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ORIGINAL ARTICLE

Health Related Quality of Life in Children with Primary Immune Deficiency Diseases

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ABSTRACT

Background: Primary immunodeficiency diseases (PID) represent a heterogeneous group of inherited disorders that compromise the immune system, predisposing affected individuals to recurrent infections, autoimmunity, and other complications. As advances in diagnosis and management extends the lifespan of these patients, there isagrowing recognition of the importance of evaluating their health-related quality of life (HRQoL). This study aimed to assess HRQoL in children diagnosed with PID compared to age- and sex-matched healthy ones.

Methods: This case-control study aimed to assess HRQoL in children diagnosed with PID compared to age- and sex-matched healthy peers. The study was conducted at the Primary Immunodeficiency Unit of Zagazig University Hospitals from August 2020 to February 2024. The study enrolled 51 children with PID and 51 healthy controls. Data were collected using a structured interview and the Pediatric Quality of Life Inventory (PedsQL 4.0), which captures physical, emotional, social, and school functioning.

Results: Children with PID showed significantly lower total HRQoL scores than controls, both in self-reports and parent-reported assessments ($p<0.001$). All four functional domains were notably affected. Familial Mediterranean Fever (FMF) was the most common diagnosis among cases (56.9%), and it showed a strong association with reduced QoL scores ($p=0.0001$). Parent-reported physical functioning correlated positively with age ($r=0.363$, $p=0.009$), and older children (13–18 years) showed better physical domain scores than younger age groups.

Conclusion: The study highlights the considerable impact of PID on children's daily lives and overall well-being. These findings underscore the need for integrated care approaches that not only address clinical management but also focus on enhancing the quality of life for affected children and their families.

Keywords: Health Related; Quality of Life; Primary Immune Deficiency.

INTRODUCTION

Primary immunodeficiency diseases (PIDs) represent a broad spectrum of inherited disorders in which one or more components of the immune system are either absent or functionally impaired. These immunological defects result in increased vulnerability to recurrent infections, autoimmune

complications, chronic inflammation, and even malignancies [1].

The majority of PID cases stem from genetic mutations that affect immune system development or function. It is essential to differentiate these primary forms from secondary immunodeficiencies, which may develop due to factors like infections, malnutrition, malignancies, or treatments such as chemotherapy or immunosuppressive medications [2].

Genetically, PIDs may follow various inheritance patterns, including autosomal dominant, autosomal recessive, or X-linked, and their clinical presentation can vary depending on the degree of gene penetrance [3].

According to the latest classification by the International Union of Immunological Societies (IUIS), a total of 485 distinct genetic immune disorders have now been recognized, following the inclusion of 55 newly identified monogenic defects and one phenocopy. This updated classification system categorizes inborn errors of immunity into ten major groups: (1) immunodeficiencies affecting cellular and humoral immunity, (2) combined immunodeficiencies with syndromic features, (3) predominantly antibody deficiencies, (4) diseases of immune dysregulation, (5) congenital phagocytic defects, (6) innate immunity defects, (7) autoinflammatory disorders, (8) complement deficiencies, (9) bone marrow failure syndromes, and (10) phenocopies of primary immunodeficiencies [4].

In recent years, there has been growing recognition of the importance of evaluating health-related quality of life (HRQoL) in patients with PIDs. Understanding patients' lived experiences has become a critical aspect of guiding care and improving treatment adherence and satisfaction [5]. HRQoL encompasses physical, emotional, and social dimensions of well-being, and assessing these elements provides valuable insight into patient outcomes and helps tailor individualized clinical management [6].

The present work aimed to assess HRQoL in children diagnosed with PID compared to age- and sex-matched healthy ones to evaluate the impact of Primary Immunodeficiency Diseases (PIDD) and their treatment on the quality of life of affected patients, as well as to assess the burden of the disease on the quality of life of parents of children with PID.

