Sleep and psychological characteristics of children with cancers and type 1 diabetes and their caregivers

Daniela Di Riso, Silvia Spaggiari, Giacomo Gaiga, Maria Montanaro, Silvana Zaffani, Valerio Cecinati, Claudio Maffeis, Nicola Cellini

PII: S1389-9457(23)00018-7

DOI: https://doi.org/10.1016/j.sleep.2023.01.014

Reference: SLEEP 5511

To appear in: *Sleep Medicine*

Received Date: 24 September 2022

Revised Date: 29 December 2022

Accepted Date: 19 January 2023

Please cite this article as: Di Riso D, Spaggiari S, Gaiga G, Montanaro M, Zaffani S, Cecinati V, Maffeis C, Cellini N, Sleep and psychological characteristics of children with cancers and type 1 diabetes and their caregivers, *Sleep Medicine* (2023), doi: https://doi.org/10.1016/j.sleep.2023.01.014.

Authors' contributions: Conceptualization, D.D.R., and N.C.; Methodology, D.D.R., and N.C.; formal analysis, D.D.R., C.D., S.S., and N.C.; Investigation: D.D.R., S.S., G.G., M.M., S.Z., V.C., C.M., and N.C.; Data Curation, C.D. and S.S.; Writing—original draft preparation, D.D.R., S.S, G.G., and N.C.; Writing—review and editing: D.D.R., S.S., G.G., M.M., S.Z., V.C., C.M., and N.C.; Supervision: D.D.R., S.S., G.G., M.M., S.Z., V.C., C.M., and N.C.; Project administration, D.D.R., and N.C. All authors have read and agreed to the published version of the manuscript.

Sleep and psychological characteristics of children with cancers and Type 1 diabetes and their caregivers

Daniela Di Riso[1], Silvia Spaggiari[1], Giacomo Gaiga[1], Maria Montanaro[2], Silvana Zaffani[3], Valerio Cecinati[2], Claudio Maffeis[3], Nicola Cellini*[4]

[1]Department of Developmental Psychology and Socialization, University of Padova, Padova, Italy
[2]Complex Structure of Pediatrics and Pediatric Oncohematology "Nadia Toffa", Central Hospital Santissima Annunziata, 74121 Taranto, Italy
[3]Pediatric Diabetes and Metabolic Disorders, Department of Surgical Sciences, Dentistry, Paediatrics and Gynaecology, University of Verona, 37134 Verona, Italy
[4]Department of General Psychology, University of Padova, Padova, Italy

RUNNING HEAD: *Sleep in Pediatric Diabetes and Cancer*

***Corresponding author:**
Nicola Cellini, PhD
Department of General Psychology, University of Padova
Via Venezia 8, 35131 Padova, Italy
Phone number: +39 0498276712
E-mail: nicola.cellini@unipd.it

Conflicts of interest: This is not an industry-supported study. None of the authors have potential conflicts of interest to be disclosed

Availability of data and material: The data that support the findings of this study are available from the corresponding author upon reasonable request. The study was not pre-registered. No custom code was made to analyze the data

Authors' contributions: Conceptualization, D.D.R., and N.C.; Methodology, D.D.R., and N.C.; formal analysis, D.D.R., S.S., and N.C.; Investigation: D.D.R., S.S., G.G., M.M., S.Z., V.C., C.M., and N.C.; Data Curation, D.D.R. and S.S.; Writing—original draft preparation, D.D.R., S.S, G.G., and N.C.; Writing—review and editing: D.D.R., S.S., G.G., M.M., S.Z., V.C., C.M., and N.C.; Supervision: D.D.R., S.S., G.G., M.M., S.Z., V.C., C.M., and N.C.; Project administration, D.D.R., and N.C. All authors have read and agreed to the published version of the manuscript.

Sleep and psychological characteristics of children with cancers and Type 1 diabetes and their caregivers

Daniela Di Riso[1], Silvia Spaggiari[1], Giacomo Gaiga[1], Maria Montanaro[2], Silvana Zaffani[3], Valerio Cecinati[2], Claudio Maffeis[3], Nicola Cellini*[4]

[1]Department of Developmental Psychology and Socialization, University of Padova, Padova, Italy
[2]Complex Structure of Pediatrics and Pediatric Oncohematology "Nadia Toffa", Central Hospital Santissima Annunziata, 74121 Taranto, Italy
[3]Pediatric Diabetes and Metabolic Disorders, Department of Surgical Sciences, Dentistry, Paediatrics and Gynaecology, University of Verona, 37134 Verona, Italy
[4]Department of General Psychology, University of Padova, Padova, Italy

RUNNING HEAD: *Sleep in Pediatric Diabetes and Cancer*

***Corresponding author:**
Nicola Cellini, PhD
Department of General Psychology, University of Padova
Via Venezia 8, 35131 Padova, Italy
Phone number: +39 0498276712
E-mail: nicola.cellini@unipd.it

Conflicts of interest: This is not an industry-supported study. None of the authors have potential conflicts of interest to be disclosed

Availability of data and material: The data that support the findings of this study are available from the corresponding author upon reasonable request. The study was not pre-registered. No custom code was made to analyze the data

Authors' contributions: Conceptualization, D.D.R., and N.C.; Methodology, D.D.R., and N.C.; formal analysis, D.D.R., C.D., S.S., and N.C.; Investigation: D.D.R., S.S., G.G., M.M., S.Z., V.C., C.M., and N.C.; Data Curation, C.D. and S.S.; Writing—original draft preparation, D.D.R., S.S, G.G., and N.C.; Writing—review and editing: D.D.R., S.S., G.G., M.M., S.Z., V.C., C.M., and N.C.; Supervision: D.D.R., S.S., G.G., M.M., S.Z., V.C., C.M., and N.C.; Project administration, D.D.R., and N.C. All authors have read and agreed to the published version of the manuscript.

Abstract

Objectives: Children with chronic illnesses and their parents are more at risk to develop sleep problems, which are linked to worse psychological and physical well-being. This study aimed to assess sleep patterns and their connections with psychological outcomes in children with type 1 diabetes (T1D) and cancer and their caregivers, compared to a control sample. In addition, we explored the associations between caregiver and child's sleep quality across the three groups.

Methods: We enrolled 56 children with T1D, 33 children with cancer, and 61 healthy children between 7 and 15, and their respective caregivers. Caregivers filled out an ad-hoc survey assessing their sleep disturbances, parenting stress, general well-being, anxiety, and their children's sleep patterns and psychological adjustments.

Results: Children with cancer showed lower sleep quality than the other groups. Moreover, worse psychological adjustment was associated with greater sleep disturbances in both clinical groups. As for caregivers, the cancer group reported the worst sleep quality and greater anxiety compared to the other samples. Greater anxiety was also linked to worse sleep quality. Furthermore, greater sleep problems in children were associated with poorer caregivers' sleep quality in the whole sample and the T1D group.

Conclusions: A better understanding of sleep patterns and problems for chronically ill children and their parents is fundamental to provide adequate care for these vulnerable populations. Furthermore, an illness-specific approach may better inform and guide the practitioners in clinical practice.

Keywords: Caregivers; Parental distress; Pediatric diabetes; Pediatric cancers; Sleep disturbances

1. Introduction

Sleep is a milestone in the assessment of well-being in youth and their caregivers, both in the short and the long term [1]. Indeed, difficult sleep patterns seem to be associated with physical and psychological detrimental outcomes [2]. For instance, in children, sleep problems are correlated to unhealthy weight increase, poor cardiometabolic control [see 3], the risk of manifesting affective and behavioral problems, and attention vulnerabilities that could increase school difficulties [4] Youth with chronic illnesses are more at risk to develop sleep problems [5]. The literature indicates that youth with neurologic diseases [6], respiratory problems [7], kidney disease [8], type 1 diabetes (T1D), and cancer [9], show a higher prevalence of chronic sleep problems than healthy peers, mostly characterized by greater difficulties in falling asleep and night-time awakenings. As to caregivers of chronically ill children, literature reports similar difficulties, indicating frequent chronic partial sleep deprivation [10]. For instance, caregivers of children with cancer [11, 12], T1D [13], and epilepsy [14], report poorer sleep quality and higher insomnia symptoms, especially nighttime awakenings and difficulty in falling asleep, compared to the caregivers of healthy children.

