



Cross-sectional Study

The relationship between oxytocin levels with empathy and breastfeeding intention in female medical students: A cross-sectional study

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ABSTRACT

Scientific evidence regarding the relationship of oxytocin to social and emotional behavior is consistently reported. This study aims to analyze the relationship between empathy and breastfeeding intention with oxytocin levels in medical students. A cross-sectional study of 59 female students at the Faculty of Medicine and Health, Universitas Muhammadiyah Jakarta in April 2018–June 2019 selected by purposive sampling technique. The measurement of empathy level using the ©Jafferson Emphatic Scale Student Version (JES-SV) questionnaire, breastfeeding intention using the Infant Feeding Intentions (IFI) questionnaire, and oxytocin levels using the Enzyme-Linked Immunosorbent Assay (ELISA). Analysis of the relationship between oxytocin levels with empathy and breastfeeding intention used the independent samples *t*-test. The results showed that students' age ($p = 0.030$) and education stage ($p = 0.036$) were related to empathy. Age ($p = 0.001$) and education stage ($p = 0.004$) of students were also associated with serum oxytocin levels respectively. Empathy was significantly related to breastfeeding intention ($p = 0.033$). Oxytocin serum levels of female medical students are associated with empathy ($p = 0.016$) and breastfeeding intention ($p = <0.001$). Further studies on the role of oxytocin on empathy and breastfeeding intention need to include other factors to obtain more comprehensive information. Empathy and breastfeeding intention was not only associated with oxytocin levels. Psychological or educational interventions during the learning process at the academic and professional levels are also needed to support the process of forming these two social aspects.

1. Introduction

Oxytocin is a neuropeptide involved in various social behaviors in a wide variety of species. Recent research on its effects in humans has yielded a compelling picture of its role in the dynamic functioning of the social brain [1]. Oxytocin is a hormone that is often associated with birth and breastfeeding, but this hormone in this final study is also involved in social life, especially in social behavior and social relationships between humans [2]. Oxytocin is the core of the anatomical and physiological substrate for mammalian reproduction. The mammalian brain and pelvis can be physically remodeled by the action of oxytocin. Oxytocin is required for birth and may be particularly important for mammalian species, including primates, where infants have large heads [2]. Oxytocin helps protect the brain from hypoxia, especially during the birth process [3]. For social neuroscience, few molecules can be more important and interesting than the neuropeptides oxytocin (Oxytocin) and arginine vasopressin (AVP). These peptides have played a key role throughout mammalian evolution in the regulation of complex social

cognition and behavior. Recently, studies have begun to provide evidence that the function of this neuropeptide is impaired in mental disorders associated with social deficits [4]. A wide variety of behaviors, including maternal care and aggression, partner bonding, sexual behavior, and memory and social support, as well as behaviors related to anxiety and dealing with stress, are affected by brain oxytocin [5].

This discovery makes the neuromodulator/neurotransmitter system a promising brain target for psychotherapeutic intervention and treatment of various psychiatric illnesses, for example, anxiety disorders, social phobia, autism, and postpartum depression. The results showed there was a temporary disturbance, although there was no correlation between oxytocin levels and cognitive performance [6]. However, the neuropeptide oxytocin, together with the vasopressin arginine, plays a key role in encoding information relevant to social interactions and is critically involved in the regulation of complex social cognition and behavior, including attachment, social recognition, social exploration, and anxiety and behaviors related with fear [7].

Scientific evidence has consistently shown that levels of oxytocin are

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associated with empathy. The studies reported that higher oxytocin levels were associated with higher empathy [8–10].

A study by Geng et al. demonstrated that the hypothalamic neuropeptide oxytocin can significantly increase emotional empathy in relation to reduced amygdala activation [10]. Likewise, the study conducted by Hubble et al. showed that there was a relationship between oxytocin and emotional behavior. In this study, it was reported that oxytocin can affect the focus of attention on eye gaze and increase affective empathy for fear [9].

