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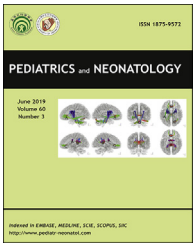

Original Article

Investigation of the effect of training attachment behaviors to pregnant mothers on some physical indicators of their infants from birth to three months based on the separation of male and female infants

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Key Words
attachment;
infant;
weight

Background: Maternal attachment to the fetus during pregnancy improves infant's growth and development and is an important criterion for public health. The aim is to investigate the effect of training attachment behaviors to pregnant women on some growth health indicators of infants.
Methods: This is a clinical trial with convenience sampling which was conducted on 190 pregnant women in Hafez Hospital in Shiraz who randomly classified into intervention and control groups. For the intervention group, 6 sessions of 90-min classes were held. After delivery, both groups were compared in terms of physical growth (weight, height, head circumference) at birth, one and three months after birth. The data were analyzed using repeated Measurement.
Results: Weight increase in female infants in the intervention group compared to the control group was significant at birth ($p = 0.016$), one month ($p = 0.010$) and three months after birth ($p = 0.014$). Height increase in female infants in the intervention group compared to the control group was significant at birth ($p = 0.025$), one month ($p < 0.001$) and three months after birth ($p = 0.009$). Male gender was not statistically significant in any age group but it increased the size of the head circumference of three-month-old infants.
Conclusion: Training of attachment skills to mothers improves height and weight of female infants in three steps. The average index for boys in the intervention group was higher than that of control group, but it was not significant.

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1. Introduction

There is strong evidence in relation to the attachment between parents and fetus during pregnancy that is reflected in the behavior of parents. Women who expressed more attention to their fetus with abdominal touch and talk to the fetus during pregnancy, also showed more love, attention and attachment to the infant after the birth.[1,2] Also training fathers about the attachment skills or reducing the father's domestic violence increased paternal-fetal attachment and reduced mother's anxiety score's.[3,4] Maternal-fetal attachment is an influential factor in the index of motor development and physical growth of infants during pregnancy and after birth.[5,6] One of the most important factors in reducing maternal attachment is stress and anxiety during pregnancy.[7] Anxiety and unpleasant mood of the mother during pregnancy directly affects the mood of the fetus.[8,9] In addition to the devastating effects of anxiety on the relationship between mother and infant studies have shown other adverse consequences.[10–14] Generally, it can be said that anxiety and stress during pregnancy worsen pregnancy outcome.[15] people's responses to different treatments and strategies to reduce fear and anxiety in pregnancy are very good.[16] Attachment behavior training was shown to reduce mother's anxiety and increase the degree of her attachment to the infant.[17] Another study showed that reducing maternal anxiety increased maternal and fetal attachment in IVF mothers.[18]

According to available evidence, training of attachment behavior along with reduction of anxiety and stress in mothers eventually leads to reduced obstetric, maternal and infant complications. In another study, there was a significant relationship between mother attachment and level of anxiety.[19] The use of non-pharmacological treatments, such as cognitive-behavioral treatments and relaxation for the treatment of stress during pregnancy are considered safer and more effective solutions than psychotropic drugs.[20,21] The effects of maternal-fetal attachment on infant mental health and its process of growth and development have attracted attention.[22] Numerous studies in different populations reveal an association between intrauterine growth restriction and perinatal and postnatal developments, which differ according to the sex of newborns with intrauterine growth restriction.[23] To evaluate the effect of fetal sex on pregnancy outcome, Melamed et al. conducted a retrospective study on 66.387 (34.367–51.8% male fetuses and 32.020–48.2% female fetuses) singleton pregnancies over a period of 11 years. They concluded that although the incidence of preterm delivery and cesarean section was higher for males, female fetuses were more likely to develop intrauterine growth restriction.[24] Protection of the health of infants is one of the best investment strategies for economic and social development of each country. In order to achieve this objective, physical health of infants should take priority. However, our study was interventional and focused on whether the "training" of these attachment behaviors could have an impact on the health indicators of infants.

2. Materials and methods

2.1. Participants and study size

In this clinical trial, training of attachment behavior (as an intervention) was performed in 6 sessions (Table 1) and the physical, weight, height and head circumference indicators of infants were compared between experimental and control groups. The study population included low-intermediate risk pregnant women of 18–40 years old and gestational age of 28–34 weeks who were referred to Hafez Hospital in Shiraz-Iran.

