited. This study aimed to determine the effect of warm compresses to reduce IL-1β levels in primary dysmenorrhea. The research design used a quasi-experiment with a pretest-posttest study design. The population of this study was students experiencing dysmenorrhea. A total of 24 respondents was taken by using a simple random sampling technique. Hot water bags were the equipment for this study. The instrument for measuring pain used NRS (Numeric Rating Scale), and IL-1 β levels used the ELISA method. The data were analyzed by the Wilcoxon test and Mann-Whitney Test. The study showed there was a positive effect of warm compresses on dysmenorrhea ($p \leq 0.05$). There were significant differences in the intensity of menstrual pain and IL-1β levels among the two groups of study ($p \leq 0.05$). The recommendation for the next research should be focused on the different types of pain that commonly occur among women.

Keywords: dysmenorrhea; pain management; pediatric nursing; nursing care; warm compresses

Introduction

Primary dysmenorrhea is also one of the gynecological problems that occurred among adolescents and women of reproductive age. Primary dysmenorrhea starts a few hours before or shortly after menstruation begins with pain and cramps for the first 2 days of menstruation (Harel, 2008). Primary dysmenorrhea generally occurs among adolescents in 6-12 months after menarche. The prevalence of dysmenorrhea was 94% among adolescents aged 10-20 years, and 8.8% of women should be hospitalized due to this condition (De Sanctis et al., 2015). In the UK, 41-97% of women experienced dysmenorrhea and 11-14% experienced severe pain and cramps (De Sanctis et al., 2015). In Japan, at least 46% of high school students aged 12-15 years experienced a moderate level of pain due to dysmenorrhea and 17.7% experienced severe pain due to dysmenorrhea. Meanwhile, in Georgia, a total of 70% of students didn't go to school due to menstrual pain. In Indonesia, the prevalence of primary dysmenorrhea was 54.89%, and 45.11% of secondary dysmenorrhea (Ristiani et al., 2021).

Some studies mentioned that the age of menarche, menstrual volume, smokers, obesity, heredity, and alcohol consumption were considered the main factors causing dysmenorrhea (De Sanctis et al., 2015; Habibi, Huang, Gan, Zulida, & Safavi, 2015; Ju, Jones, & Mishra, 2015). In primary dysmenorrhea, the level of pro-inflammatory expression of cytokine genes (IL1β, TNF, IL6, and IL8) significantly increase on the first day of menstruation, whereas anti-inflammatory cytokines (ILF5 and IL11) are reduced. Many studies showed that proinflammatory cytokines stimulated the synthesis or release of PGF2a and OT, which induce uterine hypercontractility, decrease endometrial blood flow, and cause pain (Friebe-Hoffmann, Chiao, & Rauk, 2001). Proinflammatory cytokines (IL-1β, TNF-α, and IL-6) caused blood vessel constriction (Ahnstedt, Stenman, Cao, Henriksson, & Edvinsson, 2012), increased procoagulant activity (Aksu, Donmez, & Keser, 2012) and induced sensory neuron stimulation (Ji, Gereau IV, Malcangio, & Strichartz, 2009).

Pharmacological intervention to alleviate dysmenorrhea non-steroidal anti-inflammatory drugs (NSAIDs) inhibiting the activity of the cyclooxygenase enzyme (Marjoribanks, Ro, Farquhar, & Proctor, 2015). However, this medication leads to gastric reflux (Marjoribanks et al., 2015). Moreover, the consumption of NSAIDs in patients with the chronic disease increases the risk of angina, acute myocardial, and bleeding (Hochberg et al., 2012). Considering the side effect of that medication, it seems like non-pharmacological interventions are recommended as they may have effectiveness against dysmenorrhea like warm compresses, cold compress, slow stroke back massages, acupuncture, and acupressure. A warm compress is a compress using warm water causing vasodilation and decreasing muscle tension; so the dysmenorrhea pain decrease. Some studies mentioned that warm compresses intervention for 20 minutes with a temperature of 40^0C reduced the intensity of the pain (Murtiningsih & Karlina, 2015). Another research found that warm compress effectively decreased the intensity of menstrual pain (Dahlan & Syahminan, 2016; Dhirah & Sutami, 2019; Mahua, Mudayatiningsih, & Perwiraningtyas, 2018; Rahmadhayanti, Afriyani, & Wulandari, 2017). However, the results of previous studies showed no differences in levels of β-endorphin, IL-6, and TNF-α among adolescents who experienced dysmenorrhea after being given cold compresses and warm compresses (Mukhoirotin, Kurniawati, & Fatmawati, 2018). Some previous research mentioned that warm compress influenced menstrual pain. We hypothesize that the effect of warm compresses on IL-1β levels has not been known. For this reason, our study aims to evaluate the effect of warm compresses on IL-1β levels on primary dysmenorrhea. It is expected that the finding may help community nurses promote warm compresses to students with dysmenorrhea.

