

# Depressive disorders in children with chronic kidney disease treated conservatively

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## Abstract

**Background.** Children with chronic kidney disease (CKD) experience a lot of mental and emotional stress, which can lead to the development of depressive disorders. The prevalence of depressive disorders in CKD children is estimated to be between 7% and 35%.

**Objectives.** The aim of our study was to analyze the prevalence and characteristics of depression and depressive symptoms in children and adolescents with CKD treated conservatively.

**Materials and methods.** The cross-sectional, multicenter study was conducted in 73 CKD children aged 8–18 and in 92 of their parents. To assess the mental wellbeing of CKD children, Kovacs's Children's Depression Inventory 2 (CDI2) was used as CDI2: Self-Report and CDI2: Parent Form.

**Results.** The majority of CKD children acquired medium scores in CDI2, 11% of participants reported symptoms suggesting depressive disorder, and among them 8.2% met the criteria for depression. A significant relationship was found between age and interpersonal problems, age at CKD diagnosis, and total score and ineffectiveness, CKD duration and total score/emotional problems. Depressive symptoms were associated with the stage of CKD, and they differed significantly between stages III and IV. We noticed the child–parent disagreement on reported depressive symptoms. Parents perceive their children's mental state as worse than the children themselves.

**Conclusions.** There is a problem of depression in children with CKD treated conservatively. Variables associated with depressive symptoms in CKD children treated conservatively require further study. Key factors predisposing to the development of depression seem to be age at the time of diagnosis, disease duration, and progression of CKD from stage III to IV. Disparities between depressive symptoms self-reported by CKD children and their parents' assessment require further analysis. However, these disparities indicate that the final diagnosis of the occurrence of depressive disorders should be based on a multidimensional assessment of the patient's situation.

**Key words:** children, chronic kidney disease, depressive disorders, Kovacs's Children's Depression Inventory 2

## Background

Chronic kidney disease (CKD) significantly impacts children's quality of life. As a disease with no definitive cure, CKD requires children to receive long-term medication, regular examinations and hospitalizations.<sup>1</sup> Children with CKD experience an increased amount of psychological stress.<sup>2,3</sup> The disease may also influence patients' mental and emotional health, which can result in symptoms of depression and anxiety.<sup>4,5</sup>

According to DSM-5 criteria for children and adolescents, clinical depression (major depressive disorder (MDD)) is characterized as a combination of depressed mood or loss of interest or pleasure lasting most of the day, nearly every day for 2 weeks or longer. It must be accompanied by 4 or more additional symptoms and cause clinically significant distress or impairment.<sup>6</sup> Depression in the presence of chronic somatic disease may also influence how the patient perceives a disease and whether they will adhere to medical recommendations. Finally, it may be connected to CKD progression and all-cause mortality.

In the adult population, the prevalence of interview-diagnosed depression amounts to 22.8% of patients with end-stage CKD and 26.5% of those with CKD stages 1–5.<sup>7</sup> According to World Health Organization (WHO), around 10% of children and adolescents have a mental disorder, and 3% develop a depressive disorder.<sup>8</sup> In a study conducted by Kogon et al., 7% of children and adolescents with CKD met the study criteria for depression, and 5% reported elevated depressive symptoms.<sup>9</sup> Based on other data, the prevalence of depressive disorders in CKD children is estimated to be 7–35%.<sup>10–12</sup>

Although the problem of depressive disorders in the pediatric population is now increasingly discussed, data on their prevalence and specificity in CKD children treated conservatively are scarce. Most of the data relate to the entire group of patients with CKD, regardless of the disease stage.<sup>13,14</sup> Still, the inclusion of dialysis and transplant patients and patients with a range of kidney function may result in diluted findings. Another problem may be the use of proper tools to measure depression. These should be standardized and adapted to the studied group.

## Objectives

The aim of the study was to analyze the prevalence and characteristics of depression and depressive symptoms in children and adolescents with CKD treated conservatively.

## Materials and methods

### Study design and sample

This paper describes the results of a cross-sectional, multicenter study of children with CKD treated conservatively,

recruited from 8 pediatric nephrology centers in Poland. The study protocol adhered to the Declaration of Helsinki and was approved by the Ethics Committee of Wrocław Medical University, Wrocław, Poland (approval No. KB-490/2021). The study was conducted among patients and their parents/caregivers between September 2021 and May 2022. Written informed consent was obtained from all study participants (73 CKD children and 92 of their parents).

### Inclusion criteria

Inclusion criteria for children were as follows: 1) age 7–18 years, 2) stage II of CKD or higher according to the Kidney Disease Outcomes Quality Initiative (KDOQI)<sup>15</sup> based on the estimated glomerular filtration rate (eGFR) measured with the Schwartz formula at the time of the study,<sup>16</sup> 3) conservative treatment of CKD, 4) CKD diagnosed at least 3 months before the beginning of the study, and 5) informed consent. Exclusion criteria for children were: 1) history of severe to profound intellectual disability, 2) transplantation, 3) cancer diagnosis, 4) hospitalization within 14 days before inclusion in the study, 5) a significant life event unrelated to their kidney disease in the past 30 days, such as losing a family member.

### Data sources

A medical chart review was performed to obtain the following information: primary diagnosis of kidney disease, additional non-renal comorbidities, patient's age at CKD diagnosis and CKD stage at diagnosis, current stage of CKD, disease duration, current number of medications taken by the child, family structure, and parents' opinions on their children's observed changes in appetite and sleep problems over the past 6 months. Recent data on body weight and height, presence of hypertension, blood hemoglobin, serum creatinine, and albumin values were also included in the analysis.

