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ATTRIBUTION OF EMOTIONS TO NEUTRAL FACES BY ADOLESCENTS IN THE PRE- AND POSTOPERATIVE PERIOD AND THEIR MOTHERS

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The work examines the perception of faces by adolescents and their mothers under the stress associated with the surgery. We hypothesized that stress can facilitate attribution of negative emotions to neutral faces, while feelings of support from the mother and others can play the opposite role. This means that the bias of emotions attributed to neutrals can be used to assess the level of stress. The study involved: adolescents N1 = 46, 12—17 years old, (M = 14.02, SD = 1.57), 59% boys who were treated in the department of pediatric bone pathology and adolescent orthopedics of National Medical Research Center of Traumatology and Orthopedics named after N.N. Priorov, as well as their mothers N2 = 46 (32—51 years old, M = 41.24, SD = 4.47). The following methods were used: Social support questionnaire SOZU-22, Varga-Stolin parental attitude questionnaire, Perceived stress scales for children and adults, Pain scale. Respondents were asked to chose the most suitable adjective to each of 11 images of emotionally neutral faces. The hypotheses put forward were generally not confirmed. For mothers, despite the absence of changes in the level of stress after child's surgery treatment, the frequency of choosing positive emotions significantly increases and the frequency of attributing negative emotions to neutral faces decreases. In children, there is a significant decrease in stress after surgery, but the change in the assessment of neutral faces is associated not with the stress level, but with the assessment of pain, as well as with the characteristics of the mother's attitude and characteristics of social support. At the same time, differences were revealed between the results of girls and boys.

Keywords: adolescents, attribution of emotions, neutral faces, stress, surgery, social support, parenting attitudes.

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АТРИБУЦИЯ ЭМОЦИЙ НЕЙТРАЛЬНОМУ ВЫРАЖЕНИЮ ЛИЦА ПОДРОСТКАМИ В ДО- И ПОСТОПЕРАЦИОННОМ ПЕРИОДЕ И ИХ МАТЕРЯМИ

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Исследование посвящено изучению особенностей восприятия лиц подростками и их матерями, находящимися в условиях стресса, связанного с операцией. Мы предположили, что стресс может способствовать атрибуции отрицательных эмоций нейтральному выражению лица, а ощущение поддержки со стороны матери и других людей может играть противоположную роль. И следовательно, смещение атрибутируемых нейтральному выражению лица эмоций может быть использовано для оценки уровня стресса. В исследовании приняли участие подростки (N1=46) 12—17 лет, (M=14,02; SD=1,57), из них 59% мальчики, 41% девочки, находившиеся на лечении в отделении детской костной патологии и подростковой ортопедии НМИЦ ТО имени Н.Н. Приорова, а также их матери (N2=46) 32—51 года (M=41,24; SD=4,47). Были использованы следующие методики: Опросник социальной поддержки SOZU-22, Опросник родительского отношения Варги—Столина, Шкалы воспринимаемого стресса для детей и взрослых, Шкала боли. Для оценки респондентам было предложено 11 изображений лиц с эмоционально нейтральным выражением. Выдвинутые гипотезы в целом не подтвердились. У матерей, несмотря на отсутствие зафиксированных опросником изменений уровня стресса после операции ребенка, существенно возрастает частота выбора положительных эмоций и снижается частота приписывания отрицательных эмоций нейтральному выражению лица. У детей происходит значимое снижение стресса после операции, однако выявленное изменение оценки нейтрального выражения лица обнаруживает взаимосвязь не с уровнем стресса, а с оценкой боли, а также с особенностями материнского отношения и характеристиками социальной поддержки. Результаты анализа также свидетельствуют о различиях в атрибуции эмоций между подростками женского и мужского пола.

Ключевые слова: подростки, атрибуция эмоций, нейтральные лица, стрессовые условия, хирургическая операция, социальная поддержка, родительское отношение.