A finding in a previous study suggested that empathy was associated with a 47% increase in baseline oxytocin. It is also proven that oxytocin is a physiological sign related to empathy. It was also found that empathy triggers people to increase their generosity [11]. Previous research has shown that oxytocin promotes the emotional and cognitive aspects of empathy, with exogenous administration of oxytocin [12]. Other studies also shows that oxytocin is linked to increased emotional empathy, which plays a role in improving social interactions [13]. This fourth level is the key to therapeutic activities between doctors and patients that can support the healing process. A doctor's empathy is one of the main goals of medical education, so it needs to be prepared from the start for medical students from the beginning of their education to take medical education [14]. The level of empathy in medical students generally increases from the first year of education to the final stage of academic and professional education [15,16].

Other studies have shown that under conditions of maternal preparation for breastfeeding, oxytocin is released in response to breastfeeding leading to milk ejection, and inducing physiological changes to increase milk production and psychological adaptations to facilitate motherhood. Stress and medical intervention during birth can influence this effect and thus affect breastfeeding initiation [17].

Oxytocin, especially in female medical students, is also associated with breastfeeding intentions, which is a predictor of successful breastfeeding practices. Furthermore, the empathy and breastfeeding intention formed by these female medical students are also associated with their success in becoming a doctor. Those who have empathy and the intention to breastfeed tend to be better at interacting with patients, especially patients who are mothers who are preparing for the lactation process or who have problems regarding breastfeeding. In addition, empathy and breastfeeding intentions were also associated with their role as future mothers. This plays a role in preparing them mentally and emotionally which determines the success of breastfeeding [18,19].

Along with the increasing age and academic stage, the empathy associated with emotional maturity in female medical students also increases. This is supported by increasing understanding and experience. Their knowledge about the importance of the benefits of exclusive breastfeeding for mothers and babies that they get during the learning process as well as the support of various scientific evidence are factors that can increase breastfeeding intentions [20]. Breastfeeding intentions are also increasing with information obtained from various literature reviews which show that breastfeeding is strongly related to preventing infection in infants [21,22].

Based on the existing findings, this study aims to determine the relationship between the level of empathy and breastfeeding intention with serum oxytocin levels in medical students.

2. Materials and methods

2.1. Study area and period

The collection of questionnaires and samples of research respondents has carried out at the Faculty of Medicine and Health Universitas Muhammadiyah Jakarta. The sample of respondents was then analyzed at the Microbiology Laboratory, Faculty of Medicine, Hasanuddin University Makassar. The time of research was carried out from April 2018 to June 2019.

2.2. Design and samples

The research design used is a cross-sectional study design. This design measures the variables studied at one time in the population. The sample in this study was 59 female medical students who were selected by the purposive sampling technique method.

2.3. Inclusion and exclusion criteria

The research subjects were selected according to the research inclusion criteria, namely active students in the 2018–2019 school year, female, and willing to participate in this study by filling out informed consent in each educational year group. The exclusion criteria for this study were that the subjects excluded from this study were students who did not fill out the questionnaire completely.

2.4. Data collection and measurements

Characteristics of students include age, level of education/semester, and place of residence obtained from questionnaires filled out by respondents. Empathy levels were measured using an adapted ©Jafferson Emphatic Scale Student Version (JES-SV) questionnaire. The questionnaire has obtained permission from the researcher who first developed this questionnaire in the United States and has gone through the review stage, translation into Indonesian, and the validity and reliability testing stage.