Patients and their parents who agreed to participate in the study were required to complete Children's Depression Inventory 2 (CDI2). The questionnaire was used to assess the prevalence, severity and specificity of depression in CKD children.<sup>17</sup> The CDI2 is an assessment tool to measure the cognitive, affective and behavioral signs of depressive symptoms in youths aged 7–18 years.<sup>17</sup> The full-length CDI2: Self-Report is a 28-item assessment that yields a total score (TS), 2 scale scores (emotional problems (EP) and functional problems (FP)), and 4 subscale scores: negative mood/physical symptoms, interpersonal problems, ineffectiveness, and negative self esteem. Raw scores are converted to T-scores. T-scores of 40–59 were defined as medium, and a total T-score of 60–64 as elevated. A total score  $\geq 65$  identifies potentially depressed individuals and we used it as the threshold defining the presence of depression. The test was based

on experiences over the past 2 weeks and the test time was approx. 15 min. CDI2: Parent (CDI:P) form consists of 17 items that correspond to the self-report version and are suitably rephrased. Parent assessment yields a TS and 2 scale scores (EP and FP). The CDI2 has been translated into many languages, including Polish, and was standardized for the Polish population.<sup>18</sup> The reliability of CDI2: Self-Report Polish version has been reported to range from 0.84 to 0.87 (Cronbach's  $\alpha$  coefficient) and the validity has been established at the level of 0.66. The reliability of the CDI2: Parent Form Polish version has been evaluated at the level of 0.82–0.86 and the validity of 0.74. In the current study, the CDI2 was used in paper-and-pencil format.

The differences in Kovacs's score between the children's assessment and their parents' assessment were analyzed using the t-test for matched pairs. The concordance of the differences between the child's assessment and the parents' assessment with a normal distribution (t-test for matched pairs assumption) was checked using the Shapiro–Wilk test (TS:  $W = 0.99$ ,  $p = 0.650$ , EP:  $W = 0.98$ ,  $p = 0.507$ , FP:  $W = 0.98$ ,  $p = 0.476$ ).

## Statistical analyses

Participants' clinical and psychosocial characteristics were summarized using median and interquartile range (IQR) or count and proportions for continuous and categorical variables, respectively. Comparisons of clinical parameters between the 2 groups were made using a Mann–Whitney U test. Categorical data were analyzed using Fisher's exact tests. Relationships between continuous variables were analyzed using Spearman's rank correlation analysis. To evaluate the link between CKD stage and CDI results, Kruskal–Wallis one-way analysis of variance by ranks was used, followed by the post hoc Dunn's test with Bonferroni's correction. To determine the association of high Kovacs's scale scores ( $>59$ ) with selected clinical parameters, logistic regression was performed. The compliance with the assumption of non-collinearity was checked using the variable inflation factor (VIF), which was smaller than 1.8 for each of the predictors (much less than 5, which was considered the threshold value). The assumption of linear relationships between numerical predictors and the log odds was checked using Box–Tidwell test, in which all the predictors met this assumption ( $p > 0.1$  for all the predictors). A p-value  $<0.05$  was considered statistically significant.

## Results

### Participants

The study included 73 children with CKD aged 8–18, treated conservatively, and 92 parents (62 women and 30 men; in 19 cases, both parents completed the CDI2: parent form). Characteristics of the patients are shown

in Tables 1,2. The median age for CKD diagnosis was 2 years ( $Q1 = 1.0$ ,  $Q3 = 8.0$ ) and 9 years for the disease duration. At the time of the study, the median age was 13 years ( $Q1 = 11.0$ ,  $Q3 = 16.0$ ); 12 (16.43%) children presented with CKD stage II, 30 (41.1%) with stage III, 24 (32.88%) with stage IV, and 7 (9.59%) with stage V (pre-dialysis end-stage renal disease). In the last 6 months, parents did not notice any of their child's sleep-related changes. In almost all cases (93.15%), no change in appetite was observed by the parents.

Table 1. Characteristics of the patients with CKD

Characteristics of the patients		n	%
Sex	male	38	52
	female	35	48
Underlying disease	CAKUT	33	45.2
	glomerulonephritis	4	5.5
	post AKI	7	9.6
	other	29	39.7
Comorbidities	no	28	38.4
	yes	45	61.6
CKD stage at diagnosis	I	11	15.1
	II	30	41.1
	III	25	34.2
	IV	7	9.6
Family	full	54	74.0
	incomplete	19	26.0
Siblings	no	17	23.3
	1	38	52.0
	2	11	15.1
	3	3	4.1
	4	1	1.4
	5	3	4.1
Change in appetite	no	68	93.2
	yes	5	6.8
Arterial hypertension	no	39	53.4
	yes	34	46.6

CKD – chronic kidney disease; CAKUT – congenital anomalies of kidney and urinary tract; AKI – acute kidney injury.

Table 2. Anthropometric and biochemical parameters of patients with CKD

Parameter	Median (1 <sup>st</sup> quartile–3 <sup>rd</sup> quartile)	Min–max
Body mass [percentiles]	30 (7–67)	0.1–98
Height [percentiles]	16 (4–46)	0.1–85
BMI [percentiles]	52 (19–84)	0.1–98
Hemoglobin [g/dL]	12.3 (11.6–13.7)	8.5–16.4
Albumin [g/L]	44 (42–46.68)	35–53
Drugs [number]	6 (3–10)	0–16

CKD – chronic kidney disease; BMI – body mass index.