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Introduction

The ability to recognize emotions from facial expressions is an extremely important skill in terms of successfully building social interactions. That is why a significant number of researches, including those of young children, have been devoted to the study of the peculiarities of its development. A well-known example of such research is the classic experiment with a seeming cliff

[25], in which the relationship between the behavior of one-year-old children and the emotional state and facial expression of the mother was shown. Studies of the perception of emotions in young children [22; 28; 29] demonstrate the progressive development of this ability in a child, starting from 5 months, when for the first time the differentiation of positive and negative emotions by a child was revealed by different times of visual fixation on stimulus images. By early school age, the probability of correct recognition of such basic emotions as joy, sadness, fear and anger increases significantly [17; 26]. The maximum efficiency of distinguishing emotions, apparently, falls on the age of 18—30, with a slight decrease in older age [19]. Compared to younger people, older people (over 65) have more difficulty in correctly deciphering negative emotions: anger, sadness, and fear [23].

There is also evidence that the ability to recognize emotions by facial expressions is seriously impaired in a number of psychiatric diseases and psychological problems (for example, in schizophrenia, depression, anxiety disorder, attention deficit and hyperactivity disorder, behavioral disorders in children and adolescents) [7; 11].

At the same time, a relationship was found between the recognizing of some specific emotions and the emotional state of respondents, the so-called emotional congruence, which is expressed in the fact that the sensitivity to sadness is higher in respondents in a sad state, and sensitivity to joy — in those experiencing joy [3]. The categorization of emotions changes even in the situation of listening to music that differs in the mood or when reading emotionally incongruent words [18; 27]. The sad music in the experiments of N. Logeswarana and J. Bhattacharaya [16] led to an increase in estimates of the intensity of sadness and to a decrease in estimates of happiness when perceiving images of a face with a neutral expression. This fact was also confirmed by the results of a study by L. Lowry and colleagues [15] with the participation of younger (18—40 years old) and older (57—86 years old) respondents. Thus, the perception of the emotions and their valence depends on the actual state of the perceiving subject.

A number of studies published in recent years have confirmed the possibility of significant distortions in the perception of facial expression under stress. Thus, it was shown that boys of 9-10 years old, who were in an artificially created in the laboratory stressful situation, more often than their peers from the control group who were not under stress, assessed persons with an ambiguous angry-frightened facial expression as expressing fright [6]; young people of 18-30 years old under stress showed a decrease in the discrimination threshold in the perception of the emotion of surprise and an increase — in the case of disgust [8].

It was also found and confirmed by EEG recording data that respondents with high social anxiety more often attributed the emotion of anger to the neutral facial expression [20], and stress led to an increased response to stimulus images of angry faces [30]. The authors believe that the revealed tendency, namely a higher probability of attribution of negative emotions in stressful situations, is an adaptive response to a potential threat.

At the same time, there is evidence of greater sensitivity, as well as the speed of recognition of not only negative, but also positive emotions in stressful conditions, caused by the use of the Trier Social Stress Test [9; 10; 12; 14]. A study by E. Barela and A. Coen partially confirms these data: an improvement in the recognition of the emotions of anger, surprise, joy, as well as a neutral facial expression, and a decline of the fear discrimination under stress were found [5]. The study was conducted using a test procedure previously developed by the authors, in which respondents experienced short-term social stress caused by negative statements from the experimenters.

Thus, there are currently 3 assumptions about the role of stress in distinguishing emotions by facial expression:

1) sensitivity to negative emotions increases (congruent situation);

2) increased sensitivity to any emotion;

3) there is a change in sensitivity to specific emotions, regardless of their sign.

One of the interesting methodological techniques used in psychological research in recent years is the study of the attribution of emotions to neutral or ambiguous facial expressions. We were interested in the possibility of using this technique to assess the distress in children preparing for surgery and their parents. The child's dangerous illness is one of the most serious stressors for the whole family. Its effect can be quite acute and long-lasting. Currently, there are a number of approved methods aimed at assessing the stress level and related characteristics in respondents of different age groups. A comparison of the most commonly used techniques is given in the Appendix.

The main limitations of their use include: long duration, the need to use additional, sometimes expensive, equipment and the availability of skilled professionals to work with it, self-reported answers (for questionnaires), etc.

The express control method, not associated with the noted restrictions, would simplify the work with people of different ages from the risk group. We hypothesized that the level of stress experienced by the respondents would be positively correlated with the attribution of negative emotions and negatively — with the attribution of positive emotions to a neutral facial expression (***Hypothesis 1***). At the same time, social support from others, as well as a positive maternal attitude towards the adolescent on the, could act not only as a condition for her/his psychological well-being [2], but also as protective factors that reduce both the level of stress and the attribution of negative emotions (***Hypothesis 2***).