Method

This research used quasi experiment design with a pretest-posttest control group. The population of this study was all students with dysmenorrhea. To obtain the desired sample size, the author determined the inclusion criteria are students with dysmenorrhea; students not receiving analgesics, and first-day experiencing dysmenorrhea. Meanwhile, the exclusion criteria were female students who refused in the middle of the intervention. A total of 24 respondents were involved and then divided into two groups namely the warm compress group (n = 12) and the control group (n = 12). Simple random sampling was used to determine the group. Warm compresses are given by using warm water with a temperature of 40^0C-45^0C and put in a hot water bag then compressed on the abdomen for 20 minutes. The equipment for measuring temperature uses a thermometer and a hot water bag for warm compresses. The instrument for measuring pain used NRS (Numeric Rating Scale) (Berman, Synder, & Fradsen, 2015), and IL-1 β levels used the ELISA (Enzyme-Linked Immunosorbent Assay) method. NRS instrument was valid and reliable with the validity number (r = 0.71–0.99), and reliable number (0.673–0.822) (Li, Liu, & Herr, 2007). The data were analyzed by using the Wilcoxon test and Mann-Whitney Test with $\alpha \leq 0.05$. This research obtained the Ethical clearance of the Faculty of Nursing Faculty, Universitas Airlangga, Indonesia (No. 1336-KEPK).

Results

The menarche age of all respondents was 11-13 years old or in normal age menarche (79.2%). Almost all respondents have regular menstrual cycles (70.8%) with 8-15 days of menstrual period (62.5%) and respondents had an excessive volume of menstruation (75%) **(Table 1)**. The intensity of menstrual pain in the warm compresses before intervention was mostly (58.3%) in moderate pain, almost half at severe pain (41.7%), and after the intervention was almost entirely mild pain (83.3%), few experienced moderate pain (16.7%). The intensity of menstrual pain in the control group before intervention was half (50%) in moderate and severe pain and after the intervention was mostly at moderate pain (58.3%), and almost half experienced severe pain (41.7%). The results of the Wilcoxon test obtained p = 0.001, which means that there was an effect of warm compresses on the reduction of dysmenorrhea ($p < 0.05$) **(Table 2)**. The results of the Mann-Whitney test obtained $p = 0.000$, this means that there are significant differences in the intensity of menstrual pain in the warm compress and control group ($p < 0.05$) **(Table 3)**.

The analysis results showed that warm compresses are effective in reducing the intensity of menstrual pain. The results of the Mann-Whitney test obtained $p = 0.021$, this means that there are significant differences in IL-1 β levels in the warm compress vs. control group ($p < 0.05$) **(Table 4)**. The analysis results showed that warm compresses are effective in reducing IL-1β levels in primary dysmenorrhoea.

Table 1. Respondent characteristics

Characteristics	Frequency	Percentage (%)
Menarche Age		
Normal Menarche (11-13 years old)	19	79.2
Slow Menarche (>13 years old)	5	20.8
Menstrual cycle		
Regular	17	70.8
Unregularly	7	29.2
Menstrual length		
Normal (1-7 days)	9	37.5
Long (8-15 days)	15	62.5
Menstrual Bleeding		
Moderate	6	25
Heavy	18	75

Table 2. Effects of warm compress on dysmenorrhea

Group	Pre Median (Min-Max)	Post Median (Min-Max)	*p*
Warm compress	2 (2-3)	1 (1-2)	0.001
Control group	2.5 (2-3)	2 (2-3)	0.317

Table 3. Differences in menstrual dysmenorrhea after intervention

Group	Median (Min-Max)	*p*
Warm compress	1 (1-2)	0.000
Control group	2 (2-3)	

Table 4. Differences in IL-1 β level after intervention

Group	Median (Min-Max) pg/ml	*p*
Warm compress	11.14 (6.40 – 45.60)	0.021
Control group	19.20 (8.48 – 38.40)	

Discussion

The intensity of menstrual pain before giving intervention was the moderate and severe level of pain. Moreover, a moderate level of pain was found among respondents with a normal age of menarche, regular menstrual cycle, long menstrual duration (8-15 days), and excessive menstrual volume. A severe level of pain was found among respondents who had long menstrual duration (8-15 days) and excessive menstrual volume. Several risk factors can increase the incidence of dysmenorrhea are early age of menarche, longer menstrual duration, excessive menstrual volume, smoking, alcohol consumption, low social support, family history of dysmenorrhea, high caffeine diet, depression, anxiety, and stress (Mukhoirotin, 2018). The results of this study showed that severe dysmenorrhea was found among respondents with long menstrual duration and excessive menstrual volume. Long menstrual periods and heavier menstrual flow are determined by prostaglandin (Habibi et al., 2015; Ibrahim et al., 2015). The increase of endometrial prostaglandins during menstruation induces uterine hypercontractility, reduces uterine blood flow, and hypersensitivity of pain fibers (Yang et al., 2017).