The measurement of breastfeeding intention used an adapted Infant Feeding Intentions (IFI) questionnaire. This questionnaire has obtained permission from the original researcher and has gone through the translation stage into Indonesian, and tested for validity. The questionnaire consisted of five items about the mother's plan to give only formula milk to her baby; to breastfeed her baby; breastfeeding without using formula/other milk when the baby is one month old; breastfeeding without using formula/other milk when the baby is three months old, and breastfeeding without using formula/other milk when the baby is six months old. This questionnaire is rated on a five-point Likert scale (anchor: 'strongly agree' to 'strongly disagree'). This assessment is inversely valid for items 2,3,4 and 5. The total intention score was calculated using the formula: summation (item average score 1 + 2) + (item total score 3,4, and 5). Thus the total score ranged from 0 (strong intention not to breastfeed at all) to 16 (strong intention to breastfeed as the only source of infant food in the first 6 months) [20]. Scores are categorized based on the average score i.e. 'low intention' if the score is less than the median, and 'high intention' if the score is greater than equal to the median.

Enzyme-linked Immunosorbent Assay (ELISA) to determine protein levels of OXTR or oxytocin. The respondent's serum sample before use was prepared with all reagents according to the KIT used as needed at room temperature. Each sample was carried out in triplicate to ensure the correctness or validity of the ELISA results. Then the pack is filled with all reagents, standard dilution, and patient serum samples. Open the microplate strip and arrange the samples according to the number of samples to be inserted into the well. In the first step, 100 L of assay diluent containing protein buffer was added to each well. Then 100 L of standard fluid was added containing the recombinant human gene OXTR from a predetermined KIT or diluted samples from the patient's serum into each well. Then, it was incubated for 2 h at room temperature. Aspirate the liquid from each well and wash it with sterile Phosphate Buffered Saline (PBS). This washing process was carried out 4 times in a row. Then 200 L of a liquid conjugate containing streptavidin horseradish peroxidase (HRP) was added to each well and covered with a plastic cover and incubated for 2 h at room temperature. The liquid was sucked and then re-washed 4 times using sterile PBS liquid. The next process added 200 L of substrate solution containing 3,3',5,5'-Tetramethylbenzidine (TMB) liquid into each well and incubated for 20 min at room temperature where the microplate was stored in the dark to

avoid light. After completion of incubation, the reaction was stopped by adding 50 L of stop solution containing H₂SO₄ into each well and read using ELISA Reader 270 (Biomerieux, France) with a wavelength of 450 nm within 30 min. Next, read the protein concentration of OXTR with units of pg/ml Anti-Oxytocin Receptor antibody ab87312, Abcam).

2.5. Data processing and analysis

All data in the questionnaire were checked and then coded and inputted using SPSS version 22.0. Variable with continuous data, oxytocin levels were analyzed for normality using the Kolmogorov-Smirnov test. Based on the Kolmogorov test showed a normal distribution. Descriptive statistics consisting of mean, standard deviation, percentage, and categories were analyzed by univariate analysis. 95% confidence level and P-value <0.05 were used to assess statistical significance. The relationship between empathy and breastfeeding intention using the chi-square test. While the analysis of the relationship between empathy and feeding intention with oxytocin levels used independent samples T-test.

2.6. Ethical consideration

This research has passed the ethical test based on the ethical approval recommendation letter from the Health Research Ethics Committee, Faculty of Medicine, Hasanuddin University on April 16, 2018, Number 287/H4.8.4.5.31/PP36-KOMETIK/2018. Data collection was carried out by the main researcher and assisted by enumerators (staff of the Faculty of Medicine and Health Universitas Muhammadiyah Jakarta). Students filled out a questionnaire after receiving information about the study and signing informed consent. In this study, the author confirms that all methods are carried out following the relevant guidelines and regulations (Helsinki Declaration) with a Unique Identifying Number (UIN) or registration ID researchregistry8119. This manuscript has been reported in line with the STROCSS criteria [23]. This research is not experimental or intervention research.