Method

Respondents. The study involved 92 people: 46 adolescents (19 girls, 27 boys, 12—17 years old; M = 14.02; SD = 1.57) with the first time diagnosed benign tumors and tumor-like diseases, who were treated in the Department of Pediatric Bone Pathology and for adolescent orthopedics of National Medical Research Center of Traumatology and Orthopedics named after N.N. Priorov from March 2019 to March 2020, as well as their mothers (32—51 years old; M = 41.24; SD = 4.47), who expressed their informed consent to be included in the study.

Research procedure and measures. All study participants (both adolescents and their mothers) completed the set of psychological techniques twice — upon admission to the hospital and after surgery. We assumed that before the surgery, adolescents and their mothers would experience more stress and would attribute the emotional states of fear, uncertainty and confusion to a neutral face more than after successful operation. For each child, data were obtained on the diagnosis, the trauma of the operation, the type of anesthesia used and the further prognosis for health.

A battery of psychological techniques for children included:

- Perceived Stress Scale for children (PSS-C), B. White, 2006;
- Social support questionnaire SOZU-22, J. Sommer, T. Füdrik, 1993, adapted by A.B. Kholmogorova, 2007;
- 10-point Wong-Baker Faces Pain Rating Scale.

Mothers completed the following set of methods:

- Perceived Stress Scale — PSS (adapted by V.A. Ababkov and colleagues);
- Varga-Stolin parental relationship questionnaire (PRQ);
- Social support questionnaire SOZU-22.

Also, at each survey, all respondents were offered a set of photographs of children and youth (N = 11) with neutral emotional expressions [4]. The images were printed in color on a white background, photo size — A5 (148x210 mm), face size — 95x140 mm. We proposed 3 adjectives with positive, neutral and negative connotation to describe the emotional state of each sitter, for example, contented — thinking — suffering (Fig. 1).

Fig. 1. An example of a stimulus image used to study the attribution of emotions to neutral faces

The instruction for the adolescents was formulated as follows: "Look carefully at each image, three words are placed around the photo. Choose the word that best, from your point of view, describes the feelings and thoughts of the person depicted in the photograph. Let's start with this one (starting with a sample card). Look at this man. How do you think he feels? What is his face expression — playful-frightened-calm (we point to the words at the image when we call them)?" Then we assessed the frequency of positive, neutral and negative emotions chosen by each participant.

Results

It should be noted that the adolescents who took part in the study underwent mainly reconstructive plastic surgery or marginal resections to remove tumors. As a result of the surgical intervention, 34 adolescents (73.91%) received a certain favorable prognosis, 12 adolescents — the uncertain one, no unfavorable prognosis was noted. When compared using the Mann-Whitney test, no significant differences were found in the indicators of the attribution of emotions and the level of stress for adolescents with a favorable and uncertain prognosis and for their mothers. The

results of the analysis indicate only higher values of satisfaction with social support among mothers with a favorable prognosis (p = 0.062). So at further analysis we did not divide respondents into groups according to the prognosis criterion.

The data obtained for the entire sample are presented in the Table. It has been shown that after surgery, there is a decrease in the level of perceived stress in adolescents, but not in their mothers. It should be noted that the values of the stress level in adolescents in both the first and second measurements are mainly in the zone of low and medium stress levels (the maximum possible value is 39 points). At the same time, only in two adolescents before the operation the stress value exceeded 20 points, after the operation the stress level significantly decreased. At the same time, the level of stress in mothers remained at an average and high level throughout the entire examination period — both before and after surgery (standard values: low level — 0—13 points, average level — 14—26 points, high level — 27—40 points).