As widely acknowledged, PGF2α and leukotriene levels are significantly increased in primary dysmenorrhoea where in the menstruation period occurred secretory endometrial contains arachidonic acid which is converted to prostaglandin F2α (PGF2α), Prostaglandin E2 (PGE2) and Leukotrients (Sima et al., 2022). In addition, the concentration of IL-6 and oxytocin plasma also increased among women with dysmenorrhoea compared with healthy women (Yeh, Chen, So, & Liu, 2004), this makes an increase in uterine contraction (Aguilar & Mitchell, 2010; Henriet, Chevronnay, & Marbaix, 2012; Jabbour, Kelly, Fraser, & Critchley, 2006), decreased blood flow to the uterus, and it gave an impact like ischemia and pain. In primary dysmenorrhoea, IL-6, there was also a significant increase on the first day of menstruation because of proinflammatory cytokine levels (IL-1β, TNFα, and IL8). IL-1β and TNFα were increased prostaglandin and oxytocin stimulation on the first day of the menstrual phase (Friebe-Hoffmann, Baston, Hoffmann, Chiao, & Rauk, 2007; Tamura et al., 2002; Terzidou, Blanks, Kim, Thornton, & Bennett, 2011; Thompson et al., 2004).

After being given a warm compress, the intensity of menstrual pain among respondents was almost entirely mild pain. The results of statistical tests showed that there was an effect of warm compresses on the intensity of menstrual pain and there was a significant difference in menstrual pain in the warm compress group and the control group. The decrease in menstrual pain occurs because of warm compress intervention because it makes dilation of blood vessels (vasodilation), increases blood supply throughout the body, and provides a sense of comfort to the respondent. A warm compress is an action that can reduce pain by using a dilation of the blood vessel and increasing blood supply throughout the body (Berman, Synder, & Fradsen, 2015). Warm compresses are an independent intervention of nursing. As a caregiver, the nurses could be giving warm compresses to reduce menstrual pain and as an educator, the nurses could give health education about non-pharmacology therapy to reduce menstrual pain by using warm compresses. The results of this study showed that there were differences in IL-1β levels between the warm compress groups and the control group. The warm compress intervention can speed up blood circulation because of the effects of vasodilation and muscle relaxation (Berman, Synder, & Frandsen, 2015). The increased blood circulation to the uterus has an impact on the dilution of bradykinin, prostaglandins, and intravascular histamine (Yang et al., 2017). Prostaglandins can increase oxytocin release without affecting synthesis (Arulkumaran et al., 2012). Thus, decreasing prostaglandin production reduces oxytocin release. Thus, warm compresses can inhibit the activity of cyclooxygenase (COX) in that the formation of prostaglandins is also reduced.

The results of previous studies showed that after Herb-Partitioned Moxibustion (HPM) intervention there was an increase in regulation of 20α-dihydro-progesterone, pregnenolone, Prostaglandin E2, and gamma-aminobutyric acid and decreased regulation of estrone, 16-oxotrone, and prostaglandin H2. Thus, HPM can regulate internal secretion in primary dysmenorrhoea (Ma et al., 2015). Local heat intervention and warm compresses are easy to apply, but warm compresses are more efficient, and easier to find the ingredients. However, Herb-Partitioned Moxibustion requires assistance from an expert. Thus, warm compresses are more efficient in their application when compared to local heat intervention and Herb-Partitioned Moxibustion. Warm compresses are more beneficial because they can reduce proinflammatory cytokines (IL-1β levels) so the synthesis or release of PGF2a and OT decreases, decreases uterine contractions, increases endometrial blood flow, and decreases the intensity of menstrual pain.

Conclusion

Warm compresses are effective to reduce IL-1β levels in primary dysmenorrhea. This therapy can be used as an alternative intervention to overcome complaints of primary dysmenorrhea. Community nurses should work together with Schools to promote health education by using warm compresses. Future studies are needed to evaluate the effectiveness of using a wide population of teenagers.

Author's declaration

The authors made substantial contributions to the conception and design of the study and took responsibility for data analysis, interpretation, and discussion of results. For manuscript preparation, all the authors read and approved the final version of the paper.

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Availability of data and materials

All data are available from the authors.

Competing interests

The authors declare no competing interest.

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