In the context of T1D and cancer diagnosis, sleep difficulties have been reported both by youth and their caregivers [15, 16]. However, the literature mostly investigated sleep profiles in pediatric patients and their caregivers separately [17-19], and there are limited studies investigating the sleep profile within the dyad [11, 20]. Moreover, studies comparing sleep quality in different pediatric chronic conditions and their caregivers are limited. For example, Boman and colleagues [21], reported that caregivers of children with T1D presented sleep difficulties not significantly different from caregivers of children with cancer. However, the authors of this study did not report any information about sleep quality or difficulties of the children.

Focusing on T1D, accumulating evidence indicates that children and their caregivers report short sleep duration, daytime sleepiness, and a high prevalence of night awakenings, often associated with the need for nighttime medication or to check blood glucose levels [e.g., 22]. Also, irregular sleep patterns seem to be associated with problems with glycemic control, as higher HbA1C values correlate to shorter sleep duration and difficulties in sleep initiation [20, 23]. Furthermore, Bahadur et al. [24] highlighted that poor sleep quality in diabetic children is associated with poor caregivers' sleep quality. Evidence suggests that getting adequate sleep hygiene is not a priority for caregivers of diabetic youth, repeatedly struggling to avoid nighttime diabetes physical complications [e.g. hypoglycemia, 25]. Caregivers of diabetic children also reported weaker psychosocial well-being, such as higher levels of anxiety and depressive symptoms [26].

The literature on sleep and cancer also indicates that both children and caregivers experience sleep difficulties such as short sleep duration, frequent awakenings, low sleep efficiency, and

excessive daytime sleepiness [12, 18]. In this population, it has been suggested that the shock of cancer diagnosis may induce a decrease in sleep quality, while sleep problems may be maintained by treatment-related stressors, parental distress, worries, changes in family life, and dysfunctional sleep behaviors [12, 17]. Also, caregivers' accommodating behaviors (e.g., prolonged co-sleeping) in response to the diagnosis contribute to children's sleep difficulties independently of their age, cancer type, and sleep hygiene [27]. As it is for children with T1D, literature reports a strong association between a child's and mother's sleep onset and the number of nighttime awakenings, highlighting an interplay between caregivers' and children's sleep quality [17]. Moreover, it seems that the reduced sleep duration in caregivers of children with cancer strongly predicts caregivers' psychological and physical well-being [17], who usually report greater depression and anxiety levels compared to caregivers of healthy children [28].

Diabetes and cancer are two of the most studied chronic pathologies when it comes to sleep disruption in children and their parents [29], while fewer studies are available about their comparison [21]. The prevalence of childhood diabetes [30], and cancer [31] is getting higher and higher. A few studies compared the two diseases and evidenced some specificities linked to each one [21, 32]: we chose diabetes and cancer as they range from minor life-threatening conditions to severe life-threatening conditions.

In the present study, we aimed to assess sleep patterns and their association with psychological outcomes in two groups of pediatric chronic patients diagnosed with T1D and cancer and their caregivers, compared to healthy control. Specifically, the aims of this study were twofold. First, we aimed to describe the sleep patterns and psychological characteristics of the two clinical groups and their caregivers, compared to healthy controls. Second, we aimed to explore whether sleep and psychological characteristics of children can influence the sleep quality of their caregivers, taking into account the presence of a clinical condition and the time since diagnosis.

2. Materials and methods

2.1.Participants

One hundred and fifty children between 7 and 15 years old and their caregivers took part in the study (see Table 1 and 2 for demographics).

Fifty-six children with T1D (21F; 11.64±2.46 years), were recruited. The diagnosis of T1D was made from a minimum of 6 to a maximum of 168 months (14 years) before the study (67.14±40.59). The mean percentage of time passed with in-range glycemic levels (TIR%) was 60.42%±13.29.

Thirty-three children with cancer (17F; 11.12±3.15 years) joined the study. The 45.5% of them had a hematologic malignancy, the 39.4% had a solid tumor, and the 15.2% had other hematological pathologies. The diagnosis was made a minimum of 2, and a maximum of 66 months before the time of the study (22.32±12.36).

Sixty-one healthy children (27F; 11.36±2.52 years) were recruited as the control sample. A range between 91% and 97% of those respecting the inclusion and exclusion criteria agreed to participate in the study for each sub-sample. Reasons for refusal were time limits and lack of interest in the research.

The project was approved by the Ethics Committee for Clinical Trials (CESC) (Observational study n. 977/CE) and by the Institutional Ethical Committee of Verona, Italy (Prot. n. 29097). The research is in line with the Ethical and Deontological Codes of Italian Psychologists. No reward was offered for enrollment.

2.2. Procedure

Children with T1D were recruited at the Regional Center for Pediatric Diabetes, University Hospital of Verona (Italy), whereas children with cancer were recruited at the Pediatric Oncology Units of Taranto (Italy) and Treviso (Italy). For clinical children inclusion criteria were: age between 7 and 15 years and a diagnosis of the disease (cancer or T1D); in particular for children with cancer, at least two months passed from the diagnosis were necessary, given that a severe stress phase can occur immediately after the diagnosis [33]. Exclusion criteria were the absence of comorbidity with psychiatric or emotional disorders or other chronic diseases and scarce knowledge of Italian. For the control sample, inclusion criteria were age between 7 and 15 years, and exclusion criteria were a diagnosis of any pediatric chronic or psychiatric or emotional disorders and non-Italian speaking.

Patients in line with the inclusion and exclusion criteria were recruited by the ward's doctors during the outpatient control visit: those interested in collaborating were invited to sign a detailed informed consent. All children were verbally asked for their agreement to join the study and those between 12 and 15 years old had to sign a specific informant consent for participation, as requested by the Ethics Committees. The medical data were collected during routine visits to the hospital between November 2020 and May 2021. For the T1D group, questionnaires were filled in a separate room under the ward's psychotherapist's supervision before or after the medical visit, both for caregivers and children. Children with cancer and their caregivers completed the questionnaire online (via an email link). Each session lasted about 30 minutes. The study methods were designed so as not to interfere with the necessary medical procedures and to follow the Covid-19 safety guidelines.

The control sample was a convenient one, recruited through snowball sampling. Caregivers were contacted and met to be informed about the study. For those who signed the informed consent, data were collected in the same period and following the same procedure as the clinical group. The survey and questionnaires were analogous, except for the items about pediatric chronic diseases. Ethical guidelines for administration and recruitment were followed also for the control group.

2.3. Measures

All caregivers completed a survey with questions related to them and their children. Besides sociodemographic (e.g. age, occupation) and clinical (e.g., type of cancer and time since diagnosis) information, they filled out several standardized questionnaires.

2.3.1 Children's questionnaires

The Sleep Disturbance Scale for Children [SDSC; 34] was used to measure children's sleep quality. This 26-items questionnaire gives a total score that ranges from 26 to 130. Scoring higher than 39 indicates potential children's sleep-related disorders. Six factors are calculated: Disorders of initiating and maintaining sleep, Sleep breathing disorders, Disorders of arousal nightmares, Sleep-wake transition disorders, Disorders of excessive somnolence, and Sleep hyperhidrosis. The Italian version is validated for children between 6.5 and 15.3 and showed good validity and reliability. Cronbach's alpha for the total score was .82, whereas for the subscales alpha was .72 for Disorders of initiating and maintaining sleep, .30 for Sleep breathing disorders, .47 for Disorders of arousal nightmares, .48 for Sleep-wake transition disorders, .62 for Disorders of excessive somnolence, and .73 for Sleep hyperhidrosis.

The Strength and Difficulties Questionnaire [SDQ; 35] is a self-report screening questionnaire used to assess children's psychological adjustment. The SDQ consists of 25 items divided into 5 subscales: emotional symptoms, conduct problems, hyperactivity-inattention, peer relationships problems, and prosocial behaviors. A total difficulties score scale is obtained by adding all subscales' scores. Each item is rated from 0 ("not true") to 3 ("certainly true") on a 4-points Likert scale; higher scores indicate more problems in adjustment. The Italian version has been validated in a sample of 8-to-15-year-old children and adolescents [36]. Cronbach's alpha was .81 for the total score, whereas for the subscales alpha was .72 for the emotional symptoms, .52 for conduct problems, .63 for hyperactivity-inattention, .60 for peer relationships problems, and .72 for prosocial behaviors.

2.3.2 Caregivers' questionnaires

The Parenting Stress Index-Short Form [PSI-SF; 37, Italian validation: 38] was used to measure parenting stress. PSI-SF is composed of 36 items, divided into three subscales: Parental distress, Parent–child dysfunctional interaction, and Difficult child. This is a brief questionnaire rated on a 5-point Likert scale (from 1=strongly agree to 5=strongly disagree) that provides a total score and a score for each subscale; higher scores indicate higher levels of parenting stress. Cronbach's alpha was .91 for the total score, and .85, .84, and .85 for Parental distress, Parent–child dysfunctional interaction, and Difficult child subscales, respectively.