METHODS

This case-control study was conducted at the Primary Immunodeficiency Unit of the Pediatric Department, Zagazig University Hospitals. The study was carried out over a period of three years and six months, from August 2020 to February 2024, after obtaining approval from the Institutional Review Board (IRB#5987/23-3-2020) and written informed consent from all cases' relatives. The research was conducted under the World Medical Association's Code of Ethics (Helsinki Declaration) for human research .

The total sample consisted of 102 children, divided equally into two groups. The case group included 51 patients diagnosed with primary immunodeficiency disorders (21 males and 30 females), aged between 2 and 18 years. These children were admitted to the Primary Immunodeficiency Unit of the Pediatric Department at Zagazig University Hospitals. For comparison, a control group of 51 healthy children was recruited. These children were selected from outpatient clinics and presented with minor health concerns, ensuring age- and gender-matching with the patient group.

Inclusion criteria

We included children aged 2 to 18 years of both sexes who were eligible for inclusion if they were suspected to have any form of primary immunodeficiency based on the ten major categories of PID defined by the IUIS [7].

Exclusion criteria

Children were excluded if they were below two years or above 18 years of age. Additional exclusion criteria included receiving immunosuppressive therapy, or having a diagnosis of secondary immunodeficiency due to conditions such as HIV infection, nephrotic syndrome, protein-losing enteropathy, or severe

malnutrition. Children with any pre-existing psychiatric, cognitive, or communication disorders that could interfere with participation were also excluded. Furthermore, those deemed by the healthcare team to have an unstable psychological condition were not eligible for inclusion in the study.

Data collection

Two main tools were used to collect study data, including the Structured Interview Questionnaire and the Pediatric Quality of Life Inventory (PedsQL 4.0).

1. Structured Interview Questionnaire

A researcher-designed structured interview form was used to collect demographic and background information. This included the patient's age, sex, and birth date, as well as family history of similar immunodeficient conditions. Additionally, socio-demographic characteristics of the parents were gathered, such as age, education level, occupation, monthly income, and crowding index.

2. Pediatric Quality of Life Inventory (PedsQL 4.0)

The Pediatric Quality of Life Inventory, Version 4.0 (PedsQL 4.0), developed by Varni et al. [8], was previously used to assess health-related quality of life (HRQoL) in children. This validated tool provided a comprehensive evaluation of physical, emotional, social, and school functioning, incorporating both child self-report and parent proxy-report formats to capture perspectives from both children and their caregivers.

Parent proxy reports were used for children aged 2–4, 5–7, 8–12, and 13–18 years, while child self-reports were applied for those aged 5–7, 8–12, and 13–18 years. The tool consisted of 23 items grouped into four core domains: physical functioning (8 items), emotional functioning (5 items), social functioning (5 items), and school functioning (5 items).

Each item had been scored according to how much of a problem it had been during the past month, using a five-point Likert scale: 0 = never, 1 = almost never, 2 = sometimes, 3 = often, and 4 = almost always. Responses were then reverse-scored and linearly transformed to a 0–100 scale, where higher scores reflected better HRQoL. For instance, a score of 0 was converted to 100 (very good QoL), 1 to 75 (good QoL), 2 to 50 (fair QoL), 3 to 25 (poor QoL), and 4 to 0 (very poor QoL).

The questionnaire was self-administered by children capable of understanding the items. For younger children, assistance or clarification was provided. Parents were interviewed separately and were asked to allow their children to participate; both child and parent completed their versions independently whenever possible.

Statistical Analysis

Data were analyzed using Excel 2010 and SPSS v27. Medians and ranges summarized continuous variables; frequencies and percentages described categorical ones. Normality was tested with Shapiro-Wilk. Non-parametric tests (Mann-Whitney U and Kruskal-Wallis) compared groups, and the Chi-square test was used for categorical data. Regression assessed the link between PID types and quality of life, while Spearman's correlation examined age-related trends. Correlation strength was based on values near 1 (strong) or 0 (weak). A p-value < 0.05 was considered significant.