2.2. Sample size

According and similar articles.[17,25] and to formula of comparing average with a fixed number,

$$n=\frac{2\left(z_{1-\frac{\alpha}{2}}+z_{1-\beta}\right)^2\sigma^2}{d^2}$$

D = 2
α = 0.05
β=80%
σ = 5 = sd

and by considering a loss of 10% for the sample size, a sample size of 99 people per group was obtained. Simple purposive sampling method was used. After choosing samples, overall, out of the 267 qualified women entered into the study, 198 (99) in the each group, educational and control groups were assessed to be eligible for study (Fig. 1). Block randomization was used to divide them into two experimental and control groups. In this method, the number of patients increased gradually, equally and randomly. After follow up, three patients in the intervention and five in the control groups were discontinued, and the final sample consisted of 96 patients in the intervention and 94 patients in the control groups until the end of the study.

2.3. Inclusion & exclusion criteria:

Inclusion criteria were as follows: pregnant women of 18–40 years old with gestational age of[28–34] weeks who were married, residents of Shiraz with wanted pregnancies, single fetus, who had minimum third-grade middle school

Table 1 Mother's educational sessions program.

1. **Knowledge of the various organs of the body physiological changes**	4. **Awareness of the importance of talking with baby**
Awareness of effective approaches to improve and adapt to adverse changes	Encourage others (parents, siblings, etc.) in the family to talk to the baby
Detect abnormalities occurring	Touching the fetus from the abdomen and having eye contact
	Singing and humming poetry verses
Respond to issues related to nutrition, exercise, rest, work, travel, vaccination and sexual intercourse during pregnancy	Read the story and repetitive text
Knowledge of the process and stages of a normal delivery	Abdomen massage during pregnancy
	See photos and pictures and videos of ultrasound
	Beautiful words to describe the use of embryos and daily greetings
	As approaches to increase the attachment
2. Knowing about ovulation, fertilization and embryo formation	**5. Awareness of the importance of exercise and relaxation techniques to reduce fear and anxiety**
Knowledge of events during embryonic period	Stay away from negative thoughts and anxiety
Awareness since the beginning of fetal movements, hear the fetal heart rate, fetal sex determination, viability, sonography	Stay away from harmful substances, cigarettes, alcohol, etc.
Awareness of diseases affecting the mother on the fetus	Necessary nutrient intake during pregnancy
Aware of the need for iron and folic acid and its duration	The use of exercise during pregnancy
Awareness of the importance illegal drugs are contraindicated during pregnancy	As approach to increase the attachment
3. Attachment between mother and fetus	**6. Knowing how to count fetal movements and record them**
The benefits of this type of attachment	Imagine the appearance of the embryo to form the desired positive
The effect of attachment on the baby	Imagine your situation are breastfeeding
How to increase the interest and ways to arouse it	Imagine your items are embracing baby
Methods of Teaching:	**Educational tools:**
1- question and answer	1- A whiteboard and markers
2- clarification	2- Photos and slides
3- Speech	3- the movie
4- Screenings	4- Pamphlet
5- Role playing	

education, low risk of pregnancy and low and intermediate anxiety according to Spielberger questionnaire, and who were willing to participate in the study.

Low and intermediate risk admission criteria was included: age between 18 and 40 years, at term pregnancy (37—42) weeks, cephalic presentation, singleton pregnancy, longitudinal lie, regular antenatal attendance, multiparous with history of uneventful pregnancy, grand multiparous, gestational diabetic not on insulin, and dystocia with live infant.

Exclusion criteria were: absence of the mother in more than one training session, loss of pregnancy, high risk pregnancy and lack of physical health in infants and congenital malformations, and high level of anxiety according Spielberger questionnaire.