## Main results

Results of Kovacs's test in CKD children are shown in Tables 3,4. Collected data indicate that most children with CKD have acquired medium scores (according to Kovacs, points ranging from 40–59), which correspond to the typical severity of depressive symptoms in children of the same sex and of similar age (Polish standardization group). In the studied group, 8 children scored 60 points or more, 2 children were in the range of 60–64 and 6 children had 65 points and above. It indicates that within the studied group, 11% of participants presented with symptoms suggesting depressive disorder and 8.2%

**Table 3.** Results of the Kovacs' test in the group of patients with CKD (n = 73)

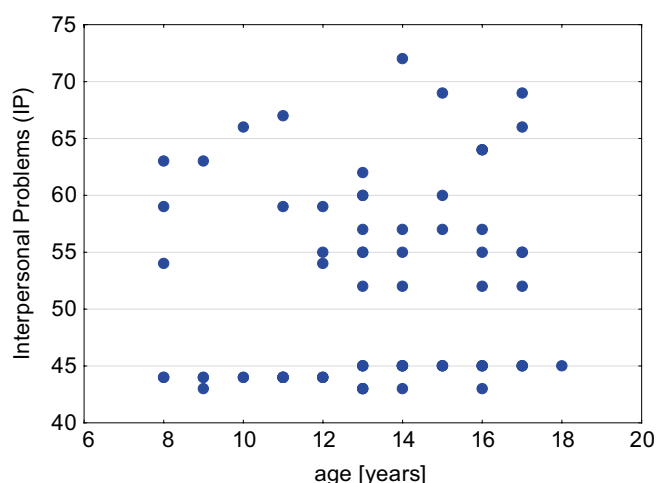
CDI2 category score	Median (1 <sup>st</sup> quartile–3 <sup>rd</sup> quartile)	Min–max
Total score	49.5 (42–55)	21–74
Emotional problems	47.5 (40.5–50.5)	27–73
Negative mood/physical symptoms	48.5 (39–55)	34–74
Negative self esteem	48 (38.5–53.5)	33–68
Functional problems	52 (44.5–57.5)	26–79
Ineffectiveness	50 (42–58)	27–79
Interpersonal problems	45 (44–58)	43–72

CKD – chronic kidney disease ; CDI2 – Children's Depression Inventory 2.

**Table 4.** Results of Kovacs's test (total score) in the group of children with CKD according to the CKD stage

CKD	Median (1 <sup>st</sup> quartile–3 <sup>rd</sup> quartile)	Min–max
Stage II (n = 12)	46.5 (40.5–54)	36–69
Stage III (n = 30)	44.5 (39–54)	21–71
Stage IV (n = 24)	54 (49–58)	36–74
Stage V (n = 9)	50.5 (48–56)	28–63

CKD – chronic kidney disease.



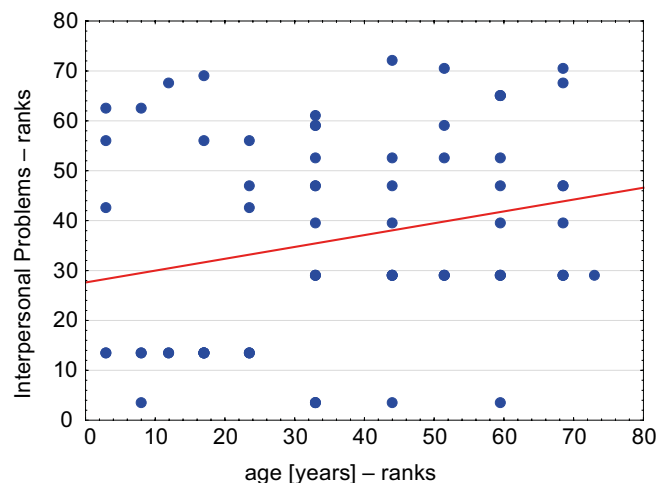
**Table 5.** The results of the logistic regression of the score in Kovacs' test (high (>59) compared to low (≤ 59)) on the selected explanatory variables

Explanatory variable	Coefficient	SE	z	p-value
Intercept	−4.15	3.01	−1.38	0.168
Age [years]	0.03	0.20	0.17	0.869
Disease duration [years]	0.02	0.11	0.22	0.828
Height [percentiles]	0.00	0.02	−0.06	0.956
BMI [percentiles]	−0.02	0.01	−1.23	0.217
Current CKD staging [1–5]	0.56	0.51	1.10	0.272
Family status [modelled: "complete"]	−0.31	0.86	−0.36	0.718
Sex [modelled: "woman"]	0.82	0.83	0.98	0.328

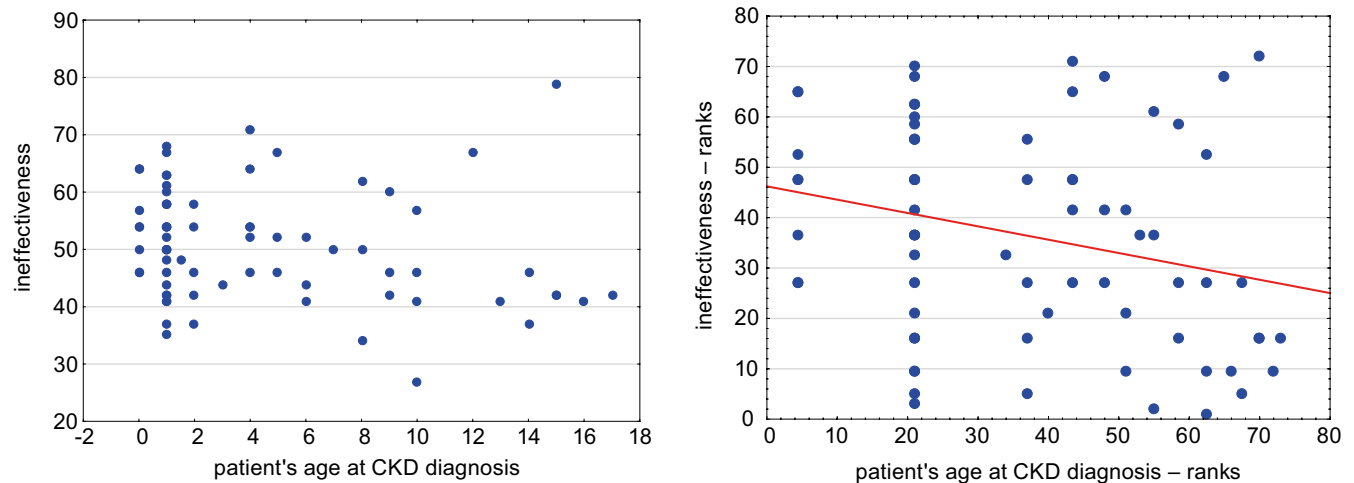
SE – standard error; z – test value.

were potentially depressed. Using the logistic regression model, no statistically significant differences were found in patients who scored >59 and ≤59 for the following traits: sex, age at the time of the study, duration of the disease, current CKD staging, family status (complete family or non-complete family), height, and body mass index (BMI) percentile (Table 5). The data from this patient subgroup were analyzed qualitatively. In the group of 8 children, there were more girls (5) than boys (3). Chronic kidney disease was diagnosed in early childhood, and in most cases the length of the disease exceeded 10 years. In 5 cases, children's weight and height were below the 10<sup>th</sup> percentile.