RESULTS

Table 1 shows a non-significant difference between cases and controls as regards age, age groups, and gender. Within the cases group, the results showed that FMF was the most prevalent PID type, constituting 56.9% of the cases (n=29), followed by ataxia telangiectasia (n=6, 11.8%). Chronic mucocutaneous candidiasis, severe combined immunodeficiency, and hypogammaglobulinemia each accounted for two cases (3.9%). The other types each accounted for one case (2.0%) (Table 2).

Regarding the quality-of-life score reported by children, the cases group exhibited a lower total score compared to healthy children ($p<0.001$), including the physical domain ($p<0.001$), the emotional domain ($p=0.02$), the social domain ($p=0.003$), and the school domain ($p=0.002$) (Table 3).

Regarding the quality-of-life scores reported by parents, the cases group demonstrated significantly lower total scores compared to the control group (p<0.001), including the physical domain (p<0.001), the emotional domain (p=0.001), the social domain (p<0.001), and the school domain (p<0.001) (Table 4).

The results of multiple regression analysis showed that cases with FMF were associated with higher total QoL scores reported by both children and parents (p-value = 0.0001 & 0.0001, respectively). In addition, cases with chronic mucocutaneous candidiasis and angioedema were associated with higher total QoL scores reported by parents (p-value = 0.032 & 0.016, respectively). No other significant associations were observed (Table 5).

The Spearman correlation analysis showed that only parent reporting of the physical domain had a positive correlation with the age of children (r=0.363, p-value=0.009). While no other significant correlation was observed (Table 6, Supplementary Figure 1).

The results showed that there was a statistically significant difference between age groups regarding parent reporting of physical domain (P=0.03). By conducting post-hoc analysis, the results showed that the age group 13-17 years old had higher physical scores than the age group of 2-4 years old. While no other significant results were found (Table 7).

Table (1): Comparison between the patient and control groups as regards age and sex

Variables	Patients (n=51)	Controls (n=51)	Test	p-value
Age (in years)				
Median (range)	10.50 (5.00 - 18.00)	12.00 (6.00 - 18.00)	0.0001[a]	0.843
Age group: n (%)				
2 – 4 years	15 (29%)	15 (29%)	0.0001[b]	1.00
5 – 7 years	7 (14%)	7 (14%)		
8 – 12 years	20 (39%)	20 (39%)		
13 – 18 years	9 (18%)	9 (18%)		
Sex: n (%)				
Male	21 (41%)	23 (45%)	0.160[b]	0.69
Female	30 (59%)	28 (55%)		

Categorical variables were presented as number (percentage); Continuous variables were presented as median (range); a: Mann Whitney U test; b: Chi-square test; p-value<0.05 was statistically significant.

Table (2): Frequency and percentage of primary immunedeficiency diseases in the patient group

Types	Frequency (n=51)	Percentage %
Familial Mediterranean Fever	29	56.9
Ataxia telangiectasia	6	11.8
Hypogammaglobulinemia	2	3.9
Severe Combined Immunodeficiency	2	3.9
Chronic mucocutanous candidiasis	2	3.9
Leukocyte Adhesion Deficiency Type 1	1	2.0

Combined Immunodeficiency	1	2.0
Autoimmune Lymphoproliferative Syndrome	1	2.0
Major Histocompatibility Complex Class II Deficiency	1	2.0
B cell defect	1	2.0
Common Variable Immunodeficiency	1	2.0
Hyperimmunoglobulin E Syndrome	1	2.0
Hyperimmunoglobulin M Syndrome	1	2.0
Angioedema	1	2.0
Wiskott-Aldrich Syndrome	1	2.0

Table (3): Comparison between cases and controls regarding the quality of life for child report