The factors that place a pregnancy at high risk pregnancy include the following:

1. Existing health conditions; high blood pressure, polycystic ovary syndrome, diabetes, kidney disease, autoimmune disease, thyroid disease, infertility, obesity, HIV/AIDS.
2. Age; teen pregnancy, first-time pregnancy after age 35.
3. Lifestyle factors; alcohol use, cigarette smoking.
4. Conditions of pregnancy; multiple gestations, gestational diabetes preeclampsia and eclampsia. If the birth was earlier than 37 weeks and babies needed intensive care, they were excluded from the study

2.4. Data sources/measurement

Tools and process of data collection included personal information form (mother demographic information, reproductive characteristics, previous pregnancy outcomes, etc.) completed before the intervention and Spielberger questionnaire completed before and after the intervention by mothers in addition to a chart of the sizes of infant growth indicators (weight in grams; height and head circumference in cm) at birth and one and three months after birth. Baby's weight is calculated by a standard scale. During the study period, it was calibrated at a specified time interval (once a week). Measurement of height is measured in a back-to-back position and the baby lay on its back. For measuring head circumference was used a cloth meter. In this way

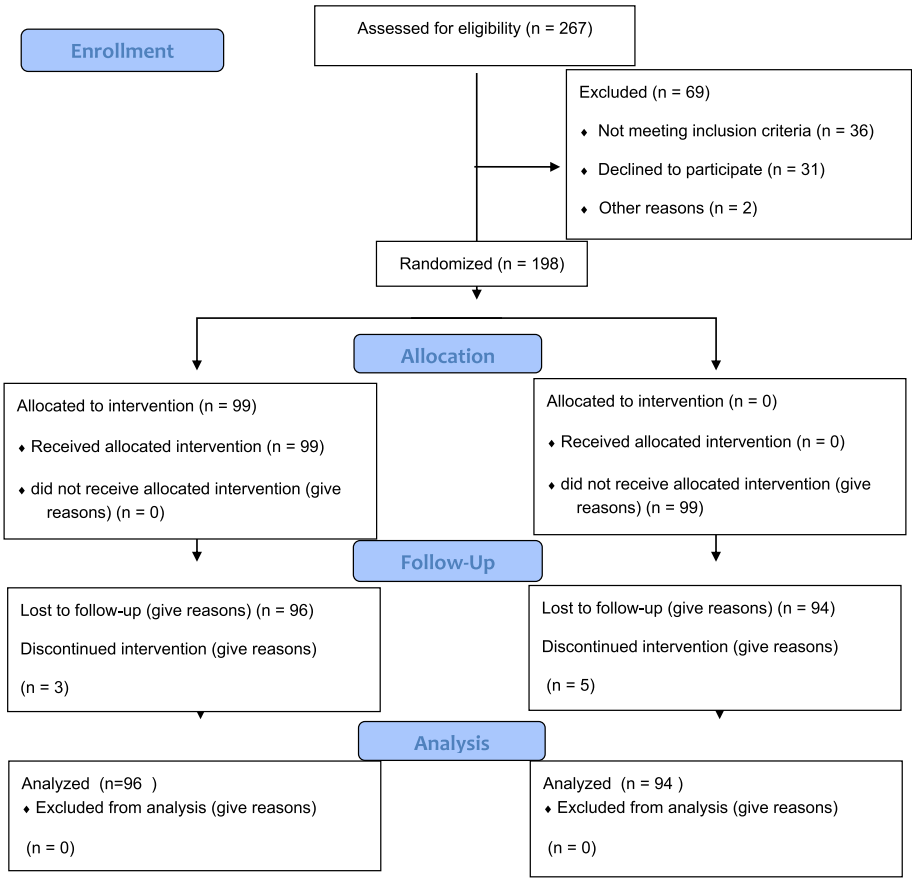

Figure 1 Flow diagram of sampling.

from the most straightforward point behind up to the furthest point on the forehead was measured.

Spielberger scale was used to assess anxiety (40 questions and 80 scores). This scale consists 40 questions of which 20 measure state anxiety and 20 measure trait anxiety. Scores of (0—19) were normal anxiety; 20—40, mild anxiety; 41—60, moderate anxiety; and 61—80 represented severe anxiety. The higher score indicated greater anxiety. In the Spielberger test, a study on 150 patients undergoing surgical procedure, reported a reliability of 97%.[26] The present study is based on reliability and validity obtained in that study. Indicators of the infant health including measurements of height, weight and head circumference at birth are considered as determinants of the physical growth of infants as well as valid evidence of intrauterine fetal growth. Determining these growth indicators are the easiest and most common methods of infants assessment, and they can be used to monitor the growth of infants in addition to the determination of physical condition.[27,28] Measurement of growth health indicators in hospital at birth, was carried out by the researcher. For measurements of one month and three months after the birth, mothers were informed by the phone to refer to our clinic. Measurements were conducted again with an aligned measuring device by the researcher. To prevent sampling error, the investigator alone performed the measurements using the same equipment for all participants.