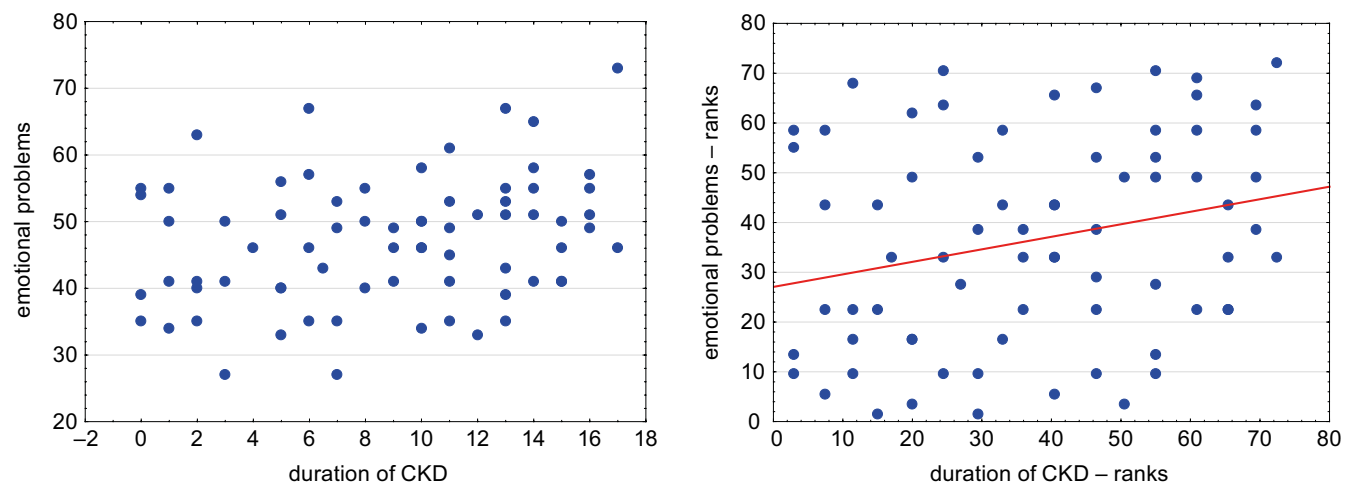
The associations between the Kovacs's test scores and clinical traits are shown in Table 6. The analysis showed a statistically significant positive correlation between patients' age and Interpersonal Problems (IP) score (Fig. 1), and statistically significant negative correlation between the age of CKD diagnosis and TS, ineffectiveness trait (Fig. 2), and, at the limit of statistical significance, negative mood/physical symptoms trait. The duration of CKD positively correlated



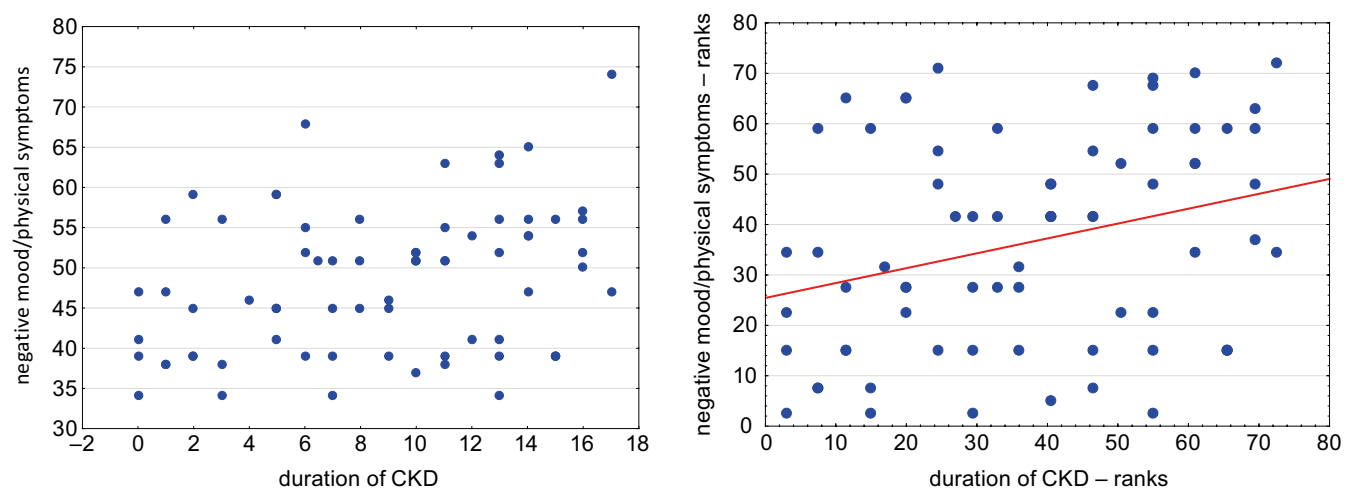
**Fig. 1.** Results of Spearman's correlation analysis between patients' age and results of interpersonal problems subscale scores ( $r = 0.24$ ,  $p = 0.041$ ). Left – original data, right – ranked data



**Fig. 2.** Results of Spearman's correlation analysis between patients' age at chronic kidney disease (CKD) diagnosis and results of ineffectiveness subscale scores ( $r = -0.26$ ,  $p = 0.026$ ). Left – original data, right – ranked data



