

# Maternal anxiety in relation to growth failure and growth hormone treatment in children

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## Abstract

Health disorders in mothers and their children are subject to mutual influences arising from the nature of mother–child relationship. The aim of the study was to analyze the issue of anxiety amongst mothers of short children in aspect of growth hormone (GH) therapy in Poland.

The study was based on a group of 101 mothers of originally short-stature children: 70 with GH deficiency treated with recombinant human GH and 31 undergoing the diagnostic process, without any treatment. Collected medical data included the child's gender, height and weight, chronological age, bone age delay, and GH therapy duration. For all children the height SDS (standard deviation score of height) and BMI SDS (standard deviation score of body mass index) were calculated. The Spielberger State-Trait Anxiety Inventory (STAI) was used to evaluate anxiety levels among the recruited mothers. Obtained results revealed low trait anxiety levels in all mothers, with no statistically significant differences between the groups. State anxiety levels were significantly higher in mothers of children without diagnosis and treatment than in mothers of children receiving appropriate therapy. Significantly lower levels of maternal state anxiety were observed during the first stage of the GH therapy, and they were further reduced in mothers of children treated for more than 4 years.

Growth failure in Polish children is not associated with high maternal anxiety as a personality trait, but lack of diagnosis and lack of appropriate treatment seem to generate high levels of anxiety as a transient state in mothers. The initiation of GH therapy induces a substantial reduction of maternal state anxiety, and the duration of this treatment causes its further decrease. Mothers of short children undergoing diagnostic process could benefit from psychological support, but it seems to be unnecessary when their children are treated with GH.

**Abbreviations:** BMI = body mass index, GH = growth hormone, GHD = growth hormone deficiency, rhGH = recombinant human growth hormone, SDS = standard deviation score, STAI = State Trait Anxiety Inventory.

**Keywords:** anxiety, short stature, growth hormone therapy, mothers, children

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## 1. Introduction

Health disorders in mothers and their children are subject to mutual influences arising from the nature of mother–child relationship. The development of this essential relation is initialized during pregnancy, and after childbirth the mothers of new-born babies undergo neurobiological changes supporting maternal attachment.<sup>[1–3]</sup> This process is influenced by multiple factors, including maternal psychological state, not only in terms of well-known depression, but also anxiety. Mothers with anxiety disorders are less engaged, less responsive, and demonstrate lower levels of sensitivity. These factors negatively affect mother–child relationship and increase the risk of disturbances in the child's development,<sup>[4,5]</sup> whereas long-term stress and negative emotional stimuli are the essential elements of the environment that may affect growth in children, causing temporary and reversible growth hormone deficiency.<sup>[6]</sup>

Short stature, when occurs as an isolated symptom, is not a life threatening condition. Children's intellectual development and motor abilities do not differ substantially from the average. Younger children in fact do not realize they are different. At the age of 8 to 9 years short children begin to be aware of their height in relation to others and at this point growth failure may influence negatively their psychosocial functioning.<sup>[7]</sup> Short stature is the essential symptom of growth hormone deficiency (GHD) in the developmental age.

Treatment with recombinant human growth hormone (rhGH) allows children to grow, but it requires regular daily injections, multiple medical check-ups, and many years of continuous therapy to sustain sufficient growth. On the one hand, we have short-stature, but apart from that a generally healthy child, on the other—many years of regular injections and medical check-ups.<sup>[8]</sup>

Motherhood affects the mental state of women in numerous ways. The experience of being a mother may give some beneficial changes, as it is linked with an overall lower stress response and with improvements in certain aspects of memory,<sup>[9,10]</sup> nevertheless, motherhood is related to additional factors favoring depression, stress, and anxiety. Postpartum depression is a well-documented disturbance, but also mothers of older children may experience higher levels of stress and anxiety, especially if their children have health disorders.<sup>[11,12]</sup> There are reports regarding the influence of short stature and growth hormone therapy on quality of life, behavior, emotional status, and other aspects of psychosocial functioning in children.<sup>[13–18]</sup> Still, little is known about the maternal psychological functioning in this condition, which is quite surprising considering the nature of the mother–child relationship.

The aim of the present study was to analyze the complex interplay between short stature in children and the anxiety levels in their mothers. Could high anxiety trait in mothers be associated with growth failure in their children? Could anxiety represent a transient state of a mother whose child is affected by growth failure? What is the influence of growth hormone therapy in short children on the anxiety levels in their mothers?

## 2. Materials and methods

The study was based on a group of 101 mothers of children with growth failure: 75 boys and 26 girls aged 5 to 16 years. In this group, 70 children received a diagnosis of GHD and were treated with rhGH for a variable period of time; 31 children were undergoing the diagnostic process required to determine the short stature aetiology, without any treatment. Detailed group characteristics are presented in Table 1. Only mothers with one short-stature child were recruited. All mothers were evaluated during the medical check-ups of their children. The study excluded adoptive mothers, and those whose children had additional chronic or acute diseases that could affect test results.