The Pittsburgh Sleep Quality Index [PSQI; Italian version: 39] was used to assess caregivers' sleep quality over the previous month. It is an 18-items self-report questionnaire, whose global sleep quality score ranges from 0 to 21: a higher score indicates poorer sleep quality. A cut-off > 5 is used to detect the presence of relevant sleep problems. Cronbach's alpha was .70.

The General Health Questionnaire-12 [GHQ-12; 40, Italian version: 41] is a self-report 12-item measure used to assess global functioning and general health. Each item is scored from 0 to 3, and the total possible score ranges from 0 to 36. Higher scores indicate poorer psychological well-being. A total score from 15 to 19 indicates difficulties in global functioning, whereas 20 is the threshold for the presence of significant distress. Cronbach's alpha was .83.

The Italian version of the Trait scale of the State-Trait Anxiety Inventory-Y [42] was used to measure trait anxiety. The trait anxiety subscale (STAI-Y2), which was used in this study, assesses the general tendency of a person to respond anxiously to perceived threats in the environment. The 20 items are evaluated on a 4-point Likert scale; the range score for each item is from 0 ("almost never") to 3 ("almost ever"). Cronbach's alpha was .96.

2.4. Statistical analysis

In children, to assess differences in sleep and psychological characteristics between the groups, we conducted several two-way ANOVAs with the Welch method, which does not assume equal variance between groups. The ANOVAs were conducted for the SDSC and SDQ total scores, and their respective subscales. The χ^2 test was used to compare the proportion of children with an SDSC score higher than 39. To compare the number of hours slept by children of the different groups, we used the first question of the SDSC. Given the ordinal nature of this variable, we employed a Kruskal-Wallis test and, in case of a significant result, we used the Dwass-Steel-Critchlow-Fligner (DSCF) as post-hoc test. Then, we conducted a Pearson's correlation to explore the association between psychological adjustment (SDQ total score) with sleep difficulties (SDSC total score).

For the caregivers, we conducted several ANOVAs with the Welch method to assess differences between groups in sleep quality (PSQI total score), sleep duration, sleep latency, as well anxiety level (STAI-Y2), and general health score. The χ^2 test was used to compare the proportion of caregivers with a PSQI score higher than 5. Then, we conducted a Pearson's correlation to explore the association between sleep quality and general health score, and anxiety level.

For all the ANOVAs, the omega square (ω^2) was reported as a measure of effect size. In case of significant differences between groups, the Games-Howell test with Tukey correction was used for post-hoc analysis, and the corrected p-value and Cohen's d were reported for each comparison. We considered ω^2 values of 0.01, 0.06, and .14 and d values of 0.2, 0.5, and 0.8 as small, medium, and large effect sizes, respectively [43, 44].

Pearson's correlations were to explore the relationship between sleep quality in children and their caregivers, considering the whole sample and the three groups separately.

Lastly, we conducted three separate linear regressions, one for each group, investigating potential predictors of sleep quality in the caregiver. The factors included in the regressions were the caregiver's anxiety level (STAI-Y2) and their children's age, sleep quality, and psychological adjustments. Moreover, for the oncological and T1D groups, we included the time that passed from the first diagnosis as a factor. Lastly, in the T1D we also included the value of the percentage of hemoglobin A1c detected during the visit when questionnaires were administered (Hb1Ac).

For all the analyses, the level of significance was set at $p<.05$.

3. Results

3.1. Children's sleep and psychological characteristics

The mean and standard deviation (SD) of the children's study variables in the three groups are reported in Table 1. No significant group differences were observed for the group age and gender distribution ($\chi2=2.111$, $p=.348$). Comparing the time that passed since the diagnosis in the two clinical groups, we observed a strong difference ($t_{85}=-5.983$, $p<.001$, Cohen's $d=-1.329$), with the oncological group having received the diagnosis more recently than the T1D group.

Table 1. Demographics, descriptive information, and main statistics of the children for each group.

	Controls N=61	Cancer N=33	T1D N=56				Controls vs Cancer	Controls vs T1D	Cancer vs T1D
CHILDREN	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	***F***	***p***	***ES***	***p (ES)***	***p (ES)***	***p (ES)***
Age	11.36 (2.52)	11.13 (3.15)	11.64 (2.46)	0.376	0.688	<0.001	-	-	-
Gender (M/F)	32/27	16/17	35/21						
Time from the Diagnosis (months)	-	22.32 (12.36)^	67.14 (40.59)						
Hb1Ac (%)	-	-	7.28 (0.75)						
Sleep Disturbance Scale for Children (SDSC)									
DIMS	11.92 (2.86)	11.69 (4.84)*	11.79 (3.52)	4.850	0.011	0.083	**0.013 (-0.768)**	0.973 (0.037)	**0.012 (0.805)**
SBD	3.79 (1.05)	4.16 (1.17)*	3.86 (1.02)	1.141	0.325	0.004	-	-	-
DA	3.51 (0.81)	4.09 (1.30)*	3.64 (1.03)	2.683	0.075	0.033	-	-	-
SWTD	8.26 (2.14)	11.00 (3.19)*	9.09 (2.62)	4.488	0.014	0.067	**0.022 (-0.675)**	0.920 (0.067)	**0.016 (0.742)**
DOES	7.85 (2.22)	8.63 (2.70)*	8.39 (2.72)	1.255	0.291	0.003	-	-	-
SHY	2.84 (1.19)	3.47 (1.87)*	3.32 (1.42)	2.774	0.069	0.021	-	-	-
SDSC Total Score	39.16 (5.96)	46.03 (11.23)*	40.10 (8.61)	5.170	0.008	0.082	**0.007 (-0.825)**	0.781 (-0.111)	**0.033 (0.714)**
Strengths and Difficulties (SDQ)									
EMO	3.14 (2.28$^{\uparrow}$	2.23 (2.44)^	2.00 (2.19)§	3.973	0.023	0.039	0.963 (0.062)	**0.022 (0.500)**	0.158 (0.439)
COND	2.53 (1.64)$^{\uparrow}$	2.23 (1.36)^	2.02 (1.68)§	1.311	0.275	0.006	-	-	-
HYP	3.70 (2.18)$^{\uparrow}$	3.00 (2.37)^	3.35 (1.86)§	0.992	0.376	0.002	-	-	-
PEER	1.90 (1.83)$^{\uparrow}$	1.68 (1.72)^	1.52 (1.68)§	0.634	0.533	<.001	-	-	-
PROS	7.23 (1.92)$^{\uparrow}$	7.87 (1.82)^	7.82 (2.21)§	1.647	0.199	0.008	-	-	-
SDQ Total Score	11.26 (5.86)$^{\uparrow}$	10.03 (5.89)^	8.89 (5.29)§	2.494	0.089	0.020	-	-	-

Note. T1D: Type 1 Diabetes; Hb1Ac: Hemoglobin 1Ac; DIMS: Disorders of Initiating and Maintaining Sleep; SBD: Sleep Breathing Disorders; DA: Disorders of Arousal; SWTD: Sleep-Wake Transition Disorders; DOES: Disorders of Excessive Somnolence; SHY: Sleep Hyperhidrosis; EMO: Emotional Symptoms; COND: Conduct Problems; HYP: Hyperactivity-Inattention; PEER: Peer Relationship Problems; PROS: Prosocial Behavior. ES: effect size. *: N=32; ^:N=31, $^{\uparrow}$: N=57, §: N=54.

The statistics of all the ANOVAs are reported in Table 1. Overall, we observed a significant difference between groups in the SDSC Total Score, with children with cancer showing lower sleep quality compared to both controls and children with T1D, whereas no significant differences were observed between children with T1D and controls. The proportion of children with an SDSC Total Score higher than 39 was not equal across groups (χ^2=8.488, p=.014), with 69.7% of the children with cancer showing a score higher than the threshold, whereas in T1D children and controls the proportion was 41.1% and 41%, respectively.

Exploring the subscales of the SDSC, we observed a significant group difference for the Disorders of Initiating and Maintaining Sleep scale with children with cancer showing greater scores compared to controls and T1D children. A similar result was observed for the Sleep-Wake Transition Disorders scale, with children with cancer showing greater scores compared to T1D children and controls, and no differences between controls and T1D children.