Table

Descriptive statistics on emotion attribution and stress levels before and after surgery

Indicators	Before surgery				After surgery				Difference between measurements
	Min	Max	Average	St. dev.	Min	Max	Average	St. dev.	Z Wilcoxon
Perceived stress (adolescents)	3	28	12,43	5,14	4	20	10,11	3,89	-2,999**
Pain level (adolescents)	0	8	2,04	2,15	0	7	2,02	1,94	-0,216
Perceived stress (mothers)	14	35	25,64	4,54	15	36	24,68	5,33	-1,191
Attribution of positive emotions (adolescents)	2	8	4,05	1,51	1	7	4,05	1,74	-0,11
Attribution of neutral emotions (adolescents)	2	7	4,02	1,24	1	9	4,05	1,83	-0,094
Attribution of negative emotions (adolescents)	0	6	2,88	1,22	0	8	2,90	1,92	-0,05
Attribution of positive emotions (mothers)	0	6	3,32	1,32	2	7	4,13	1,64	-2,578**
Attribution of neutral emotions (mothers)	1	7	4,42	1,57	0	8	4,26	1,87	-0,341
Attribution of negative emotions (mothers)	1	6	3,18	1,41	1	8	2,62	1,58	-2,54*

Note: significant differences are marked, * — p <0,05; ** — p <0.01.

Apparently, the parents' worries about the child's illness do not end with the successful completion of the surgery, sometimes mothers only at this stage allow themselves to emotionally react to a stressful situation. The results of the analysis indicate that in the group of mothers attribution of positive emotions to neutral expression are higher after the operation than before

the operation; at the second measurement mothers of the operated children still more often see positive emotions in neutral faces and less often negative ones in comparison with their results before surgery, however, for low stress this dynamics can be seen only as a trend. At the same time, no correlation was found between the level of stress severity and the likelihood of attribution of emotions of a particular sign in adolescent mothers.

As for the attribution of emotions in the group of adolescents, no significant changes in the assessments of faces were found. We hypothesized that despite the decrease in the stress level associated with the first operation in their life, adolescents who remain in the hospital continue to experience a state of emotional and physical discomfort: postoperative pain, everyday inconveniences of being in a multi-bed ward, isolation from their usual lifestyle and friends. To clarify this kind of assumption, it is necessary in the future to use the diagnostic tools that are more sensitive than PSS to assess the dynamics of adolescents' emotional and psychophysiological state.

Comparison of the results of groups of adolescents for whom the number of choices of negative emotions increased (N = 16) and decreased (N = 15) did not reveal significant differences. For further analysis, we chose a group of adolescents who demonstrated the increase of positive attributions after the surgery (Group 1, N = 16), and compared them using the Mann-Whitney criterion with a group of adolescents for whom such changes were opposite (Group 2, N = 14). The results of children who did not show any changes were not considered. The analysis indicates lower pain level both before and after surgery in adolescents of the first group ($p < 0.05$), as well as a lower level of stress and efforts to overcome it in their mothers during the second measurement (after surgery). There were no significant differences in the parenting attitudes (PRQ) and social support (SOZU-22).

Assuming that pain is the most important factor both in the pre- and postoperative period, we conducted a comparative analysis of the all the indicators in a group of adolescents whose pain decreased after surgery (Group A, N = 16) and those whose pain increased (Group B, N = 16). We found significantly higher values of satisfaction with social support for adolescents of group A ($p = 0.045$) and their mothers ($p = 0.074$), as well as higher frequency of their choice of positive emotions. Thus, our hypothesis 1 was not confirmed. For the adolescents in a situation of surgical treatment, attribution of emotions to a neutral facial expression was associated not with the level of stress, but with the level of pain.

Analysis of the relationship between the level of experienced stress and such factors as the attitude of parents towards the child and the presence of social support demonstrated a significant negative relationship between child's stress level and his/her acceptance by mother (Spearman's Rho = -0.376, $p < 0.05$) for all participants in the adolescent group. The attitude to a child as a "little loser" showed tendency to correlate with the frequency of choosing negative definitions for describing emotions (Rho = 0.29); this relationship was more pronounced in for boys (Rho = 0.34), and for them this mother's attitude was significantly correlated with the level of stress (Rho = 0.531, $p < 0.01$). Lack of emotional support from others was also a stressful factor for adolescent boys (Rho = — 0.413, $p < 0.05$); at the same time, it is also possible that under stressful conditions, boys are less sensitive to the support expressed by others. The higher the perception of the emotional support, the more often boys describe faces as having a neutral expression (Rho = 0.456, $p < 0.05$).