3. Result

Students who are over 21 years old are 62.7%, the final stage of professional education is 39.0% slightly higher than the initial academic 33.9%, as many as 71.2% of female students live in dormitories/boarding houses, and most of the female students have a high level of

empathy and breastfeeding intention, which is equal to 61.0%. The mean oxytocin serum levels in university students were 1.65 ng/mL ± standard deviation of 1.03 ng/mL, the median value was 1.16 ng/mL, the lowest level was 0.45 ng/mL, and the highest level was 3.54 ng/mL.

Table 1 also shows that there is a significant relationship between student age with empathy and serum oxytocin levels ($p = 0.030$ and 0.001), but it is not related to breastfeeding intention ($p = 0.107$). The educational stage was related to empathy and serum oxytocin levels ($p = 0.036$ and 0.004), but not related to breastfeeding intention ($p = 0.086$). Student residence was not related to empathy, breastfeeding intention, and serum oxytocin levels ($p = 0.940$; 0.090 ; and 0.489 , respectively). Empathy in students was significantly related to breastfeeding intention ($p = 0.033$). Empathy and breastfeeding intention were significantly related to serum oxytocin levels ($p = <0.001$ and 0.016).

In the early academic stages, the average serum oxytocin in female students who had high empathy was not much different from that of students who had low empathy. At the last academic and last profession stages, the average serum oxytocin level was higher in female students who had high empathy compared to students who had low empathy. Of the three educational stages, the highest levels of serum oxytocin and empathy are in students who are in the last profession stage (see Fig. 1).

Fig. 2 shows that at the early academic stage the average serum oxytocin in female students who had high breastfeeding intentions was not much different from those of students who had low breastfeeding intentions. At the last academic stage, the average serum oxytocin level was higher in female students who had high breastfeeding intentions than students who had low breastfeeding intentions. The mean serum oxytocin levels in last profession students who have high breastfeeding intentions are not much different from those of students who have low breastfeeding intentions.

4. Discussion

Medical students are not only educated about the concepts of medical science and how to communicate with patients but are also educated to learn to empathize with patients [24]. Hojat's definition of empathy in patient care is defined as a predominantly cognitive trait (rather than affective or emotional), which involves understanding (not feelings) of the patient's experiences, concerns, and perspectives, combined with the ability to communicate that understanding, and the desire to help the patient [25]. Empathy is one of the important factors in patient care,

Table 1

Distribution of female student characteristics and their relationship to empathy, breastfeeding intention, and serum oxytocin levels.

Variable	N	%	Empathy		Breastfeeding Intention		Oxytocin Serum Levels	
			p-value	OR (CI 95%)	p-value	OR (CI 95%)	p-value	OR (CI 95%)
Age								
<21 years	22	37.3	0.030*	3.90 (1.28–11.92)	0.107	2.83 (0.95–8.49)	0.001*	0.81–1.36
≥21 years	37	62.7						1.63–2.34
Education Stage								
First Academic	20	33.9	0.036*		0.086		0.004*	0.78–1.31
Last Academic	16	27.1						1.43–2.56
Last Profession	23	39.0						1.45–2.41
Residence								
Boarding/Hostel	42	71.2	0.940	1.25 (0.39–4.01)	0.090	0.31 (0.10–1.00)	0.489	1.28–1.90
Parent's House	17	28.8						1.20–2.39
Empathy								
Low	23	39.0	–	–	0.033*	3.38 (1.12–10.16)	<0.001*	0.82–1.26
High	36	61.0						1.67–2.40
Breastfeeding Intention								
Low	23	39.0	0.033*	3.38 (1.12–10.16)	–	–	0.016*	0.90–1.60
High	36	61.0						1.54–2.67
Oxytocin Serum Levels								
Mean	1.65							
Standard Deviation	1.03							
Median	1.16							
Min-max	0.45–3.54							