**Fig. 3.** Results of Spearman's correlation analysis between duration of chronic kidney disease (CKD) diagnosis and results of emotional problems scale scores ( $r = 0.25$ ,  $p = 0.032$ ). Left – original data, right – ranked data



**Fig. 4.** Results of Spearman's correlation analysis between duration of chronic kidney disease (CKD) diagnosis and results of negative mood/physical symptoms subscale scores ( $r = 0.30$ ,  $p = 0.012$ ). Left – original data, right – ranked data

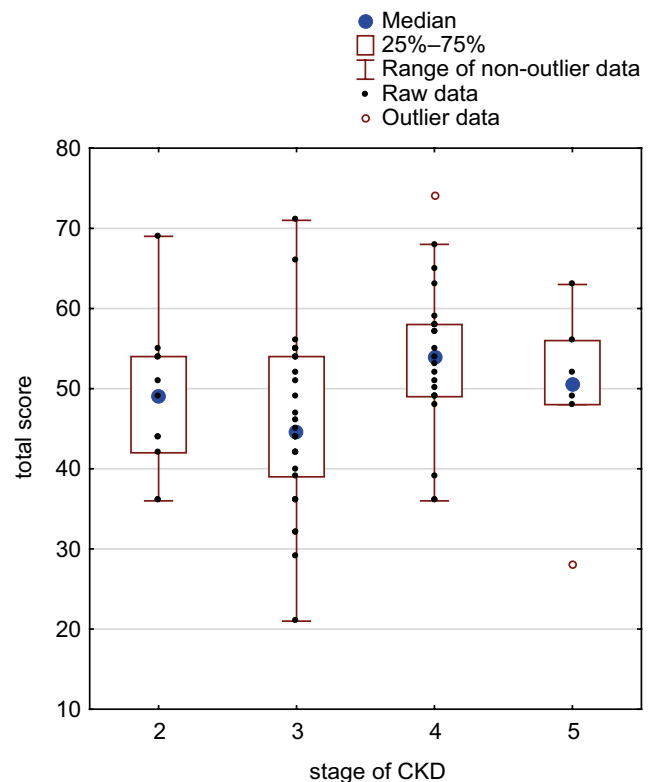
**Table 6.** The relationship between results of Child Depression Inventory 2 (CDI2) test and clinical parameters in CKD children

Parameter	Total score	Emotional problems	Negative mood/physical symptoms	Negative self-esteem	Functional problems	Ineffectiveness	Interpersonal problems
Age <sup>1</sup>	0.02 (0.863)	0.19 (0.105)	0.15 (0.206)	0.09 (0.479)	-0.09 (0.431)	-0.19 (0.112)	0.24 (0.041)
Patient's age at CKD diagnosis <sup>1</sup>	-0.22 (0.061)	-0.19 (0.112)	-0.23 (0.050)	-0.19 (0.101)	-0.22 (0.067)	-0.26 (0.026)	0.02 (0.898)
Duration of CKD <sup>1</sup>	0.21 (0.092)	0.25 (0.032)	0.30 (0.012)	0.16 (0.177)	0.14 (0.222)	0.14 (0.230)	0.07 (0.547)
Gender <sup>2</sup>	-0.07 (0.946)	0.92 (0.356)	0.54 (0.589)	-0.01 (0.996)	-0.49 (0.624)	-0.16 (0.875)	0.51 (0.608)
Current stage of CKD <sup>3</sup>	9.68 (0.046)	11.21 (0.024)	8.94 (0.062)	7.10 (0.131)	6.20 (0.185)	2.82 (0.588)	5.58 (0.334)
Body mass [percentiles] <sup>1</sup>	-0.05 (0.666)	-0.08 (0.534)	-0.07 (0.581)	-0.08 (0.533)	0.03 (0.801)	0.01 (0.939)	-0.06 (0.637)
Body height [percentiles] <sup>1</sup>	-0.12 (0.309)	-0.15 (0.197)	-0.18 (0.137)	-0.12 (0.332)	-0.08 (0.492)	-0.04 (0.770)	-0.10 (0.408)
BMI [percentiles] <sup>1</sup>	0.003 (0.979)	0.03 (0.812)	0.04 (0.713)	0.01 (0.959)	-0.02 (0.870)	-0.01 (0.917)	-0.04 (0.723)
Serum creatinine <sup>1</sup>	0.19 (0.117)	0.10 (0.392)	0.22 (0.068)	-0.02 (0.879)	0.15 (0.223)	0.05 (0.658)	0.14 (0.254)
Hemoglobin <sup>1</sup>	-0.09 (0.446)	-0.03 (0.795)	-0.06 (0.625)	-0.09 (0.467)	-0.07 (0.559)	-0.01 (0.951)	-0.08 (0.507)
Albumin <sup>1</sup>	-0.10 (0.384)	-0.01 (0.956)	-0.07 (0.535)	-0.02 (0.865)	-0.14 (0.245)	-0.04 (0.761)	-0.20 (0.085)
Number of drugs <sup>1</sup>	0.13 (0.291)	0.07 (0.569)	0.18 (0.127)	-0.08 (0.495)	0.08 (0.492)	0.07 (0.550)	-0.03 (0.787)

CKD – chronic kidney disease; BMI – body mass index; <sup>1,2,3</sup> tests used; p-value is given in parentheses; p < 0.05 in bold; <sup>1</sup> The Spearman's rank-order correlation (correlation coefficient  $r_s$ ); <sup>2</sup> Mann–Whitney test with correction for continuity (U-value); <sup>3</sup> analysis of variance (ANOVA) Kruskal–Wallis test by ranks (H-value).

with EP and negative mood/physical symptoms traits (Fig. 3,4). There was a positive correlation between the age of diagnosis and the ineffectiveness trait. A statistically significant correlation between the current stage of chronic kidney disease (CKD) and TS and EP was found. Analysis of multiple (two-sided) comparisons showed a significant difference between CKD stage III and IV ( $z = 2.88$ ;  $p = 0.040$  for TS and  $z = 3.14$ ;  $p = 0.017$ ), with higher scores noted in patients with CKD stage IV (Fig. 5). Slightly above the threshold for statistical significance was a link between the current CKD stage and a negative mood/physical symptoms trait, with the analysis of multiple (two-sided) comparisons showing marginal statistical significance between stages III and IV of CKD (Dunn's test:  $z = 2.76$ ;  $p = 0.057$ ) (Table 7). In addition, lower height was associated with increased emotional problems and a more negative mood.