Child report	Cases	Controls	Test[a]	p-value
Physical				
Median (range)	84.37 (18.70 - 93.75)	100.00 (87.50 - 100.00)	36.59	**<0.001***
Emotion				
Median (range)	80.00 (40.00 - 95.00)	90.00 (80.00 - 95.00)	5.11	**0.02***
Social				
Median (range)	77.50 (15.00 - 95.00)	90.00 (70.00 - 100.00)	8.88	**0.003***
School				
Median (range)	75.00 (0.00 - 90.00)	90.00 (70.00 - 95.00)	9.78	**0.002***
Total				
Median (range)	77.56 (27.19 - 92.19)	91.25 (84.69 - 97.50)	25.91	**<0.001***

*Continuous variables were presented as median (range); a: Mann Whitney U test; *p-value<0.05 was statistically significant.*

Table (4): Comparison between cases and controls regarding quality of life for parent report

Parents report	Cases	Control	Test[a]	p-value
Physical				
Median (range)	82.81 (12.50 - 96.80)	96.87 (90.62 - 100.00)	26.77	**<0.001***
Emotion				
Median (range)	75.00 (35.00 - 95.00)	90.00 (80.00 - 95.00)	10.14	**0.001***
Social				
Median (range)	80.00 (15.00 - 100.00)	95.00 (70.00 - 100.00)	11.29	**<0.001***
School				
Median (range)	80.00 (0.00 - 90.00)	90.00 (70.00 - 95.00)	11.49	**<0.001***
Total				
Median (range)	79.38 (23.13 - 94.20)	91.55 (83.44 - 96.72)	35.31	**<0.001***

*Continuous variables were presented as median (range); a: Mann Whitney U test; * p-value<0.05 was statistically significant.*

Table (5): Association between types of PID and total child and parent quality of life

Variables	QoL of children	QoL of parents
Major Histocompatibility Complex Class II Deficiency	0.986	NA
Hyperimmunoglobulin E Syndrome	0.716	0.811
Common Variable Immunodeficiency	0.591	0.670
Chronic mucocutanous candidiasis	0.253	**0.032***
Hyperimmunoglobulin E Syndrome	0.115	0.194
Familial Mediterranean Fever	**0.0001***	**0.0001***
Angioedema	0.060	**0.016***
B cell defect	NA	0.909
Combined Immunodeficiency	NA	0.716
Wiskot Aldrich	NA	0.626
Autoimmune Lymphoproliferative Syndrome	NA	0.520
Hypogammaglobulinemia	NA	0.300
Leukocyte Adhesion Deficiency Type 1	NA	0.267
Constant (ataxia telangiectasia)	.	.

*Multiple regression analysis was conducted; NA, not applicable; PID, Primary immunedeficiency disease; QoL, Quality of life; *p-value<0.05 was statistically significant.*

Table (6): Correlation between age in years and study variables among the patient group

Variables	Age in years	
	r	**p-value**
Child report		
Physical	0.226	0.186
Emotion	0.141	0.412
Social	0.108	0.531
School	0.265	0.118
Total	0.213	0.211
Parent report		
Physical	0.363	**0.009***
Emotion	0.083	0.563
Social	0.185	0.193
School	0.161	0.259
Total	0.228	0.108

*r: Spearman's rank correlation coefficient; * p-value <0.05 was statistically significant.*

Table (7): Comparison between the age groups in years and quality of life in child and parent reports of cases

Variables	Age groups in years			p-value
	5-7 years	8-12 years	13-18 years	
Child report				
Physical	62.50 (25 - 81.25)	85.93 (18.7 – 93.75)	90.62 (34.37 – 93.75)	0.136
Emotion	80 (60 – 90)	80 (40 – 95)	85 (60 – 95)	0.240
Social	70 (20 – 90)	75 (15 – 95)	90 (15 – 95)	0.297
School	70 (0 – 80)	77.5 (0 – 90)	80 (30 – 85)	0.120
Total	72.81 (35 – 82.81)	76.32 (27.19 – 92.19)	86.88 (34.84 – 92.19)	0.143
Parent report				
Physical	62.50 (21.87 – 78.12)	84.37 (12.50 – 9375)	87.50 (53 – 96.80)	**0.03***
Emotion	70 (35 – 90)	72.50 (40 – 95)	90 (35 – 95)	0.208
Social	70 (15 – 85)	82.50 (20 – 100)	85 (25 – 100)	0.164
School	50 (27 – 90)	80 (0 – 90)	80 (20 – 90)	0.428
Total	56.88 (27.06 – 81.25)	79.38 (23.13 – 93.44)	84.84 (33.25 – 94.20)	0.146