The results of the group of adolescent girls indicate that the most important factor for them is the symbiotic attitude of the mother — it correlated both with the level of stress (Rho = 0.443) and with the choice of positive and neutral definitions when describing facial expressions

(Rho = — 0.630 and 0.617 at p <0.01). The severity of stress and pain, in turn, correlated with the choice of neutral definitions for describing facial expressions (Rho = 0.702 and 0.789 at p <0.01, respectively). Indicators of the level of social integration and the level of stress in adolescent girls are in a negative relationship (Rho = — 0.527, p <0.05). The methodological toolkit chosen in this study does not allow us to draw an unambiguous conclusion about the causal relationships between the described phenomena, but it can be assumed that the influence of the selected factors is reciprocal — a high level of stress prevents the establishment of reliable social interactions, and insufficient involvement in a society serves as an obstacle to using the resource of communication with friends to counteract stress.

Thus, it is impossible to speak of a simple relationship between the characteristics of mother's attitude to her child, the level of social support with stress level and the tendency to choose positive or negative definitions for neutral faces, i.e., hypothesis 2 was also not confirmed. However, it is necessary to pay attention to the differences in the nature of the experience of pre- and postoperative stress between boys and girls. Boys are more sensitive to mother's negative attitude towards their failures and the lack of emotional support from others. The results of the analysis of assessing facial expressions indicate that in a favorable situation the frequency of choosing neutral definitions increases. For girls, the disadvantages are the mother's symbiotic relationship and lack of social integration. Their choice of neutral definitions for describing facial expressions on the contrary is a sign of the high levels of pain and stress.

Discussion

So, we can make a conclusion about the contradictory nature of the results obtained. On the one hand, changes in mothers' assessments of neutral facial expression before and after surgery on their child could be a more sensitive marker of stress changes than the traditionally used PSS-10 questionnaire. During conversations with a psychologist, mothers constantly pointed to an improvement in their condition, which was not shown by PSS, however, most of them allowed themselves to demonstrate their emotions only after a successful surgical intervention. At the same time, they paid attention to the necessity to focus on their son's or daughter's recovery, and were actively involved in organizing the child's further rehabilitation. At this stage, re-filling long psychological questionnaires was often seen as tedious and unnecessary. At the same time, the performance of short, non-blank techniques (Relationship Color Test and Emotion attribution to faces) was perceived more positively.

The adolescents also showed the same more interested attitude to the assessment of emotions from facial images than the questionnaires.

Our data indicate gender differences in the characteristics of experiencing stressful situations and are consistent with the results of studies by M. Klabunde, I.-D. Sigfusdottir, N.L. Piquero [13; 21; 24] and many others, confirming the existence of differences in psychophysiological and psychological reactions to stress in girls and boys. For example, girls in stressful conditions often try to close themselves, which correlates with our data on a decrease in the likelihood of attribution of emotions and the choice of neutral descriptions of faces in situations of greater stress. In boys, the state of stress, on the contrary, attracts attention to the outside world, increasing the frequency of attribution of emotional manifestations from photographs. However, for a more detailed study and analysis of the patterns of attribution of emotions by facial expression by adolescents, an increase in the sample of participants is required.

It's very important to discuss the limitations of this study. First of all, it is a question of organizing the stimulus material. We have moved away from the traditional morphing option in favor of more ecologically valid images of real faces. However, the respondents were limited in each case to only three of the definitions we proposed to describe the emotional state of a sitter. In the future, it is planned to propose a different instruction for performing the experimental task, according to which the participants could freely describe the emotional state of the persons on the stimuli photos.

Serious limitations are also associated with the small number and variety of facial images used as stimuli. And here, probably, one should take into account the results obtained in the study of V.A. Barabanschikov and E.G. Khose that the configuration of a sitter's face can contribute to the attribution of a particular expression, even for neutral face [1]. When changing faces using the FantaMoph program, the authors found that, for example, an increase in the height of the mouth and eye line, as well as the distance between the pupils, led to the evaluation of a calm face as joyful, and a decrease in the height of the mouth and eye line with an increase in the length of the nose gave the face an expression of fear. Probably, in the future, it is also necessary to assess the proportions of the faces, which were selected as a stimulus material.

The next limitation is in the methods for assessing the level of severity of stress. Insufficiently wide variability of this parameter in our case limited the possibility of distinguishing contrasting groups. This problem can be overcome, from our point of view, by including a control group of respondents in calm conditions in the study.