Lastly, we explored the first item of the SDSC, which asks "How many hours of sleep does your child get on most nights", with 5 possible answers (9-11 hours, 8-9 hours, 7-8 hours, 5-7 hours, less than 5 hours). Given the ordinal nature of this variable, we employed a Kruskal-Wallis test, with the group as the only factor, showing a significant Group effect (χ2=6.696, p=.035, ε^2=0.045), with the children with cancer sleeping less than controls (p_{DSCF}.=.047).

The analysis of the SDQ total score (Table 1) revealed only a significant difference between groups for the Emotional subscale, with lower emotional symptoms for T1D children compared to controls.

Next, we explored the relationship between the SDQ total score and the SDSC total score (Fig. 1), showing that increasing psychological adjustments were mildly associated with poorer sleep quality in the whole sample (r=.258, p=.002), and this association was moderate and significant in T1D (r=.428, p=.001) and cancer groups (r=.399, p=.029), but not in the control group (r=.034, p=.803).

Lastly, for the T1D group, we explored the relationship between the Hb1Ac level and both the SDSC and SDQ total scores, showing no significant correlations (r=.-052, p=.704; r=.067, p=.632).

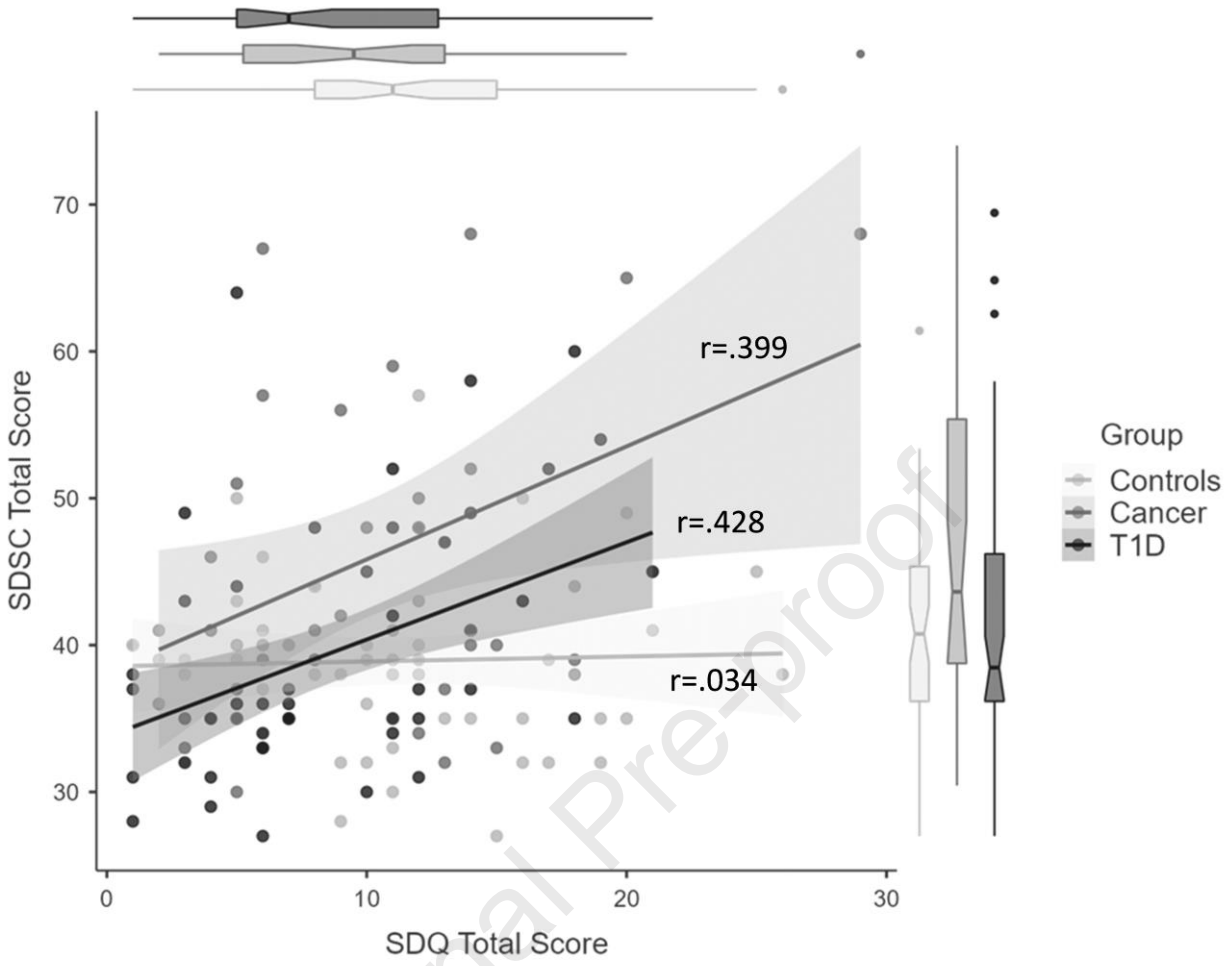

Figure 1. Relationship between children's psychological adjustment (SDQ Total Score) and their sleep disturbances (SDSC Total Score) in the three groups. Shaded areas represent standard errors. Above: boxplots of the SDQ Total Score in the three groups. On the right: boxplots of the SDSC Total Score in the three groups. For the boxplots, the middle lines in the boxes represent the median, whereas the extreme of the boxes represents the 25th and the 75th percentile (interquartile range). The whiskers above and below the boxes extend to 1.5 times the interquartile range. Data points outside the whiskers are outliers.

3.2. Caregivers' sleep and psychological characteristics

The mean and standard deviation (SD) of the caregivers' study variables in the three groups are reported in Table 2. Caregivers were all females, and a significant group difference was observed for the age ($F_{2,147}$=3.391, p=.036, η^2p =.044), with the oncological group being significantly younger than the controls (p*holm*=.031, Cohen's d=-0.561).

Table 2. Demographics, descriptive information, and main statistics of the caregivers for each group.

	Controls N=61	**Cancer N=33**	**T1D N=56**				**Controls vs Cancer**	**Controls vs T1D**	**Cancer vs T1D**
CAREGIVERS	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**	***F***	***p***	***ES***	***p (ES)***	***p (ES)***	***p (ES)***
Age	44.97 (5.43)	41.76 (6.21)	44.05 (5.74)	3.095	0.051	0.031	-	-	-
Occupation									
Full-time worker	24 (39.4%)	7 (21.9%)	27 (38.9%)	-	-	-	-	-	-
Part-time worker	26 (42.6%)	8 (25%)	13 (23.2%)	-	-	-	-	-	-
Housewife/Unemployed	11 (18%)	17 (43.1%)	16 (28.6%)	-	-	-	-	-	-
Pittsburgh Sleep Quality Index (PSQI)									
Bedtime (hh:mm)	22:36 (00:45)	23:11 (00:59)*	22:54 (01:16)	5.376	0.007	0.045	**0.012 (-0.608)**	0.088 (-0.401)	0.664 (0.207)
Rise time (hh:mm)	06:32 (00:36)	06:34 (00:41)*	06:38 (01:10)	0.034	0.967	<.001	-	-	-
Sleep Duration (h)	7.01 (1.12)	6.11 (0.98)*	6.46 (1.10)	8.627	<0.001	0.090	**<0.001 (0.852)**	**0.025 (0.500)**	0.222 (-0.352)
Sleep Onset Latency (min)	16.53 (15.02)	27.08 (23.30)*	15.89 (13.98)	3.172	0.048	0.055	0.063 (-0.628)	0.965 (0.041)	**0.044 (0.669)**
PSQI Total Score	5.21 (2.70)	8.28 (4.28)*	6.39 (3.28)	7.440	0.001	0.100	**0.001 (-0.940)**	0.132 (-0.330)	0.059 (0.610)
Parenting Stress Index (PSI-SF)									
Parental Distress	26.91 (7.20)	29.82 (8.21)	26.91 (8.21)	1.606	0.207	0.010	-	-	-
Parent-Child Dysfunctional Interaction	22.55 (7.04)	22.67 (7.29)	22.63 (7.80)	0.03	0.997	<.001	-	-	-
Difficult Child	27.72 (6.19)	27.53 (8.06)*	28.55 (8.56)	0.220	0.803	<.001	-	-	-
PSI-SF Total Score	77.26 (17.22)	79.94 (19.30)*	78.09 (21.24)	0.215	0.807	<.001	-	-	-
STAI-Y2	38.80 (9.47)	47.76 (11.26)	41.73 (7.89)	7.528	0.001	0.105	**<0.001 (-1.070)**	**0.006 (-0.525)**	0.114 (0.545)
General Health Questionnaire	16.25 (4.75)	18.36 (4.89)	16.80 (4.15)	2.057	0.134	0.017	-	-	-

Note. T1D: Type 1 Diabetes; PSQI: Pittsburgh Sleep Quality Index. STAI: State-Trait Anxiety Inventory. ES: Effect Size. *N=32

The statistics of all the ANOVAs are reported in Table 1. Overall, we observed a lower sleep quality in the caregivers of children with cancer compared to both controls and, although not significantly, T1D. Although the distribution of caregivers with a PSQI score higher than 5, indicating poor sleep quality was not significantly different in the three groups (χ^2=5.050, p=.080), in the oncological group 62.5% of the caregivers reported poor sleep quality, whereas in T1D and control groups the proportion was 53.6% and 39.3%, respectively.