A comparative overview of the results of Kovacs's test for children and their parents is shown in Table 8. A statistically significant difference was found within the TS (parental mean score  $54.56 \pm 10.18$ , child's  $49.00 \pm 10.62$ ,  $t = 4.92$ , degree of freedom (df) = 70  $p < 0.001$ ), and trait-related subscales of EP (parental mean score  $52.57 \pm 10.21$ , child's  $47.13 \pm 9.58$ ,  $t = 4.67$ , df = 71,  $p < 0.001$ ) and FP (parental mean score  $54.74 \pm 9.95$ , child's score  $50.96 \pm 10.04$ ,  $t = 3.40$ , df = 71,  $p = 0.001$ ) (Fig. 6). In the case where both

**Fig. 5.** Total score in regard to the current stage of chronic kidney disease (CKD)



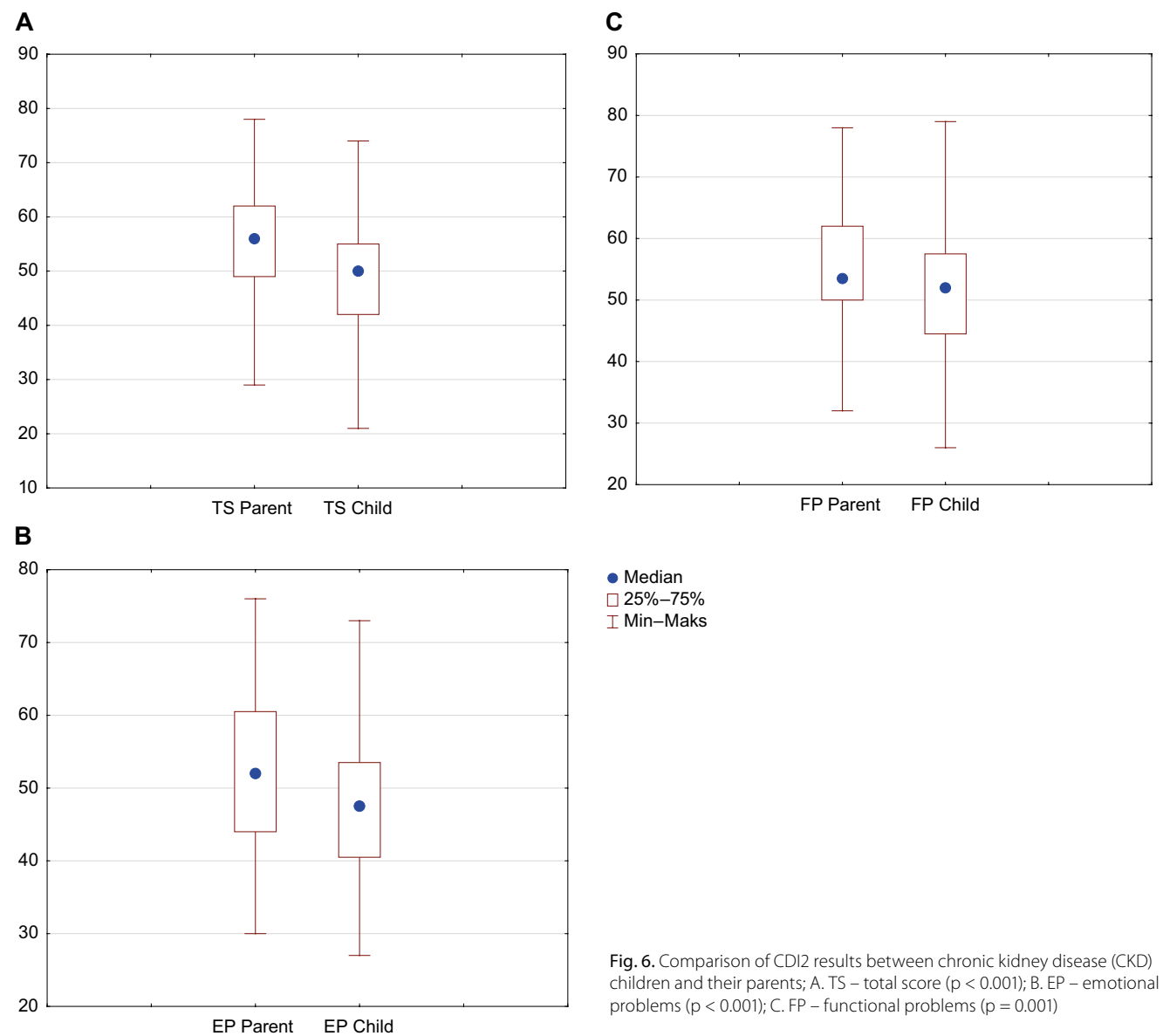
**Table 7.** The results of Dunn’s post hoc test of the differences in the negative mood/physical symptoms trait scores between the current chronic kidney disease (CKD) stages

CKD stage	1	2	3	4	5
1	–	1.0000	1.0000	1.0000	1.0000
2	0.1371	–	1.0000	0.4191	1.0000
3	0.1215	0.0556	–	0.0575	1.0000
4	0.8702	2.0345	2.7617	–	1.0000
5	0.5420	0.8715	1.0328	0.6621	–

1–5: CKD stages, right-top part: p-values, left-bottom part: z-values

**Table 8.** Comparative summary of Child Depression Inventory 2 (CDI2) results in a group of chronic kidney disease (CKD) children (CDI2: Self-Report) and their parents (CDI2: Parent Form)