*Continuous variables were presented as median (range); Kruskall-Wallis test was used; *p-value <0.05 was statistically significant*

DISCUSSION

Given the chronic nature of primary immunodeficiency diseases (PIDs), these conditions can significantly impact a child's overall psychosocial development. This includes alterations in self-image, self-esteem, social interactions, and daily activity participation—paralleling the challenges faced by children with other long-term illnesses or even adults living with PID [9]. As a result, evaluating outcomes in PID should go beyond traditional clinical parameters to encompass patient-reported outcomes, which offer essential insights into how children and their families perceive and adapt to living with the condition across various dimensions of daily life.

One of the most important patient-reported outcome measures is health-related quality of life (HRQoL). This multidimensional concept incorporates physical, psychological, emotional, and social well-being, making it especially relevant for evaluating the effects of chronic diseases in pediatric populations [10]. In children with PID, HRQoL assessment serves as a critical tool for understanding not only the burden of the disease itself but also the impact of the treatments involved. These evaluations can help inform care plans and support services tailored to the child's and family's specific needs.

In the current study, the median age was 10.5 years in the PID group and 12.0 years in controls, with no significant difference. This aligns with the findings of Kuburovic et al. [11], who reported similar age distributions between groups (mean age: 11.3 vs. 12.4 years; $p = 0.3$), suggesting that age may not influence HRQoL outcomes. Gender distribution was also comparable (PID: 41% males, 59% females; controls: 45% males, 55% females), with no statistically significant difference.

Unlike the current results, Kuburovic et al. [11] reported a significantly male-dominant PID group (84%) compared to 48% in the JIA group and 59.6% in healthy controls. This skewed distribution may be due to sex-linked immunodeficiencies like X-linked agammaglobulinemia (XLA), which affects only males. Additionally, more severe presentations in males could lead to earlier

diagnosis and higher referral rates, explaining the imbalance.

In the case group, Familial Mediterranean Fever (FMF) was the most common PID (56.9%), followed by ataxia telangiectasia (11.8%). Other PIDs—such as hypogammaglobulinemia, celiac disease, and chronic mucocutaneous candidiasis—were less frequent (3.9% each), while Leukocyte Adhesion Deficiency (LAD), Combined Immunodeficiency (CID), Autoimmune Lymphoproliferative Syndrome (ALPS), and others appeared in only 2% of cases. This highlights FMF as the predominant diagnosis in the cohort. In contrast, Meelad et al. [12] reported predominantly antibody deficiencies as the most common PIDs, particularly XLA, along with CID and phagocytic defects. Their findings align with global trends, where antibody deficiencies are the most prevalent.

In the current study, children with PID had a significantly lower median total quality of life score (77.56; range: 27.19–92.19) compared to controls (91.25; range: 84.69–97.50), indicating a notable gap in perceived well-being. These findings are consistent with Meelad et al. [12], who also reported significantly reduced HRQoL in children with PID, reinforcing the negative impact of PID on various aspects of daily functioning and emotional health.

Supporting the current study results, Peshko et al. [13] also found significantly lower HRQoL scores in children with PID compared to healthy peers. This adds to the growing evidence that PID substantially affects the daily well-being of affected children.

The marked reduction in HRQoL among children with PID is likely due to their heightened susceptibility to recurrent infections, which often require frequent medical visits, hospitalizations, and prolonged treatments. These factors contribute to physical symptoms like fatigue and chronic pain and limit participation in school and social life. The chronic, unpredictable nature of infections further disrupts normal experiences, hindering psychosocial development and overall quality of life [14].