We also observed that the caregivers of the two clinical groups slept less than the controls, and the caregivers of children with cancer spent more time falling asleep compared to the T1D and, although not significantly, the controls.

We did not observe significant differences in parenting stress or general health between groups. However, the caregivers of the two clinical groups reported a higher level of stress compared to the controls.

Exploring the relationship between the PSQI and the STAI-Y2 (Fig. 2), we observed that increasing anxiety was associated with poorer sleep quality in the whole sample (r=.479, p<.001), and this association was significant in the T1D (r=.498, p<.001) and control groups (r=.414, p=.001), but only at the trend in the cancer group (r=.347, p=.052).

Lastly, we also explored the relationship between the PSI-SF Total Score and the STAI-Y2, showing a strong association between these two measures in the whole sample (r=.588, p<.001) as well as in the controls (r=.551, p<.001), cancer (r=.575, p<.001) and T1D group (r=.737, p<.001).

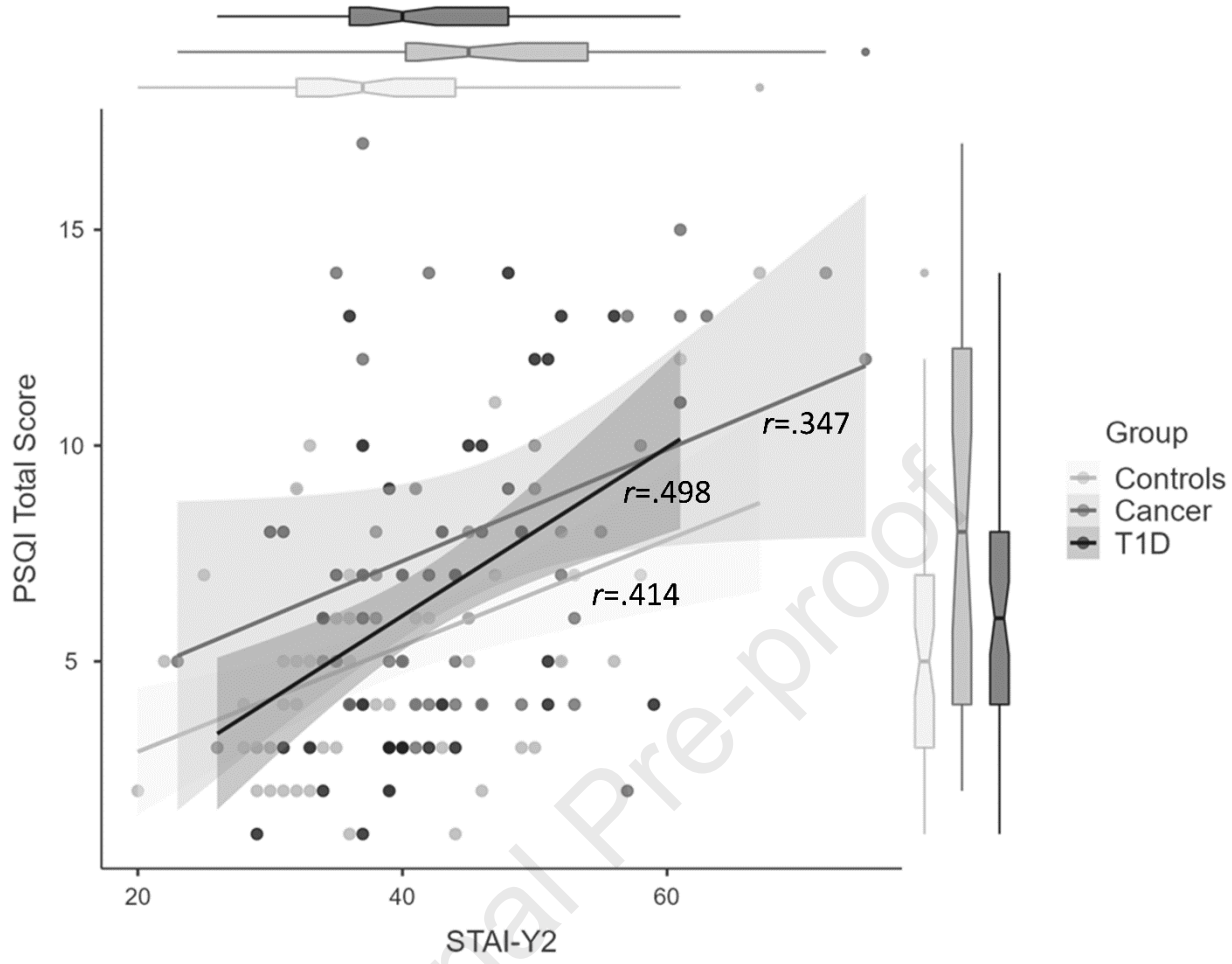

Figure 2. Relationship between caregivers' anxiety level (STAI-Y2) and their sleep quality (PSQI Total Score) in the three groups. Shaded areas represent standard errors. Above: boxplots of the STAI-Y2 Total Score in the three groups. On the right: boxplots of the PSQI Total Score in the three groups. For the boxplots, the middle lines in the boxes represent the median, whereas the extreme of the boxes represents the 25th and the 75th percentile (interquartile range). The whiskers above and below the boxes extend to 1.5 times the interquartile range. Data points outside the whiskers are outliers.

3.3. Relationships Between Child's and Caregiver's Sleep

We observed a moderate association between the child's (SDSC total score) and caregiver's (PSQI total score) sleep in the whole sample (r=.401, p<.001, Fig. 3), indicating that poorer sleep quality in children was associated with poorer sleep quality in their caregivers. Considering the three groups separately, we observed significant strong associations only in the T1D group (r=.592, p<.001) whereas no significant associations were observed for cancer (r=.207, p=.255) and control group (r=.142, p=.276).