Results of CDI2	Children with CKD (n = 73)		Parents (n = 92)
	median (1 <sup>st</sup> quartile–3 <sup>rd</sup> quartile)	min–max	median (1 <sup>st</sup> quartile–3 <sup>rd</sup> quartile)
Total score	49.5 (42–55)	21–74	55 (47–60)
Emotional problems	47.5 (40.5–50.5)	27–73	52 (44–60.5)
Functional problems	52 (44.5–57.5)	26–79	52.5 (50–59.5)



**Fig. 6.** Comparison of CDI2 results between chronic kidney disease (CKD) children and their parents; A. TS – total score ( $p < 0.001$ ); B. EP – emotional problems ( $p < 0.001$ ); C. FP – functional problems ( $p = 0.001$ )

parents assessed the severity of their child's depressive symptoms, no difference between female and male parents was found (TS – t-test for matched pairs:  $|t| = 0.62$ ,  $df = 19$ ,  $p = 0.542$ , EP – Wilcoxon test for matched pairs:  $Z = 0.16$ ,  $N = 14$ ,  $p = 0.875$ , FP – t-test for matched pairs:  $|t| = 0.33$ ,  $df = 19$ ,  $p = 0.747$ ).

## Discussion

The CDI used in this study was based on self-report of depressive symptoms that the patient experiences or has experienced lately.

The study did not show that the vast majority of CKD children treated conservatively presented with emotional difficulties associated with depression. Only 2 study participants (2.7%) had elevated results on the Kovacs's test (total T-score 60–64), and 6 (8.2%) met the criteria of depression (total T-score  $\geq 65$ ). Our results are in line with the analysis carried out by Stahl et al.<sup>14</sup> concerning psychiatric disorders in CKD children based on the parent-reported diagnoses. As a part of the baseline assessment, 345 children completed CDI2, and among them, only 2.3% met the screening threshold for clinically significant depressive symptoms. In another study, 7% of CKD children and adolescents (median GFR 41.6 mL/min/1.73 m<sup>2</sup> (1<sup>st</sup> quartile (Q1) = 31.9, 3<sup>rd</sup> quartile (Q3) = 53.6)) met the study criteria for depression, and 5% reported elevated depressive symptoms in CDI.<sup>9</sup> In some works, the percentage of children with CKD and depression is higher. However, most studies on depression/anxiety and health-related quality of life (HRQoL) in children with CKD focus on severe CKD, end-stage renal disease (ESRD) and kidney transplantation patients, with less emphasis on patients with mild-to-moderate CKD.<sup>7,12,19,20</sup> The study groups were different in age and heterogeneous in terms of the type of CKD treatment. For example, in the study on 71 patients with CKD aged 8–25 years (among them, 3% on dialysis and 25% with functioning transplant), depression was identified in 12 (17%) patients.<sup>13</sup> In addition, different instruments were used for the diagnosis of depressive disorders in the abovementioned study, such as CDI2 and Beck Depression Inventory (BDI). Furthermore, it cannot be ruled out that some self-reported variables could be subject to information bias, as patients may under- or overreport symptoms. We cannot also exclude other confounders (e.g., personality traits). Different factors may mediate the development of depressive disorders.<sup>21–24</sup> However, research on these potential factors is inconclusive.

In our study, no association between the presence of general depressive symptoms (TS, EP, FP, and 3 of 4 subscale scores) and the patient's age was found. However, we stated a positive correlation between the age and the interpersonal problems subscale results. Other authors report that the period of early adolescence may represent a particularly

formative and vulnerable time in the development of mood and interpersonal skills. We also revealed that the patient's age at CKD diagnosis may be linked to depressive symptoms. The younger the age of diagnosis, the more probable that general depressive symptoms will occur and lower effectiveness will be perceived. Our results indicate that implementation of proper psychological care from the moment of the diagnosis is necessary. It is also worth noting that a lack of effectiveness might result from “learned helplessness”. It is a phenomenon observed when humans have been conditioned to expect pain, suffering or discomfort without a way to escape it.<sup>25</sup> Lack of efficiency can also be connected with overprotective parenting styles and the elimination of the child's daily chores to alleviate the burden of illness. However, this area requires further research.

Our study has shown a link between depressive symptoms (EP and negative mood/physical symptoms) and the duration of the disease. It may indicate the negative impact of chronic disease-associated difficulties on a child's emotional functioning. This suggestion is proven right by the significant difference in depressive symptoms between the III and IV stages of CKD. Our observations indicate a lack of patients' adaptation to CKD, which may be caused by insufficient access to psychological care in Poland. Results of the study by Kogon et al. also indicated that having a diagnosis of CKD for a more extended period may be associated with a higher likelihood of depression.<sup>12</sup> The authors speculated that the burden and stress of living with CKD increases over time and may worsen a child's ability to adjust. However, in the other paper, Kogon et al.<sup>13</sup> found that CKD duration was not related to depression. In addition, their result showed that eGFR was unrelated to depression. Our observations vary. We found a relationship between depressive disorders and the current stage of CKD, regarding emotional problems in particular. The analysis showed statistically significant differences between children with III and IV stage of CKD with more advanced disturbances declared by patients with CKD stage IV. Our data are consistent with the observations of Stahl et al.,<sup>14</sup> who noted a trend toward increased prevalence of depression with advancing CKD stage. Also, Roumelioti et al. showed that the severity of CKD was associated with lower quality of life ratings and increased reporting of weakness, fatigue and daytime sleepiness.<sup>26</sup> The last symptoms may be masks of depression. An association between the level of renal dysfunction and emotional-behavioral problems seems to be real. Intensifying metabolic disorders, deterioration in body functioning and medical complications, hospitalizations, need for aid from parents or caregivers, and change in interpersonal relations on the child–parent axis may lead to emotional burdens. Johnson et al.<sup>27</sup> presented a fascinating hypothesis that biological factors inherent to progressive CKD are likely to disrupt endocrine and neurological transmitters and influence mood and emotional functioning. The authors rightly advocate research into the potential mechanisms of that relationship.