Medical data collected for the purposes of the study included the child's gender, height and weight, chronological age, bone age delay

(estimated as a difference between the bone and the chronological age), and growth hormone therapy duration. Based on these data, for all the children the height SDS (standard deviation score of child's height in relation to gender and age) and BMI SDS (standard deviation score of child's body mass index in relation to gender and age) were calculated in accordance with the guidelines.<sup>[19,20]</sup>

The Spielberger State-Trait Anxiety Inventory (STAI) was used to assess the anxiety levels in mothers.<sup>[21,22]</sup> It is a widely used, 40-item questionnaire that estimates both state (STAI-S) and trait anxiety (STAI-T). Anxiety as a state is interpreted as a transient condition, and anxiety as a trait is considered as a relatively constant feature of personality. The first part (questions 1–20) assesses anxiety reactions to the current situation, the level of anxiety at the time of the study. The second part (questions 21–40) evaluates the individual predisposition to experience anxious responses. The questionnaire rates all the responses on a four-point intensity scale ranging from 1 to 4. Subsequently the results are calculated into sten scores, defined by reference to a standard normal distribution, with a mean of 5.5 and a standard deviation of 2. Interpretation of the scale: 5 to 6 sten scores points at the average intensity of anxiety, below these values anxiety is rated as low, while above is rated as high. STAI has strong psychometrics. The reliability of Polish version was based on internal compliance and absolute stability assessment of both its subscales. Internal compliance calculated by Cronbach's alpha coefficient is 0.84 to 0.94.

Medical data and psychological questionnaires were collected and analyzed in years 2015 to 2019. Participation in the study was voluntary.

In the statistical analysis Kolmogorov–Smirnov test was used in evaluating the compatibility of the variables with the normal distribution. For quantitative variables compatible with the normal distribution Pearson correlations were calculated, while Spearman correlations for qualitative and non-normally distributed variables. Subsequently, the test of significance for a correlation coefficient was used to assess the relevance of interdependence for all correlations between the analyzed traits. Furthermore, a one-sided test of means with two groups and different variances was used (Student's *t* test). For the examined model, also ANOVA test for independent samples was performed followed by a post hoc NIR test. The statistical power analysis for the obtained sample size was 0.966. *P* value < .05 was prospectively determined to indicate significant differences. Statistical analysis was performed in Gretl 1.10.1.

The study has been carried out in accordance with the Code of Ethics of the World Medical Association. Its protocol was

**Table 1**  
Clinical characteristics of analyzed group of children with short stature, and anxiety levels of their mothers.

		All originally short statured children (N = 101)	Children with GHD treated with rhGH (N = 70)	Short children without diagnosis and treatment (N = 31)
Gender	Boys	75	54	21
	Girls	26	16	10
Age (years)		11.06 ± 3.72*	12.16 ± 3.45*	8.55 ± 3.09*
Bone age delay (years)		1.78 ± 1.08*	1.65 ± 1.08*	2.10 ± 1.02*
rhGH treatment duration (years)		–	2.59 ± 1.99*	–
BMI-SDS		–0.21 ± 0.86*	–0.17 ± 0.85*	–0.32 ± 0.88*
Height SDS		–2.12 ± 1.03*	–1.86 ± 1.04*	–2.70 ± 0.75*
Maternal state anxiety (sten scores)		5.77 ± 1.78*	5.39 ± 1.56*	6.64 ± 1.96*
Maternal trait anxiety (sten scores)		4.44 ± 1.88*	4.29 ± 1.78*	4.74 ± 2.09*

BMI = body mass index, GHD = growth hormone deficiency, rhGH = recombinant human growth hormone, SDS = standard deviation score.

\* Mean value ± standard deviation.