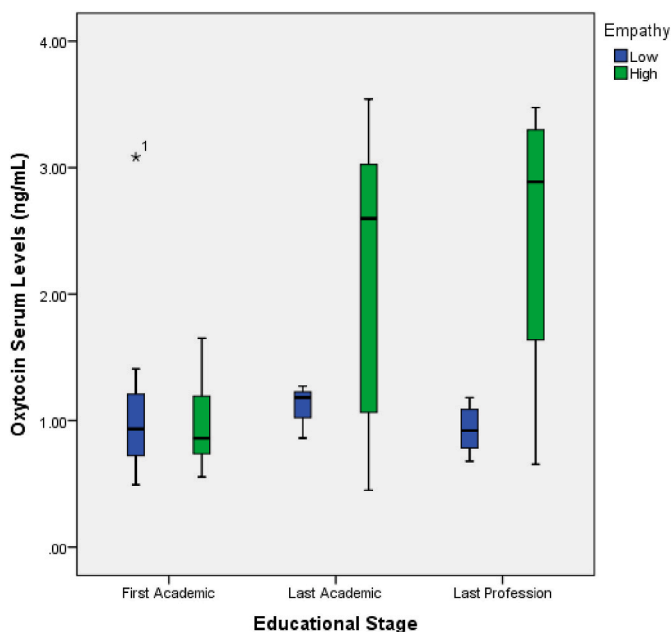


Fig. 1. Error Bar of Serum Oxytocin Levels based on Empathy Levels at the Stages of Student Education.

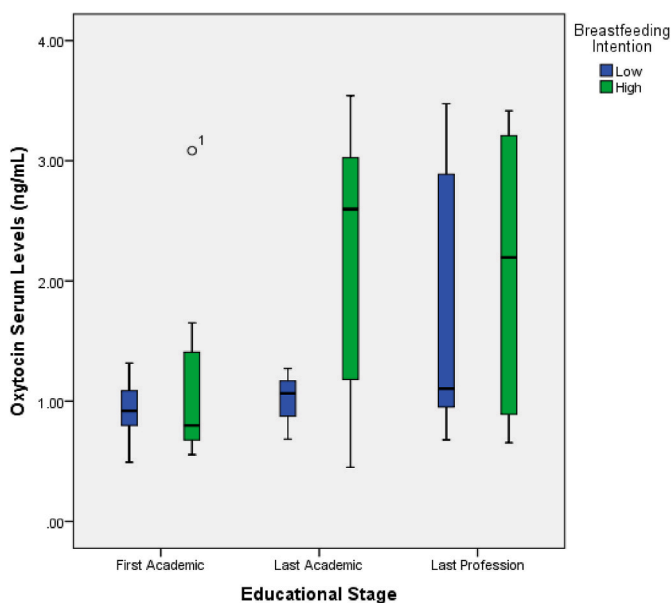


Fig. 2. Error Bar of Serum Oxytocin Levels based on Breastfeeding Intention at the Stages of Student Education.

medical education, and professionalism, especially in several medical disciplines, so empathy needs to be developed in various academic and cultural contexts [26]. Some of the factors that can influence the development and maintenance of empathy in medical students are age, gender, psychological well-being, culture, and various aspects of medical education such as clinical experience, educational curriculum, and communication skills [27].

The age of students is related to empathy, this shows that the older the students, the higher the sense of empathy. In line with Tegge's research which obtained the results that student age significantly affects the level of empathy among students of all majors [28]. Student age is also associated with serum oxytocin levels. Students aged 21 years had higher serum oxytocin levels than those in the <21 years age group.

Older people have higher serum oxytocin levels compared to other age groups [29].

Educational stages of medical students related to empathy and serum oxytocin levels. The empathy of students has increased along with the increase in the stages of education. There was an increase in oxytocin and empathy in medical students, especially those who had gone through the final stage of academic education and the final stage of the profession, while for new or early academic students, oxytocin levels did not affect the level of student empathy. Students before experiencing the medical learning stage did not find a relationship between oxytocin levels and empathy, but at the end of the academic and professional stages, the relationship was significant and quite strong. This proves that the learning process stimulates the production of oxytocin and will subsequently affect several neurotransmitters in the amygdala in the Limbic system, leading to increased empathy. Previous research has shown that the level of empathy in medical students gradually increases after clinical training in medical colleges [30].