In the physical functioning domain, children with PID had a significantly lower median score (84.37; range: 18.70–93.75) compared to healthy peers (100.00; range: 87.50–100.00), reflecting limitations like fatigue, reduced mobility, and less physical activity. These results align with Peshko et al. [13], who also reported reduced physical functioning in children with PID, indicating that the disease impacts more than immune function—it affects daily physical capabilities and overall quality of life.

However, not all studies support reduced physical functioning in children with PID. Meelad et al. [12] found no significant difference in physical health between PID patients and controls. Similarly, an Italian study on children with XLA reported physical health perceptions comparable to healthy peers—and in some cases, better than those with rheumatologic diseases [15].

The reduced physical functioning in the current PID cohort may stem from activity restrictions—either self-imposed or caregiver-advised—due to fatigue or infection risk. Limited participation in play and sports, vital for physical and psychosocial development, can lead to reduced endurance, social isolation, and lower self-esteem, negatively affecting both physical and emotional quality of life [16].

In the emotional functioning domain, children with PID scored significantly lower (median: 80.00; range: 40.00–95.00) than controls (median: 90.00; range: 80.00–95.00), indicating greater emotional distress and reduced psychological well-being. This aligns with Peshko et al. [13], who also found lower emotional functioning in children with PID, underscoring the emotional burden of chronic immunological conditions.

In contrast, Meelad et al. [12] found no significant differences in emotional functioning between PID patients and controls. This discrepancy may be due to variations in sample composition or disease severity—the current study may have included more heterogeneous or severely affected cases. Children with frequent hospitalizations or interventions are

more likely to experience heightened emotional distress, including anxiety, sadness, or fear of illness.

In the social functioning domain, children with PID had a significantly lower median score (77.50; range: 15.00–95.00) than controls (90.00; range: 70.00–100.00), highlighting challenges in peer relationships, group participation, and social integration. These findings align with Peshko et al. [13], who also reported reduced social functioning in children with PID, likely due to illness-related absences, activity restrictions, or caregiver overprotectiveness.

Similarly, Kuburovic et al. [11] reported significantly lower social domain scores in children with PID, reinforcing the impact of immunodeficiency on peer interactions and social development. These limitations may contribute to isolation and a diminished sense of belonging, adversely affecting psychosocial health and overall quality of life.

In contrast to the current study findings, Meelad et al. [12] found no significant difference in the social domain between children with PID and healthy controls.

In the school functioning domain, the current study PID group had a significantly lower median score (75.00; range: 0.00–90.00) compared to controls (90.00; range: 70.00–95.00), highlighting the adverse effects of PID on school attendance, academic performance, and classroom engagement.

These findings are consistent with Meelad et al. [12] and Peshko et al. [13], who both reported significantly reduced school functioning in children with PID, likely due to frequent absences from illness and medical care. Zebracki et al. [17] further noted that PID not only affects school performance but also places strain on family life, contributing to parental distress and limited family activities. These broader impacts highlight the need for integrated educational and psychological support in the care of children with PID.

In contrast, Kuburovic et al. [11] found no significant difference in school functioning between children with PID and healthy controls. They attributed this to consistent school attendance and daily activity participation among PID patients, likely supported by regular immunoglobulin replacement therapy, which reduces infections and stabilizes health, thereby lessening the disease's academic impact.

These contrasting findings emphasize the importance of treatment accessibility, disease management strategies, and healthcare system support in shaping outcomes such as school performance and overall well-being in children with PID.

Parents of children with PID reported significantly lower total quality of life scores (median: 79.38; range: 23.13–94.20) compared to parents of healthy children (median: 91.55; range: 83.44–96.72), reflecting greater caregiver concern. These findings align with Meelad et al. [12], who also reported lower parent-rated QoL in the PID group. In the current study, scores were significantly lower across all domains—physical, emotional, social, and school—whereas Meelad et al. [12] found no significant difference in the emotional domain. This discrepancy may relate to differences in disease severity or a higher proportion of severely affected children in the current study sample.