The study of additional factors related to the choice of neutral or emotional definitions for facial expressions in girls and boys also requires attention. Being in a stressful situation and the presence of constant pain in girls lead to their withdrawal in themselves and a decrease in reaction to other people's emotions. That is why, from our point of view, girls tend to describe facial expressions as neutral. The symbiotic relationship with the mother also allows the girl to stay out of contact with the "alien" world. The specificity of the regularities of recognizing facial expressions in boys seems to be somewhat different: mother's negative attitude to the failures and problems of the child leads him to seek support in other people, and therefore to increased attention to their emotional state. At the same time, the feeling of emotional support from others correlates with a decrease in the level of stress and, probably, reduces the need to read the emotions of others, making them less sensitive to them.

Conclusions

Our hypotheses about the relationship between the probability of attribution of negative emotions and the level of stress, the attitude of the mother to the child, and social support in general have not been confirmed.

In mothers, despite the absence of changes in the level of stress measured by the PSS questionnaire after the operation of the child, the frequency of choosing positive emotions significantly increases and the frequency of attributing negative emotions to a neutral facial expression decreases. This means that the methodology for diagnosing the level of stress based on the assessment of the emotional state of a person by the expression of his face appears to be, taking into account the data obtained in the study, more effective than standard questionnaire diagnostic methods.

The results of this study indicate a significant decrease in the level of stress in children after surgery; however, the change in the assessment of neutral facial expressions turns out to

be associated not with the level of stress, but with the assessment of pain, as well as with certain characteristics of maternal attitude and social support. The obtained data also indicate gender-related differences in the characteristics of the experience of pain, stressful situations and coping strategies: boys are characterized by increased sensitivity to the maternal attitude towards their failures and emotional support from others. For girls, the risk factors are the mother's symbiotic relationship and lack of social integration. Their choice of neutral definitions of faces is associated with high levels of pain and stress.

The tasks of further research in this area and the development of a valid method for assessing the level of stress severity are to increase the sample size, study the features of assessing the emotional state of another person by the expression of his face in a stressful situation with the involvement of a control group, as well as expanding and validating the database of facial expressions.

Application

Methods for assessing stress levels

	Self-reported methods		External assessment	Projective techniques	Instrumental methods
	The experience of stressful events in life	**Assessment of one's own state**			
Examples of methods	Questionnaire about traumatic situations — Life Experience Questionnaire-LEQ (Norbeck, 1984; Tarabrina, 2007); The Life Events and Difficulties Schedule — LEDS (Brown, Harris, 1978); The Stress and Adversity Inventory — STRAIN (Slavich, Shields, 2018)	Mississippi Scale-MS (Keane et al., 1987; Tarabrina, 2007); Questionnaire for assessing the severity of psychopathological symptoms — Simptom Check List-90-r-Revised, SCL-90-R (Derogatis et al, 1973; Tarabrina, 2007); Perceived Stress Scale — PSS-10 (Cohen et al., 1983; Ababkov et al., 2016)	Coding of observed behavioral and facial expressions in infants (Grunau et al., 1987), Clinical observation of the child (Yoo et al., 2014)	Draw-A-Person test; House—Tree—Man; «Man in the Rain»; Positive and Negative Affect Test — IPANAT (Mitina, Padun, Zelyanina, 2017)	Measurement of heart rate, RR, blood pressure, SaO2, cortisol levels, etc.
Content	The respondent reports on the presence in his life of events from the list of potentially stressful situations	The respondent reports on his own psychological or behavioral characteristics typical to people in a stressful situation.	The observer records the external manifestations of stress in the evaluated person	Stress manifests itself when completing a seemingly neutral task	Measurement of physiological and biochemical correlates of stress
Limitations	They do not provide information about the subjective experience of events, their stressfulness. Do not work in case of stress caused by future events or chronic stress/	MS and SCL-90 work more with post-traumatic conditions, assess the level of PTSD, they are less sensitive for low stress	Requires long-term qualified observation	Difficulty of interpretation, higher contribution of individual characteristics of respondents	The need for special equipment and the ability to work with it, additional stress of respondents (especially children) caused by instrumental examination; ambiguity in the relationship between physiological and psychological characteristics (for example, a change in cortisol level may be associated with the dynamics of infectious disease, heart rate correlates with body temperature)/

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