This study shows that there is a relationship between empathy and breastfeeding intention in medical students. The empathy that students have will affect their breastfeeding intention in the future. A study showed that social influence was an important predictor of positive breastfeeding beliefs and future intentions to breastfeed in adolescents [31]. Positive emotions in mothers were significantly associated with reports of better breastfeeding experiences in the first 12 months [32]. Capponi & Roland's 2019 research shows that an emotional aspect is involved in intended breastfeeding behavior. Breastfeeding is a manifestation of an experience that involves physical contact which is often associated with feelings of love for the baby but is also associated with the emotion of disgust for some respondents who do not intend to breastfeed [33]. The research of Mattei et al., 2016 regarding psychological factors, found that neuroticism was negatively related to breastfeeding intentions [34]. The effects of breastfeeding on maternal depression are highly heterogeneous, mediated both by breastfeeding intentions during pregnancy and by maternal mental health during pregnancy [35].

Empathy levels in medical students are related to serum oxytocin levels. High serum oxytocin levels were found in students with high levels of empathy. The increase in oxytocin is closely related to the increase in empathy in medical students. This finding is in line with the results of previous studies that oxytocin greatly affects human empathy [25,29,36-39]. It was also found that social behavior disorders, including empathy disorders related to oxytocin, were also found [8,40]. Currently, interventions with oxytocin to affect empathy are also common through intranasal oxytocin [4].

Research Gang et al. showed that OXT could increase both empathy ratings as well as influence moral and self-aware emotional responses. This behavioral effect of OXT was associated with decreased physiological arousal and decreased responsiveness in the right amygdala and anterior insula, but not in the mentalization network (mPFC). Furthermore, the effect of OXT on the amygdala was strongest in individuals with high trait anxiety. Thus, OXT in this context might promote an anxiolytic effect resulting in a more cognitive rather than emotional assessment of shame level [10].

Empathy is one of the important aspects that a doctor needs to have good social interactions, especially with patients. A doctor who has high empathy significantly contributes to the patient's recovery rate, namely being able to understand the patient's health problem and respond appropriately [13,41].

Individual empathy describes a multidimensional construction that includes cognitive aspects, namely the ability to identify emotions expressed by others, as well as emotional aspects, namely the ability to feel the same emotions. From a neurobiological perspective, this multidimensional functional domain is needed to identify new therapeutic approaches to helping patients recover. Oxytocin functions as a neuromodulator in the central nervous system that plays a role in social behavior in humans including empathy, trust, in-group preferences, and

socially relevant memory. However, the role of oxytocin in regulating social interactions includes an empathy component also influenced by external factors, namely those from the social environment. The process of forming empathy is also associated with interventions given to individuals in a learning process such as educational interventions regarding the importance of empathy and how to shape it so that it becomes a social behavior [42].

Other findings in this study also show that oxytocin serum levels are related to breastfeeding intention in medical students. High oxytocin serum levels were found in students with high breastfeeding intentions. Oxytocin is the main hormone that has an important role in successful breastfeeding. Many studies show that oxytocin plays a greater role in social relationships between mothers and children, both from the womb, the birth process, during breastfeeding to the process of growth and development or parenting [43–47]. Oxytocin induces physiological and psychological effects in the mother. Previous studies have shown that breastfeeding induces an immediate and short-lived release of oxytocin of about 20 min. The number of oxytocin pulses during breastfeeding is associated with greater milk production and a longer duration of lactation, which may be inhibited by stress. Breastfeeding-induced oxytocin release is associated with increased prolactin levels, decreased levels of stress hormones namely adrenocorticotrophic hormone (ACTH) and cortisol, and somatostatin (a gastrointestinal hormone) [48].