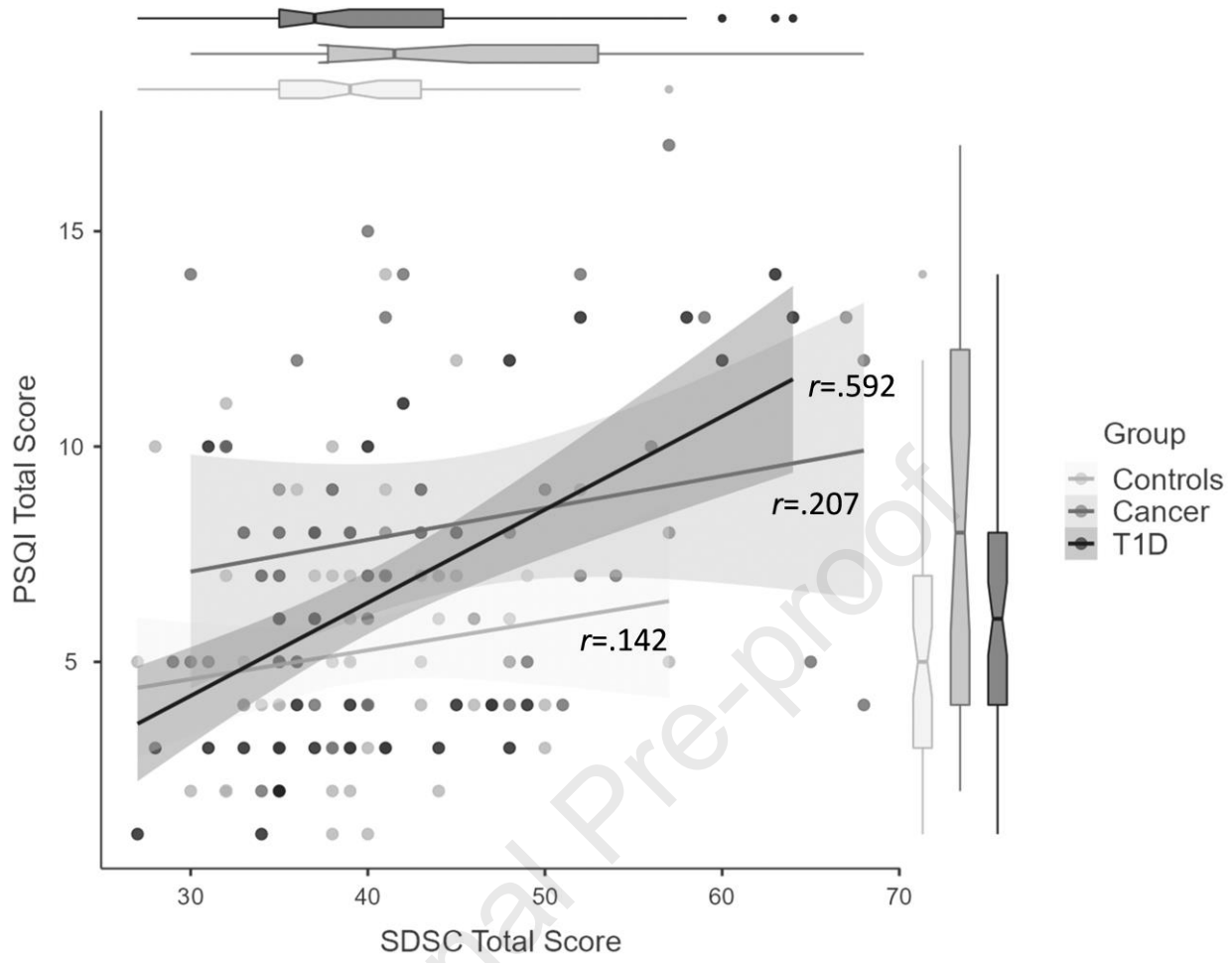

Figure 3. Relationship between children's and their caregivers' sleep quality (SDSC Total score and PSQI Total Score, respectively) in the three groups. Shaded areas represent standard errors. Above: boxplots of the SDSC Total Score in the three groups. On the right: boxplots of the PSQI Total Score in the three groups. For the boxplots, the middle lines in the boxes represent the median, whereas the extreme of the boxes represents the 25th and the 75th percentile (interquartile range). The whiskers above and below the boxes extend to 1.5 times the interquartile range. Data points outside the whiskers are outliers.

We also explored the relationship between the sleep duration of the caregivers, as reported in the PSQI, and the sleep duration of their children, as assessed by the first item of the SDSC, showing a mild positive association in the whole sample ($r_{spearman}$=.174, p=.034). Considering the three groups separately, we observed a moderately significant association only in the control group ($r_{spearman}$=.410, p=.001) but not in the oncological ($r_{spearman}$=-.040, p=.829) and the T1D group ($r_{spearman}$=-.101, p=.461).

3.4. Regression analysis

The results of the three linear regressions are reported in Table 3. Overall, the analysis showed that in the control group the sleep quality of the caregiver was significantly associated only with their anxiety level, whereas in the cancer group it was significantly associated with both their anxiety level and the time passed from the first diagnosis of their children. In the T1D group, the sleep quality of the caregiver was significantly associated with their anxiety level and their children's sleep quality.

Table 3. Multiple regressions of caregivers' sleep quality in the three groups.

	Controls			Cancer			T1D		
	b (95%CI)	std. *β*	*p*	*b* (95%CI)	std. *β*	*p*	*b* (95%CI)	std. *β*	*p*
Intercept	-3.12 (-9.48, 3.24)	0	0.330	1.102 (-8.99, 11.97)	0	0.823	-8.07 (-16.97,0.83)	0	0.075
Age	0.15 (-0.02, 0.42)	0.14	0.258	-0.01 (-0.47, 0.47)	-0.01	0.994	-0.088 (-0.44, 0.25)	-0.07	0.602
SDSC	0.01 (-0.11, 0.13)	0.02	0.895	0.08 (-0.04, 0.21)	0.22	0.191	0.205 (0.087, 90.32)	0.53	0.001
SDQ	0.10 (-0.02, 0.21)	0.21	0.088	-0.23 (-0.47, 0.02)	-0.34	0.072	-0.062 (-0.22, 0.10)	-0.10	0.430
STAI-Y2	0.13 (0.06, 0.20)	0.45	<0.001	0.16 (0.04, 0.29)	0.44	0.011	0.11 (0.01, 0.21)	0.28	0.043
Time from the Diagnosis	-	-	-		-0.38	0.027	0.02 (-0.01, 0.04)	0.24	0.080
HbA1c	-	-	-	-	-	-	0.27 (-0.74, 1.28)	0.06	0.594
Model Fit	$F(4, 52)=4.523$			$F(5, 21)=4.455$			$F(6, 47)=4.814$		
	p =0.003			p =0.006			p <0.001		
Adj. R^2	0.201			0.399			0.302		

Note. *b* = unstandardized beta; std. *β* = standardized beta; CI = confidence intervals. T1D: Type 1 Diabetes; Hb1Ac: Hemoglobin 1Ac; SDSC: Sleep Disturbance Scale for Children total score; SDQ: Strengths and Difficulties total score; STAI: State-Trait Anxiety Inventory

4. Discussion

Pediatric populations with chronic conditions, such as T1D and cancer, are considered at high risk to develop sleep problems [e.g., 5, 9]. Indeed, sleep difficulties are commonly reported in children with cancer and their caregivers both during the treatment period and years later [45]. Similarly, inadequate sleep is often observed in children with T1D and their caregivers [23]. The present study aimed to concurrently assess sleep patterns and their association with psychological outcomes in both pediatric chronic patients diagnosed with T1D and cancer and their caregivers, compared to healthy controls.

Specifically, our first aim was to compare sleep and psychological characteristics of both clinical children and their caregivers to healthy controls. We observed that children with cancer reported more disturbed sleep, mainly characterized by greater difficulties in initiating and maintaining sleep, a lower sleep duration, and more parasomnias (e.g., sleepwalking, nightmares, bruxism, sleep talking). More than 2/3 of the children with cancer reported an SDSC to score higher than 39, suggesting that this clinical group may be more likely to develop sleep-related disorders than healthy controls and children with T1D, which reported potential sleep problems in approximately 41% of the cases This result is only partially in line with the current literature, which reports a greater presence of sleep problems for both children with cancer [18] and diabetes [9] compared to healthy peers.

These results may be due to our sample's characteristics: children with cancer received the diagnosis significantly more recently than those with diabetes. A greater stress phase occurs immediately after the diagnosis, and it may also affect sleep patterns [33]. Considering that 22 out of 57 children with T1D (38.6%) had their diagnosis when they were ≤4 years old, a period characterized by a very different sleep pattern compared to late childhood and puberty, it is likely that over the years both the sleep patterns and the child's anxiety levels may have indeed stabilized. As reported by Sawyer and colleagues, also in pediatric cancer the psychological problems are greater after the diagnosis and tend to get better over time [33]. It should be also considered that cancer is a life-threatening condition, with a high level of uncertainty about the clinical outcomes, while diabetes can be successfully medically managed. Thus, receiving a diagnosis of cancer may be more stressful and need more careful care. Furthermore, children with diabetes reported having overall good glycemic levels. Considering that sleep problems seem to be influenced by glycemic control in this population [20], a good glycemic level may have been a protective factor. Overall, the observed differences in sleep patterns and problems in the two clinical conditions suggest that there is a need to develop disease-specific approaches to sleep and sleep-related problems in different chronic pediatric conditions.

Moreover, although our data did not show a clear group difference in emotional and behavioral symptoms, we observed that increasing SDQ scores were associated with greater sleep disturbances in both clinical conditions, but not in the control group. One possible explanation is that SDQ detects the risk of emotional difficulties, and health and chronic samples with severe risk of emotional outbursts were excluded from the recruitment. Also, both the clinical wards incorporated a well-designed psychological unit aimed to contain emotional and behavioral symptoms.