2.5. Statistical analysis

For comparing weight, height, and head circumference indices at birth, and one and three months after birth, we used SPSS version 16 and repeated measurement, and if the result was statistically significant ($p = 0.05$), then the analysis was done by t-test.

2.6. Ethical considerations

This research project was approved by the local Ethics Committee of Shiraz University of Medical Sciences and written informed consents were obtained from all the participants. The research proposal No: 92-6857 was financially supported by Shiraz. The research was registered: IRCT: 2014042217393N1.

2.7. Data extraction

In this clinical study detailed data (sample characteristics, type of intervention, study design) detailed data were gathered on the use of outcome measures. A primary outcome is the importance of teaching mother-to-fetal attachment skills during pregnancy and Its Forecasting for infant growth. The Secondary outcome is the importance of planners' attention to teaching pregnant mothers.

Pregnancy training in addition to maternal and infant health are also important for community health.

3. Results

The study results revealed no significant difference between the study groups regarding the demographic variables including mother's age ($p = 0.494$), level of education ($p = 0.596$), occupation ($p = 0.801$), gravidity ($p = 0.688$), state anxiety ($p = 0.807$), trait anxiety ($p = 0.230$), total anxiety ($p = 0.433$) and body mass index ($p = 0.283$). The two groups were homogeneous in terms of the above variables. The average age of the women in the intervention group and control group was 28.04 ± 6.02 and 27.72 ± 5.55, respectively. There was no significant difference between mean age of the participants in the test, and both groups were homogeneous in terms of related variable ($p = 0.705$). There was no relationship between body mass indexes of pregnant women in the two groups. Also using the test to compare the average of two independent groups, at significance level of $p = 0.733$, the average weight before pregnancy was homogeneous in both groups. The average weight of male infants in the intervention group at birth ($p = 0.251$), one month after birth ($p = 0.664$), and three months after birth ($p = 0.694$) was higher than average weight of male infants in the control group, but this difference was not statistically significant (Table 2).

However, weight increase in female infants in the intervention group compared to the control group was significant at birth ($p = 0.016$), one month after birth ($p = 0.010$) and three months after birth ($p = 0.014$). In a comparison between all infants, without gender segregation, the weight increase in the intervention group compared to the control group was also statistically significant at birth ($p = 0.010$), one month after birth ($p = 0.041$), and three months after birth ($p = 0.010$). The average height of male infants in the intervention group at birth ($p = 0.420$), one month after birth ($p = 0.223$), and three months after birth ($p = 0.264$) was higher than average height of male infants in the control group, but this difference was not statistically significant.

However, the height increase in female infants in the intervention group compared to the control group was significant at birth ($p = 0.025$), one month after birth ($p = 0.00$), and three months after birth ($p = 0.009$). In a comparison between all infants, without gender segregation, the height increase in the intervention group compared to the control group was also statistically significant at birth ($p = 0.027$), one month after birth ($p = 0.00$), and three months after birth ($p = 0.009$) (Table 3).

The average head circumference of male infants in the intervention group at birth ($p = 0.783$) and one month after birth ($p = 0.392$) was higher than the average head circumference of male infants in the control group, but this difference was not statistically significant. However, the increased head circumference in male infants in three months after birth ($p = 0.044$) was statistically significant. In female infants, the increase in the average head circumference was not significant at birth ($p = 0.665$), one month after birth ($p = 0.466$), and three months after birth ($p = 0.082$).

In a comparison between all infants, without gender segregation, the increase in the average head circumference was not significant at birth ($p = 0.608$) and one month after birth ($p = 0.257$), but it was statistically significant three months after birth ($p = 0.008$) (Table 4).