The psychological state of the mother during birth affects the action of oxytocin and affects the initiation of breastfeeding. The higher the level of oxytocin in the mother, the easier the process of expulsion of breast milk. Oxytocin levels before the lactation period were also associated with the mother's readiness to breastfeed. Mothers who are more ready to breastfeed their babies tend to have higher levels of oxytocin than mothers who have low levels of oxytocin. In addition, the experience of mothers in parenting is also associated with oxytocin levels, where multiparous mothers have higher oxytocin levels than primipara mothers. Mothers who are experienced in caring for babies are easier to recognize the baby's facial expressions and feel what the baby is feeling. This ability is also supported by the mother's education and knowledge regarding child care, especially in the practice of breastfeeding. Oxytocin levels in mothers are also associated with empathy, emotional bonding, and mother's affection for her baby so that it can increase bonding between mother and baby which supports successful breastfeeding. Furthermore, this will have an impact on the emotional characteristics of the baby in the next period of life [48,49].

5. Conclusion

The level of empathy and breastfeeding intention is related to oxytocin serum levels in female medical students. Female medical education who has a high level of empathy and breastfeeding intention have a high level of oxytocin. The level of empathy, breastfeeding intention, and oxytocin levels increased according to the stages of education. These results can be used as an evaluation of the learning process at the academic and professional stages so that efforts can be made to improve learning methods to help achieve competence and study success. Although oxytocin levels are associated with empathy and breastfeeding intention, further study is needed to analyze the influence of external factors (social environment) such as psychological or educational interventions on empathy and breastfeeding intention given during the learning process at the academic and professional levels are needed to support the process of forming empathy and breastfeeding intention, especially for female medical students.

6. Limitations of the study

The limitation of this study is that it only assesses the relationship between oxytocin levels with empathy and breastfeeding intention but does not assess the influence of external factors that play an important

role in the formation of empathy and breastfeeding intention, such as psychological or educational education, especially in the learning process at the academic and professional levels. In addition, the measurement of oxytocin levels, empathy, and breastfeeding intention was only carried out at the academic and professional levels but had not been measured when participants carried out the process as doctors on real duty in the workplace.

Ethical approval

This research has passed the ethical test based on the ethical approval recommendation letter from the Health Research Ethics Committee, Faculty of Medicine, Hasanuddin University on April 16, 2018, Number 287/H4.8.4.5.31/PP36-KOMETIK/2018.

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Author contribution

1. Conceptualization funding acquisition role/writing-original draft: DR. Tria Astika Endah Permatasari, MKM. 2. Conceptualization, role/writing- original draft: DR. Tria Astika Endah Permatasari, MKM. DR. Amir Syafruddin, M. Med.Ed. 3. Resources, project administration: DR. Tria Astika Endah Permatasari, MKM. DR. Amir Syafruddin, M. Med. Ed. 4. Data curation, methodology: DR. Amir Syafruddin, M. Med.Ed. 5. Supervision: DR. Tria Astika Endah Permatasari, MKM. DR. Amir Syafruddin, M. Med.Ed. 6. Formal analysis, validation: DR. Amir Syafruddin, M. Med.Ed.

Registration of research studies

- 1. Name of the registry: Analysis of The Relationship between Empathy and Breastfeeding Intention with Oxytocin Levels in Medical Student: A Cross-Sectional Study
- 2. Unique Identifying number or registration ID: researchregistry8119
- 3. Hyperlink to your specific registration (must be publicly accessible and will be checked): <https://www.researchregistry.com/register-now#user-researchregistry/registerresearchdetails/62d8d98193c4db0021932303/>

Guarantor

1. DR. Tria Astika Endah Permatasari, MKM.
2. DR. Amir Syafruddin, M. Med.Ed.

Consent

This study has received approval from the ethics committee and written informed consent was required for each participant.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Declaration of competing interest

The authors declare that they have no competing interests.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.amsu.2022.104486>.

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