**Table 2****Correlations of anxiety levels in mothers with their children medical data.**

	All mothers (N=101)		Mothers of children with GHD treated with rhGH (N=70)		Mothers of short children without diagnosis and treatment (N=31)	
	State anxiety	Trait anxiety	State anxiety	Trait anxiety	State anxiety	Trait anxiety
Age	$r=-0.31$ $P=.002$	$r=-0.05$ $P=.96$	$r=-0.33$ $P=.007$	$r=-0.06$ $P=.62$	$r=0.08$ $P=.67$	$r=0.28$ $P=.13$
Gender	$r=0.09$ $P=.38$	$r=0.17$ $P=.10$	$r=-0.01$ $P=.96$	$r=0.10$ $P=.40$	$r=0.38$ $P=.39$	$r=0.25$ $P=.17$
Bone age delay	$r=0.04$ $P=.70$	$r=0.03$ $P=.76$	$r=0.19$ $P=.12$	$r=0.13$ $P=.30$	$r=-0.06$ $P=.75$	$r=-0.100$ $P=.62$
rhGH treatment duration	$r=-0.23$ $P=.23$	$r=-0.002$ $P=.99$	$r=-.06$ $P=.62$	$r=0.11$ $P=.37$	–	–
BMI SDS	$r=-0.01$ $P=.89$	$r=0.06$ $P=.57$	$r=0.04$ $P=.73$	$r=0.02$ $P=.88$	$r=-0.04$ $P=.83$	$r=0.16$ $P=.38$
Height SDS	$r=-0.17$ $P=.10$	$r=-0.03$ $P=.76$	$r=-0.04$ $P=.74$	$r=0.02$ $P=.86$	$r=-0.09$ $P=.65$	$r=-0.005$ $P=.98$

BMI=body mass index, GHD=growth hormone deficiency, rhGH=recombinant human growth hormone, SDS=standard deviation score.

approved by the local Ethics Committee at Poznan University of Medical Sciences. All mothers gave informed consent.

### 3. Results

Anxiety as a trait was low in all the recruited mothers, and no statistically significant difference ( $P=.156$ ) emerged in a subgroup analysis based on their children treatment status (i.e., lack of a diagnosis/treatment vs GHD under treatment). However, when considering anxiety as a state the overall sample presented medium anxiety levels and a statistically significant difference emerged between the two subgroups, with the mothers of children without a diagnosis or treatment presenting higher levels of anxiety ( $P=.001$ ). Detailed results are presented in Table 1.

The results further suggest an inverse association between maternal state anxiety and the child's chronological age in the subgroup undergoing pharmacological treatment, with the mothers of younger children experiencing the highest levels of state anxiety; the association was lost when analyzing the subgroup with no diagnosis or treatment (Table 2). Furthermore, no correlation was observed between maternal state anxiety and the child's gender, bone age delay, height SDS or BMI-SDS.

Anxiety levels in mothers were also associated with the duration of rhGH treatment (Tables 2 and 3). Statistical analysis was performed for all mothers, and for this purpose the total sample was divided into four subgroups: mothers of not treated children, treated for a short period of time (up to 1 year), treated

for a moderate period of time (from 1 to 4 years), and treated for a long period of time (above 4 years). Significant reduction of maternal state anxiety was observed at the first stage of the therapy, and then was further reduced in mothers of children treated for more than 4 years.

### 4. Discussion

The illness of a child, including short stature, or the need for ongoing growth hormone treatment, requires numerous adaptations in many aspects of the everyday life for the child and the family, which in turn demands mastering new psychological competencies. This includes expectations of parents towards their children's appearance, effects of the therapy, and a child's potential positive or negative reaction to the therapeutic process. Parents may be concerned about the necessity of long-term treatment, the method of growth hormone administration (injections), as well the potential side effects, but also often ask themselves questions about the future life of their children, the impact of the disease on education, daily life, contacts with peers. Parental distress may in turn generate problems with self-esteem in a child and impair developing skills related to the appropriate treatment.<sup>[2,3,24]</sup> What is important, effective therapy with growth hormone requires close cooperation of parents with attending physician, and their understanding of the treatment principles, as they are responsible for daily medicine administration at home, in strict accordance with medical recommenda-

**Table 3****Maternal anxiety in aspect of growth hormone treatment duration in children.**

	Growth hormone treatment duration (years)	N	Mean ± standard deviation
State anxiety (sten scores)	0 (not treated)	31	6.64 ± 1.96 <sup>A,B</sup>
	From 0.25 to 1	25	5.24 ± 1.23 <sup>A</sup>
	From 1 to 4	29	5.76 ± 1.64
	Above 4	16	4.94 ± 1.77 <sup>B</sup>
Trait anxiety (sten scores)	0 (not treated)	31	4.74 ± 2.09
	From 0.25 to 1	25	4.12 ± 1.61
	From 1 to 4	29	4.41 ± 1.92
	Above 4	16	4.37 ± 1.82

<sup>A</sup> $P=.003$ .<sup>B</sup> $P=.005$ .

tions.<sup>[25–27]</sup> In conclusion, parental attitude and emotional state may, in a favorable or unfavorable manner influence the effectiveness of treatment.