In contrast to the current study results, Kuburovic et al. [11] found that parents of children with PID reported significantly lower school functioning compared to both healthy controls and children with JIA, while other domains were less affected. This suggests that parental perceptions may vary based on clinical presentation, treatment demands, and available educational support.

Among the different PID diagnoses in the current study, familial Mediterranean fever (FMF) was most strongly associated with lower QoL scores in both child and parent reports, with a significant reduction observed in the FMF subgroup ($p = 0.0001$), highlighting its substantial impact on daily life and well-being.

In the current study, conditions such as chronic mucocutaneous candidiasis ($p = 0.253$), angioedema ($p = 0.060$), hyper IgE syndrome

(p = 0.716), CVID (p = 0.591), hyper IgM syndrome (p = 0.115), and 3-MHC2 deficiency (p = 0.986) showed no significant association with child-reported QoL. These results differ from Meelad et al. [12], who also found no statistically significant predictors based on PID subtype, though trends were noted. Predominantly antibody deficiency showed a mild positive (non-significant) association (B = 6.73, p = 0.45), while immune dysregulation and combined immunodeficiencies had negative trends nearing significance (B = -26.51 and -37.28; p = 0.06).

In the current study, phagocyte defects and undefined PIDs showed no significant impact on HRQoL, likely due to the very small number of cases in these categories, which limits statistical power. Additionally, the heterogeneity of clinical severity within these diagnoses and potential stability of individual patients at the time of assessment may have contributed to relatively preserved quality-of-life scores. These factors, combined with variability in parent and child perceptions of illness impact, may explain the absence of a measurable association in the current study findings.

In the current study, parent-reported data showed FMF remained strongly associated with lower QoL (p = 0.0001). Additionally, candidiasis (p = 0.032) and angioedema (p = 0.016) were significant negative predictors, while hyper IgE syndrome (p = 0.811), CVID (p = 0.670), and B-cell defects (p = 0.909) were not significantly associated.

Candidiasis and angioedema were significant negative predictors of parent-reported HRQoL, possibly due to their visible, symptomatic nature—such as persistent infections or swelling—which can cause parental concern and heightened stress. In contrast, conditions like hyper IgE syndrome, CVID, and B-cell defects did not show significant associations, likely reflecting milder or better-managed disease states in the included cases or limited sample sizes reducing the ability to detect statistical significance. Additionally, variable clinical expression and caregiver adaptation over time may have influenced perceived quality of life in these less symptomatic or well-controlled conditions.

These outcomes again contrast with Meelad et al. [12], who found no significant associations between PID subtypes and parent-reported QoL scores. Their analysis revealed high p-values and broad confidence intervals across all PID categories, including antibody deficiencies, immune dysregulation, phagocyte defects, and undefined immunodeficiencies—implying that diagnosis alone was not a strong predictor of parental perceptions of HRQoL.

This study's strengths include a solid case-control design with age- and sex-matched healthy controls, enabling clear comparison of HRQoL. It offers a comprehensive assessment across physical, emotional, social, and school domains and provides detailed analysis of PID subtypes, adding depth to understanding how different conditions impact quality of life.

Despite its strengths, this study has several limitations. The small, heterogeneous sample—reflecting the rarity and diversity of PID—limits generalizability. Its cross-sectional design captures HRQoL at a single point, without tracking changes over time. The sample size also restricted analysis of treatment effects on quality of life. Additionally, variability in disease severity and access to care may have influenced QoL reporting, introducing potential bias.

CONCLUSION

The current study showed that children with PID are likely to experience significantly lower HRQOL compared to healthy peers, particularly within physical, emotional, social, and school functioning. Children with PID were primarily influenced by the chronic nature of their condition and its impact on daily life, physical activity, and emotional well-being.

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Citation

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