Focusing on the caregivers, our sleep results partially mirrored the children's outcomes, with the oncological group reporting poorer sleep quality and longer sleep onset latency than the other groups, whereas both caregivers of children with cancer and T1D slept less than caregivers of healthy controls. Again, these results are partially in line with the literature: more frequent sleep difficulties are reported for both caregivers of children with cancer [11] and diabetes [13] compared to those of healthy children. Moreover, Boman et al. [21] reported no differences in sleep problems between caregivers of children with cancer and diabetes. However, the more recent diagnosis of cancer may have more severely affected caregivers' sleep patterns and psychological well-being: parents may control their children more frequently during the night, being worried about the effects of the disease. Cancer is actually a more complex and frightening condition. Parents of children with cancer also reported more anxiety symptoms and a lower, although not statistically significant, general health than the other groups, whereas no group differences were observed for parental stress. Boman et al. [21] found higher levels of anxiety for parents of children with cancer than those of children with diabetes, underlying that cancer is a more life-threatening condition compared to diabetes, and requires a specific approach in clinical settings.

Our second aim was to explore the associations of sleep quality between the caregiver/child dyad across the three groups. We expected that increased sleep problems in children would be associated with poorer sleep quality in caregivers. However, our data support this hypothesis only when taking into account the whole sample and focusing on the T1D group. This result is indeed interesting and in line with literature focusing on the fact that T1D caregivers are particularly on the alert during the night to check for nighttime physical complications such as hypoglycemia crisis [e.g., 25]. Presumably, less restful sleep for their children could be a possible warning of something to be urgently managed (e.g., glycemic levels monitoring, insulin administration) and could impact intensively on caregivers' sleep quality. Supporting this idea, 11 caregivers of T1D children (19.6% of the responders) reported in an open question of the PSQI to wake up several times a night to monitor glucose concentrations. Interestingly, these caregivers reported a worse sleep quality than the other caregivers of children with T1D (PSQI total score: 8.73±3.64 vs 5.82±2.96; p=.007). Here

is another possible relevant difference between the pathologies, that may be considered in clinical programs.

We also aimed to explore whether sleep and psychological characteristics of children can influence how their caregivers sleep. Our analyses revealed that children's age and their emotional and behavioral symptoms were not significant predictors of caregivers' sleep quality. Instead, caregivers' anxiety level was the common predictor of sleep quality across the group, whereas children's sleep problems were significant only for the T1D group and the time passed from the diagnosis was a significant predictor for the oncological group. This latter result is interesting, suggesting that the shock of cancer diagnosis may induce a decrease in caregivers' sleep quality, which may ameliorate over time, similarly to what has been observed for psychological distress [21] and accounting for a disease's peculiarity.

Some limitations have to be considered. First, medical data regarding the severity of the diseases are absent, and we cannot exclude a different level of physical well-being in our clinical samples. Second, self-report questionnaires were used to collect data on sleep patterns. Questionnaires are indeed useful, but they provide only subjective data, which often do not correlate with objective sleep assessment such as actigraphy and polysomnography [e.g., 46]. Further studies may capitalize on combining sleep questionnaires with both sleep diaries and actigraphy. In addition, all caregivers were female and the age range of children was wide, thus making it troublesome to generalize the results. Also, the strong difference in time passed since the diagnosis in the two clinical groups may have influenced the results. Furthermore, for the T1D group, the presence of the ward's psychotherapist during the questionnaires' compilation, may have influenced the responses. Lastly, the PSI-SF investigates general parenting stress that concerns all caregivers with no distinction on the presence of chronic illness. The development of innovative tools assessing pediatric stress could allow us to analyze more specifically the differences between various chronic diseases; Italian validations of the available questionnaires are needed.

To conclude, sleep is fundamental for people's physical and psychological well-being [e.g., 2], especially for chronically ill children and their parents [26, 28]. The present research focuses on the sleep characteristics of children with cancer and diabetes and their caregivers, directly comparing the two conditions. Children with cancer showed lower sleep quality, and worse psychological adjustment was associated with greater sleep disturbances in both clinical groups. When it comes to caregivers, the oncological group reported the worst sleep quality and greater anxiety. Anxiety and sleep quality were also negatively associated. Furthermore, greater sleep problems in children were associated with poorer caregivers' sleep quality in the whole sample and the T1D group. Certainly, the presence of a clinical team who can support the caregivers during the different stages of the

disease is fundamental for the prevention of sleep and behavioral problems. Psychologists can try to comprehend the origin of the sleep disorder through clinical interviews, to better understand if this can be attributed more to medical aspects (such as the use of drugs) or psychological (for example, anxiety) and then adequately inform and explain to parents how to deal with them. In addition, it would be useful to teach children with chronic diseases and their families to adopt good sleep routines or arrange training for sleep hygiene. A disease-specific approach is necessary to reach a better understanding and provide appropriate care for each population. Studying in depth the differences between the groups in sleep patterns and psychological wellbeing may help develop disease-specific prevention and intervention programs to use in clinical practice. Clinicians may be more aware of the sleep disruption risks related to each condition, and pay specific attention to these aspects, even in a preventative way. Future studies should focus on identifying specific risk factors for sleep problems in these populations, assessing, for example, the influence of being on active/maintenance treatment for cancer and how sleep change over time since the diagnosis of a chronic condition.

References

1. Schlieber, M. & J. Han, 2021. The Role of Sleep in Young Children's Development: A Review. *The Journal of Genetic Psychology,* 182, 205-217.
2. Carskadon, M.A. & D.H. Barker, 2020. Editorial Perspective: Adolescents' fragile sleep—shining light on a time of risk to mental health. *Journal of Child Psychology and Psychiatry*, 61, 1058-1060.
3. Quist, J.S., A. Sjödin, J.-P. Chaput, & M.F. Hjorth, 2016. Sleep and cardiometabolic risk in children and adolescents. *Sleep Medicine Reviews*, 29, 76-100.
4. Short, M.A., K. Bartel, & M.A. Carskadon, 2019.*Sleep and mental health in children and adolescents*, in *Sleep and health*. Elsevier, 435-445.
5. Sivertsen, B., M. Hysing, I. Elgen, K.M. Stormark, & A.J. Lundervold, 2009. Chronicity of sleep problems in children with chronic illness: a longitudinal population-based study. *Child and Adolescent Psychiatry and Mental Health*, 3, 1-7.
6. Hulst, R.Y., J.W. Gorter, J.M. Voorman, E. Kolk, S. Van Der Vossen, J.M. Visser-Meily, M. Ketelaar, S. Pillen, & O. Verschuren, 2021. Sleep problems in children with cerebral palsy and their parents. *Developmental Medicine and Child Neurology*, 63, 1344-1350.
7. Meltzer, L.J. & C.E. Pugliese, 2017. Sleep in young children with asthma and their parents. *Journal of Child Health Care*, 21, 301-311.
8. Stabouli, S., D. Gidaris, N. Printza, J. Dotis, E. Papadimitriou, K. Chrysaidou, F. Papachristou, & D. Zafeiriou, 2019. Sleep disorders and executive function in children and adolescents with chronic kidney disease. *Sleep Medicine*, 55, 33-39.
9. Hysing, M., B. Sivertsen, K.M. Stormark, I. Elgen, & A.J. Lundervold, 2009. Sleep in children with chronic illness, and the relation to emotional and behavioral problems—a population-based study. *Journal of Pediatric Psychology*, 34, 665-670.
10. Meltzer, L.J. & J.A. Mindell, 2006. Impact of a child's chronic illness on maternal sleep and daytime functioning. *Archives of Internal Medicine*, 166, 1749-1755.
11. Matthews, E.E., M. Neu, P.F. Cook, & N. King, 2014. Sleep in mother and child dyads during treatment for pediatric acute lymphoblastic leukemia. *Oncology Nursing Forum*, 41, 599-610.
12. Rensen, N., L.M. Steur, S.A. Schepers, J.H. Merks, A.C. Moll, M.A. Grootenhuis, G.J. Kaspers, & R.R. van Litsenburg, 2019. Concurrence of sleep problems and distress: prevalence and determinants in parents of children with cancer. *European Journal of Psychotraumatology*, 10, 1639312.
13. Landau, Z., M. Rachmiel, O. Pinhas-Hamiel, M. Boaz, Y. Bar-Dayan, J. Wainstein, & R. Tauman, 2014. Parental sleep quality and continuous glucose monitoring system use in children with type 1 diabetes. *Acta Diabetologica*, 51, 499-503.
14. Becker, D.A., E.B. Fennell, & P.R. Carney, 2003. Sleep disturbance in children with epilepsy. *Epilepsy and Behavior*, 4, 651-658.
15. Jaser, S.S., N.C. Foster, B.A. Nelson, J.M. Kittelsrud, L.A. DiMeglio, M. Quinn, S.M. Willi, J.H. Simmons, & T.D.E.C. Network, 2017. Sleep in children with type 1 diabetes and their parents in the T1D Exchange. *Sleep Medicine*, 39, 108-115.
16. Zupanec, S., H. Jones, & R. Stremler, 2010. Sleep habits and fatigue of children receiving maintenance chemotherapy for ALL and their parents. *Journal of Pediatric Oncology Nursing*, 27, 217-228.
17. Neu, M., E. Matthews, & N.A. King, 2014. Exploring sleep-wake experiences of mothers during maintenance therapy for their child's acute lymphoblastic leukemia. *Journal of Pediatric Nursing*, 29, 410-421.