The STAI, used in the present study to evaluate the level of anxiety in mothers, allows to distinguish between state and trait anxiety. State anxiety, as a transient condition, is characterized by high volatility under the influence of a wide variety of stressors. Trait anxiety, as a feature of personality, determines predisposition to initiate anxiety behavior during cognitive processes. Research studies indicate that people with high trait anxiety, compared to those with its low intensity, do not necessarily demonstrate permanently higher levels of state anxiety. They will however react with anxiety in situations highly threatening or perceived as stressful by them.<sup>[22]</sup>

Analyzing the issue of short stature in children, maternal state anxiety could be interpreted as a transient reaction, related to the diagnostic process and unclear health status of the child, resolving when the appropriate treatment is initiated and the child begins to grow. It could also be associated with a long-term and inconvenient process of treatment, but then the levels of state anxiety in mothers would not decrease during the therapy. Trait anxiety, as a relatively constant attribute of personality, should not be subject to substantial changes, but mothers with high basic levels of trait anxiety may be sensitive to any distress. Narrow field of interest and a tendency to interpret signals in a particular way may escalate anxiety as a state.

The results of the present study show high levels of state anxiety in mothers of short children without final diagnosis and treatment, significantly higher than in mothers of children diagnosed with GHD and treated with growth hormone. This means that unclear health status and uncertain medical prognosis regarding further growth is generally a much stronger stressor for mothers than the necessity for long-term treatment and regular injections.

Surprisingly—obtained results point at the low level of trait anxiety among all the analyzed mothers—lower than the average. Perhaps for mothers with low trait anxiety it is easier to deal with the problem of short stature in their children, and to seek a solution to this problem, which is a medical specialist advice. It is possible that mothers with higher levels of trait anxiety find it more difficult to solve the problem, and so they less frequently get proper medical care. It cannot also be excluded that mothers with a higher level of trait anxiety would avoid participating in a voluntary survey. Still, this result indicates that the occurrence of short stature in children is not related to high maternal trait anxiety.

Mothers of younger children present higher levels of state anxiety, which may result from the nature of mother–child relationship and a pronounced dependence of younger children on their mothers. However, in the group of children treated with growth hormone, the observed reduction of state anxiety in mothers associated with the increase in child's age may be related to the duration of treatment and the gradual improvement of growth, because in the group of untreated children its level remains consistently high and did not change with advancing age.

Analysis of maternal anxiety in relation to height SDS revealed no statistically significant dependency on the degree to which children's height differs from the average in a population of appropriate age and gender. A similar analysis performed for BMI-SDS showed that the relative excess or deficiency of body weight in children have also no impact on the level of anxiety in mothers.

In turn, the rhGH treatment duration plays an important role in regulating maternal anxiety level. It seems like it is enough just to implement this therapy to reduce state anxiety, even before obtaining its visible effectiveness—the growth improvement. Anxiety decreased significantly in the first year of the medicine administration, despite struggling with the new situation, with regular injections and medical check-ups. A slight increase during the period from 1 to 4 years of the therapy could be a delayed result of the treatment inconveniences. The lowest level of state anxiety observed among mothers of children treated for more than 4 years may be further associated with improved growth, as a result of prolonged treatment.

Anxiety is the most common disease-associated reaction, and due to its vegetative and motivational nature, it affects the treatment process. The level of anxiety is subject to change depending on the individual situation, stage of treatment and other personality traits.<sup>[21,27]</sup> In the initial stage of the disease, moderate anxiety favors rising activity, determining plans, and taking actions. Thereafter, if the anxiety persists, it often leads to excessive concentration on health and overprotection, but it can also promote the mechanism of denial and non-compliance with medical recommendations and even sometimes the withdrawal from treatment.<sup>[8,23,28]</sup> That would be a substantial problem in mothers of children treated with growth hormone, since the efficacy of this therapy depends primarily on strict compliance with medical recommendations—regarding dosage, method of administration and the medication storage. In this group, however, the level of anxiety is average and low, so it should not affect the treatment course. In turn, state anxiety in mothers of not treated children is high, so it may have a negative impact on the diagnostic process and bring the risk of discontinuation of tests aimed to find the cause of short stature. In this group, it would be advisable to identify mothers with the highest level of anxiety and provide them with psychological support to reduce the risk of children dropping out of care.

Our study analyzed the present psychological condition of mothers, and while anxiety as a maternal personality trait should be relatively stable throughout the child's life, the maternal anxiety as a state was probably subject to multiple changes. For further research, it would be advisable to evaluate and analyze also other, apart from anxiety, personality traits of mothers. It would also be valuable to estimate maternal psychological condition in terms of substantial distress in the past, especially during the infancy of children being later diagnosed and treated due to short stature.

## 5. Conclusions

Growth failure in Polish children is not associated with high maternal anxiety as a personality trait. However, lack of diagnosis and lack of appropriate treatment in short children seem to generate high levels of anxiety as a transient state in their mothers—higher than the process of growth hormone treatment with its inconveniences. The mere commencement of the therapy causes a substantial reduction of state anxiety in mothers, and advancing duration of treatment causes its further decrease.

Mothers of short children undergoing diagnostic process could benefit from psychological support, but it seems to be unnecessary when their children are treated with growth hormone.

## Author contributions

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