According to the literature, a child's gender may be connected with depression, with girls presenting depressive and anxious symptoms more often than boys.<sup>21,23</sup> Our study did not find such a link. However, in the group of 8 children with the highest TS, girls had a 5:3 advantage.

The results of our study did not show a significant relationship between constitutional parameters and the occurrence of depressive symptoms. The literature highlights short stature as a predisposing factor for depression and low HRQoL scores.<sup>28,29</sup> In our research, such a tendency has only emerged. In the group of 8 children with the highest TS, 5 patients had height below the 10<sup>th</sup> percentile. Although our group of CKD children treated conservatively represents one of the largest samples to examine this research question, it is a relatively small sample size to detect some correlations and links. It is commonly repeated that obesity is related to depression, but this statement is not fully supported by research findings.<sup>30,31</sup> Three out of 8 longitudinal studies reported associations between obesity and subsequent depression in female children and adolescents only, and 3 out of 9 studies obtained evidence in favor of the other direction. In our work, we did not notice such a relationship. However, in the study by Kogon et al.,<sup>13</sup> the presence of depression was significantly associated with the presence of obesity, defined as BMI  $\geq 95^{\text{th}}$  percentile. Probably, the dissimilarity of our observations is due to the fact that by adopting the same criteria as in the work of Kogon et al., obesity occurred in only 11% of our study participants, while in our study in as much as 30%.

In our research, we found significant differences between the results of parent-reported and self-report instruments that identified depression, both in the overall assessment and in the areas of emotional and functional problems. Parents were more likely than patients with CKD to perceive their children as depressed. Ten parents (13.7%) assessed their children as meeting the criteria for depression, and an additional 15 (20.6%) rated their children as at risk of elevated depressive symptoms. In the patients' self-assessment, the percentages were 8.2% and 2.7%, respectively. Similar observations were made by Stahl et al.<sup>14</sup> In their study, among the 346 children with CKD, 8 (2.3%) met the screening threshold for clinically significant depression symptoms, and 26 (7.5%) had a parent-reported depression diagnosis. Discordant parent and child reporting is common.<sup>32–34</sup> Also, in our work on the quality of life of children with CKD,<sup>35</sup> we found that parents describe their child's HRQoL as lower than children themselves. Various factors come into play: dissimilar experiences, different reference systems and levels of adaptation to the disease.<sup>36</sup> Parents of children with CKD feel more stress and depression caused by the burden of their child's disease and the responsibility of CKD management.<sup>37</sup> Our results may reflect the children's tendency to emphasize the positive aspects of adaptation.<sup>38</sup> On the other hand, parents may be more reliable in identifying the most strongly affected areas

of their children's functioning and the so-called "hidden morbidities".<sup>39</sup> Therefore, a dyadic child–parent approach to assessing pediatric outcomes is necessary and may provide unique information about the children's risk factors for depression and resilience to it.

A divergent assessment of CKD children's emotional and behavioral status by patients and their parents may have serious consequences, including lack of cooperation in proper therapy, demotivation for self-reliance and parental over-protection. It should also be noted that some disorders may be dynamic and change over time. The focus of children and adolescents on "here and now" and the absence of recent symptoms is likely to result in misclassification and false negative diagnoses of depressive symptoms. Thus, each case of divergence in assessing potential depressive disorders requires an individual approach and specialized psychiatric assessment. Moreover, as shown in the study by Boyd et al.<sup>40</sup> on the patterns of parent-youth reports of HRQoL among young people aged 7–20 with mood disorders, not only the pattern of parent low-youth low assessment of HRQoL but also of parent low-youth high assessment was associated with a more impaired clinical presentation, i.e., at-risk for worse mood symptoms and suicidal ideation.

## Limitations

Our study has some limitations. The study group was relatively small, although it is one of the largest in the available literature and is strictly defined. It consisted of CKD children treated only conservatively, according to the same standards.

The depressive disorders in CKD children were scored based on a self-rating scale and did not include a structured interview, which could lead to under- or overreporting of depression. However, the same validated tool was applied to all participants. Kovacs's test is considered one of the best for assessing depression. Disparities of results shown as opposed to other articles (in which different measuring scales were used) indicate that further research is needed to establish proper screening methods for depression in children with CKD.

Our analysis excluded parent-related variables that may also influence a child's emotional state, such as parents' age, education, work, and economic status, the presence of chronic diseases, and the emotional state of parents themselves.

The literature points to nursing care and peer support as potential factors protecting from developing depression.<sup>41,42</sup> We did not consider these variables. However, this field of research on children with CKD might prove vital.





## Conclusions

To sum up, the problem of depression in children with CKD treated conservatively exists and psychological

assistance should be included as a standard of care of young people with CDK. Screening in this area should be carried out considering the assessment of the patient and their parents/caregivers. The final diagnosis of the occurrence of depressive disorders must be based on a multidimensional assessment of the patient's situation. Factors connected to the prevalence of depressive symptoms in CKD children treated conservatively require further research. Establishing such factors may create an "anti-depressive" targeted psychological care which could be introduced in pediatric nephrology clinics, with specific interventions tailored to particular subgroups. Age at the time of the diagnosis and duration of the disease seem to be crucial factors determining the risk of depression. During the course of CKD, progression from stage III to stage IV is strongly linked to the worsening of the psychological state, especially regarding emotional problems. Understanding the extent to which time with a diagnosis of CKD affects the mental health of our patients will allow healthcare providers to determine when patients are most in need of psychosocial support and when interventions may be most effective.

Disparities between children's self-reports and their parents' assessments are an essential area of future research. Considering the role that parents play in children's development and treatment, child–parent disagreement may influence how parents respond to children's healthcare and emotional needs, which may impact the children's adaptation over time. The additional cost of conducting a more in-depth assessment of adaptation outcomes can be offset by implementing the most effective clinical interventions.

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