4. Discussion

Maternal-fetal attachment is a very important and influential factor in the index of motor development and physical growth of infants during pregnancy and after birth.[6,26] Hompes et al. concluded that maternal-fetal attachment during pregnancy could predict the body mass index (PVE = 6/9%) and ponderal index (PVE = 7.2%) at birth.[27] Like Hompes's study, in our study attachment increased body mass index at birth so that rate of average weight and average height were higher in the intervention group than the control group, represented as higher rates of 224.6 and 1.01, respectively.

Hompes suggested that maternal attachment behavior had an impact on infant's body mass index (i.e., height

Table 2 Comparison of the average of infants' weight at birth, one month and three months in the experimental and control groups −2014.

Age	sex	Groups		P-value
		Control	Intervention	
		Mean ± standard deviation	Mean ± standard deviation	
At birth	male	3021.90 ± 566.96	3157.50 ± 600.24	0.251
	female	2962.00 ± 658.88	3299.90 ± 648.00	0.016
	total	2999.60 ± 611.08	3224.20 ± 623.87	0.010
1 month	male	4072.30 ± 697.64	4129.40 ± 604.90	0.664
	female	3925 ± 688.15	4331.60 ± 781.72	0.010
	total	4000.50 ± 693.21	4224.20 ± 697.06	0.041
3 months	male	7571.70 ± 831.19	7631.20 ± 667.31	0.694
	female	7431.50 ± 849.15	8005.10 ± 814.64	0.001
	total	7503.10 ± 838.46	7806.50 ± 759.56	0.010

Unit of weight measurement: gram(g).

Table 3 Comparison of the average of infants' height at birth, one month and three months in the experimental and control groups −2014.

Age	sex	Groups		P-value
		Control	Intervention	
		Mean ± standard deviation	Mean ± standard deviation	
At birth	male	51.23 ± 2.73	51.71 ± 3.06	0.420
	female	50.96 ± 3.49	52.56 ± 3.18	0.025
	total	51.10 ± 3.11	52.11 ± 3.13	0.027
1 month	male	54.36 ± 2.65	55.08 ± 3.20	0.223
	female	54.44 ± 3.53	56.23 ± 3.23	0.014
	total	54.40 ± 3.10	55.62 ± 3.25	0.009
3 months	male	60.65 ± 2.86	61.34 ± 3.16	0.264
	female	60.43 ± 3.93	62.32 ± 2.94	0.011
	total	60.55 ± 3.41	61.80 ± 3.08	0.009

Unit of height measurement: centimeter (cm).

Table 4 Comparison of the average of infants' head circumference at birth, one month and three months in the experimental and control groups −2014.

Age	sex	Groups		P-value
		Control	Intervention	
		Mean ± standard deviation	Mean ± standard deviation	
At birth	male	35.05 ± 1.01	35.11 ± 1.14	0.783
	female	34.95 ± 1.09	35.05 ± 1.13	0.665
	total	35.00 ± 1.05	35.08 ± 1.13	0.608
1 month	male	36.70 ± 0.95	36.88 ± 1.15	0.392
	female	36.69 ± 0.98	36.86 ± 1.23	0.466
	total	36.69 ± 0.96	36.87 ± 1.18	0.257
3 months	male	39.99 ± 0.95	40.42 ± 1.13	0.044
	female	39.94 ± 1.15	40.39 ± 1.28	0.082
	total	39.97 ± 1.04	40.41 ± 1.20	0.008

Unit of head circumference measurement: centimeter (cm).

and weight). However, Hompes study is a descriptive study while in our intervention case, attachment would affect the weight and height of infants at birth. In the Hompes study, both the age of women participating in the study and the gestational age of mothers were higher. Most women in Hompes study were educated and employed (more than 70%), while in our study 78.40% of mothers were housewives. In other words, despite the differences between mother's ages, weeks of infant birth, mother's occupation and education, in both studies, mother's behavior and mood had an impact on the body mass index.