18. Rosen, G. & S.R. Brand, 2011. Sleep in children with cancer: case review of 70 children evaluated in a comprehensive pediatric sleep center. *Supportive Care in Cancer*, 19, 985-994.
19. Caruso, N.C., B. Radovanovic, J.D. Kennedy, J. Couper, M. Kohler, P.S. Kavanagh, A.J. Martin, & K. Lushington, 2014. Sleep, executive functioning and behaviour in children and adolescents with type 1 diabetes. *Sleep Medicine*, 15, 1490-1499.
20. Feeley, C.A., S.M. Sereika, E.R. Chasens, L. Siminerio, D. Charron-Prochownik, R.H. Muzumdar, & P. Viswanathan, 2021. Sleep in parental caregivers and children with type 1 diabetes. *The Journal of School Nursing*, 37, 259-269.
21. Boman, K.K., J. Viksten, P. Kogner, & U. Samuelsson, 2004. Serious illness in childhood: the different threats of cancer and diabetes from a parent perspective. *The journal of Pediatrics*, 145, 373-379.
22. Macaulay, G.C., S.E. Boucher, A. Yogarajah, B.C. Galland, & B.J. Wheeler, 2020. Sleep and night-time caregiving in parents of children and adolescents with type 1 diabetes mellitus–a qualitative study. *Behavioral Sleep Medicine*, 18, 622-636.
23. Monzon, A.D., A.M. Marker, A.E. Noser, M.A. Clements, & S.R. Patton, 2021. Associations between objective sleep behaviors and blood glucose variability in young children with type 1 diabetes. *Annals of Behavioral Medicine*, 55, 144-154.
24. Bahadur, E.I., Ş. Özalkak, A.A. Özdemir, S. Çetinkaya, & E.N. Özmert, 2022. Sleep disorder and behavior problems in children with type 1 diabetes mellitus. *Journal of Pediatric Endocrinology and Metabolism*, 35, 29-38.
25. Van Name, M.A., M.E. Hilliard, C.T. Boyle, K.M. Miller, D.J. DeSalvo, B.J. Anderson, L.M. Laffel, S.E. Woerner, L.A. DiMeglio, & W.V. Tamborlane, 2018. Nighttime is the worst time: parental fear of hypoglycemia in young children with type 1 diabetes. *Pediatric diabetes*, 19, 114-120.
26. Bassi, G., E. Mancinelli, D. Di Riso, & S. Salcuni, 2021. Parental stress, anxiety and depression symptoms associated with self-efficacy in paediatric type 1 diabetes: a literature review. *International Journal of Environmental Research and Public Health*, 18, 152.
27. Kim, H., E.S. Zhou, L. Chevalier, P. Lun, R.D. Davidson, E.M. Pariseau, & K.A. Long, 2020. Parental behaviors, emotions at bedtime, and sleep disturbances in children with cancer. *Journal of Pediatric Psychology*, 45, 550-560.
28. Fotiadou, M., J.H. Barlow, L.A. Powell, & H. Langton, 2008. Optimism and psychological well-being among parents of children with cancer: an exploratory study. *Psycho-Oncology*, 17, 401-409.
29. Meltzer, L. J., & Moore, M., 2008. Sleep disruptions in parents of children and adolescents with chronic illnesses: prevalence, causes, and consequences. *Journal of Pediatric Psychology*, 33, 279-291.
30. Patterson, C., Guariguata, L., Dahlquist, G., Soltész, G., Ogle, G., & Silink, M., 2014. Diabetes in the young - a global view and worldwide estimates of numbers of children with type 1 diabetes. *Diabetes Research and Clinical Practice*, 103(2), 161–175.
31. Steliarova-Foucher, E., Colombet, M., Ries, L. A. G., Moreno, F., Dolya, A., Bray, F., Hesseling, P., Shin, H. Y., Stiller, C. A., Bouzbid, S., Hamdi-Cherif, M., Hablas, A., Chirpaz, E., Buziba, N., Chesumbai, G. C., Manraj, S. S., Reynders, D., Wabinga, H. R., Chokunonga, E., … Masuyer, E., 2017. International incidence of childhood cancer, 2001–10: a population-based registry study. *The Lancet Oncology*, 18(6), 719–731.
32. Padur, J. S., Rapoff, M. A., Houston, B. K., Barnard, M., Danovsky, M., Olson, N. Y., ... & Lieberman, B. (1995). Psychosocial adjustment and the role of functional status for children with asthma. *Journal of Asthma*, 32(5), 345-353.
33. Sawyer, M., G. Antoniou, I. Toogood, M. Rice, & P. Baghurst, 2000. Childhood cancer: A 4-year prospective study of the psychological adjustment of children and parents. *Journal of Pediatric Hematology/Oncology*, 22, 214-220.

34. Bruni, O., S. Ottaviano, V. Guidetti, M. Romoli, M. Innocenzi, F. Cortesi, & F. Giannotti, 1996. The Sleep Disturbance Scale for Children (SDSC) Construction and validation of an instrument to evaluate sleep disturbances in childhood and adolescence. *Journal of Sleep Research*, 5, 251-261.
35. Goodman, R., 2001. Psychometric properties of the strengths and difficulties questionnaire. *Journal of the American Academy of Child and Adolescent Psychiatry*, 40, 1337-1345.
36. Di Riso, D., S. Salcuni, D. Chessa, A. Raudino, A. Lis, & G. Altoè, 2010. The Strengths and Difficulties Questionnaire (SDQ). Early evidence of its reliability and validity in a community sample of Italian children. *Personality and Individual Differences*, 49, 570-575.
37. Abidin, R., 2012. Parenting Stress Index (4th ed.): Lutz, FL: PAR.
38. Guarino, A., F. Laghi, G. Serantoni, P. Di Blasio, & E. Camisasca, 2016. *Parenting Stress Index–Fourth Edition (PSI-4).* Giunti O.S. : Firenze.
39. Curcio, G., D. Tempesta, S. Scarlata, C. Marzano, F. Moroni, P.M. Rossini, M. Ferrara, & L. De Gennaro, 2013. Validity of the Italian version of the Pittsburgh sleep quality index (PSQI). *Neurological Sciences*, 34, 511-519.
40. Goldberg, D.P. & P. Williams, 1988. *User's guide to the General Health Questionnaire*. Windsor: Berks: NFER-Nelson.
41. Piccinelli, M., G. Bisoffi, M.G. Bon, L. Cunico, & M. Tansella, 1993. Validity and test-retest reliability of the Italian version of the 12-item General Health Questionnaire in general practice: a comparison between three scoring methods. *Comprehensive Psychiatry*, 34, 198-205.
42. Spielberger, C.D., L. Pedrabissi, & M. Santinello, 2012. *STAI state-trait anxiety inventory forma Y: Manuale*. Giunti O.S. : Firenze.
43. Cohen, J., 1988. *Statistical Power Analysis for the Behavioral Sciences*. New York, NY: Routledge Academic.
44. Field, A., 2013. *Discovering statistics using IBM SPSS Statistics.* Fourth Edition. Sage: London.
45. Daniel, L.C., R.R. van Litsenburg, V.E. Rogers, E.S. Zhou, S.J. Ellis, C.E. Wakefield, R. Stremler, L. Walter, V.M. Crabtree, & I.P.O.S.P.S.I. Group, 2020. A call to action for expanded sleep research in pediatric oncology: a position paper on behalf of the International Psycho-Oncology Society Pediatrics Special Interest Group. *Psycho-Oncology*, 29, 465-474.
46. Werner, H., Molinari, L., Guyer, C., & Jenni, O.G., 2008. Agreement rates between actigraphy, diary, and questionnaire for children's sleep patterns. *Archives of Pediatrics & Adolescent Medicine*, 162(4), 350-358.

Highlights

- Chronic pediatric conditions are characterized by sleep disturbances
- Children with cancer report lower sleep quality than healthy control
- Psychological adjustment is associated with sleep disturbances in children with cancer and T1D
- Caregivers of children with cancer group reported the worst sleep quality and greater anxiety
- Sleep problems in children were associated with poorer caregivers' sleep quality