The study by Kaitz et al. showed that anxiety caused more complaints (especially in women with female fetus) during pregnancy. Moreover, group results showed that more male infants than female infants were under the influence of reduced birth weight. Female infants of anxious mothers compared with female infants of non-anxious women had lower weights.[28] This difference could be due to the fact that Kaitz's study was descriptive and lacked intervention, whereas in our study an intervention was made in the form of training attachment behaviors. On the other hand, the purpose of this intervention was not only reducing anxiety of mothers but also creating an emotional and psychological relationship between mother and infant in the prenatal period which raises the awareness of mothers, reduces their anxiety and improves their mood. Therefore, unlike Kaitz's descriptive study, this intervention cannot be considered only as a factor of reducing anxiety in women. In other words, girls responded more than boys to in utero maternal emotional behavior (touching, caressing, interacting, talking, etc.) and response to this behavior emerged in the form of improved indicators of physical growth. While boys responded more than girls to anxiety of the mother during pregnancy, and their response to the increase in stress hormones was reduced physical growth. In general, physical growth index both in boys and girls was significantly influenced by the behavior and mood of the mother during pregnancy.

Brunton believed that anxiety during pregnancy could have adverse effects on complications of pregnancy and the infant. The consequences of this stress on infant depend on how long these mood disorders existed in the mother. Stress in early pregnancy often influences pregnancy outcomes

and stress in late pregnancy often influences infants, especially in weight.[29] Field et al. concluded that depressed pregnant women were more likely to have infants with low weight infants at birth. They conducted screening tests on 336 black pregnant women in the 18th and 22th weeks of pregnancy in terms of depression. They were divided in to 205 women in non-depressed group and 131 women in depressed group. Then, at 20 and 32 weeks of pregnancy and at delivery, physical growth of infants was evaluated and compared. Accordingly, the average birth weight of the infants of depressed and non-depressed women was 3245.7 and 3310.2, respectively at significance level of $p < 0.05$, which indicated that there was a significant relationship between the two groups of pregnant women in terms of physical growth.[30]

On the other hand, Wadhwa et al. conducted a study to examine the relationship between stress during pregnancy and birth weight on 90 pregnant women during the third quarter of pregnancy. They concluded that any unit of increase in the score of the anxiety in pregnancy associated with 55.03 g of reduction in birth weight of the infants.[31] In addition to the impact of attachment, relaxation, anxiety, depression and mood disorders of mother on the infant's growth health indicators, discussed in detail in previous sections, adoption of attachment behaviors may influence the physical indicators of infants.[32]

On the other hand, in our study, maternal interaction with fetus and talking to fetus during pregnancy as attachment behaviors were taught to mothers. Adoption of this behavior along with other attachment behaviors led to better weight and height growth in the training group. In Standley's study on evaluation of the effect of mother's voice when talking with infant (attachment after birth) on premature infants with a low weight hospitalized in the intensive care unit infants whose mother's voice was played to them several times every day had better growth conditions than other infants, and they had higher oxygen saturation.[33]

Ferber investigated the effect of massage to improve the physical growth of infants and found that infants receiving massage were obviously better than others in terms of physical growth.[34] In our study, uterus massage performed during pregnancy as a method of attachment behavior during pregnancy, along with other training, led to better growth of infants in the training group. In all these studies, the incidence of maternal attachment behavior, especially during pregnancy, improved infant physical growth after birth. In other words, touching and massaging of the abdomen, observing images of sonography and hearing the sound of fetus heart, interacting and talking to the fetus and avoiding harmful substances during pregnancy, together, improved growth indices in the infants. The probable mechanism by which stress hormones can affect the growth of fetus or infant could be as follows; The uterus environment plays an essential role in shaping future growth and development. Psychological distress during pregnancy has been shown to perturb the delicate physiological milieu of pregnancy and has been associated with negative repercussions in the offspring, including adverse birth outcomes, long-term defects in cognitive development, and behavioral problems during childhood and high baseline levels of stress-related hormones.[35]

5. Conclusion

Training of attachment skills for the mother increases the rate of mother-infant attachment and improves infant growth health indicators. In other words, training of attachment behaviors increased the height and weight of female infants at birth, one month after birth, and three months after birth in this study. Although the impact of training on weight and height of male infants was not statistically significant in any of the age groups; the average index for boys in the intervention group was higher than that of control group. Training of these behaviors had no effect on the size of the head circumference at birth and in one-month-old infants but increased the size of the head circumference of three-month-old infants, especially males. Therefore, it is recommended that training of attachment skills to mothers to be performed as a component of routine cares during pregnancy.

Conflict of interests

None declared.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.pedneo.2018.08.002.