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Final dissertation

Sleep quality and its associations with psychological well-being in chronic ill children and their caregivers

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INDEX

INTRODUCTION

Sleep is a fundamental basic function of human functioning: although it is configured as a “suspension of consciousness”, it is an active process which also holds the role of supporting cerebral maturational processes. Another central characteristic of sleep is that it contributes to the achievement of a good level of well-being.

Generally, there are conditions in life that may affect well-being, such as chronic illnesses. Poor sleep quality and consequent worse daytime functioning frequently occur in the clinical population.

In recent years health care and sanity posed their focus not only in treatments and taking charge of patients. Today taking care for patients regard a wider view for the sick person. Never before have the avant-gardes made themselves available not only for treatment but for health as a construct that does not mean only treatments against something or as remedies, but precisely as a support for feeling good. Don't cure, don't prevent, but support the development.

In particular this is extremely true for pediatric patients, continuously in development. This switch from “cure” to “care” poses great challenges in pediatric treatments, which do not only concern the treat of the disease, but also the global taking care of the pediatric patient.

Great attention is given to all the functions that may be affected by the chronic conditions, just as psychological functioning up to basic function, such as sleep.

The idea of the present study is to start giving a panoramic view of sleep, defining it specifically. This because what drives the research through the atypical is what typically happens in the development: the definition of sleep is given to not prescind its typical functioning and in order to recognize its atypical or dysfunctional manifestations. So, the central theme of this study is sleep, a function that supports development and other central cognitive functions. The basic description of sleep could not be ignored, conceptualized as: evolutionary stage to be reached, support for the development of other functions, part of the guarantor of the well-being of the human being.

The importance of sleep study in children can be deduced from how it already impacts in the very first stages of life (from conception) the well-being of the child and from how it

contributes and supports the correct performance of basic processes, suitable for the functioning of the body (making it extremely close to a chronic pathology).

In the present study, sleep habits and their links with psychological characteristics were deepened in chronically ill children: particularly 56 children affected by type 1 diabetes, 33 children with cancer, and 61 controls (with an age range between 7 and 15) were considered, along with their related caregivers. The first study's aim regarded the exploration of the associations between sleep and psychological outcomes in the two clinical samples and their caregivers, comparing them with the control sample, respectively. Successively, the associations between parental and children's sleep quality were analyzed in all the three groups. Standardized questionnaires and ad-hoc surveys were administered to assess caregivers' measures of parenting stress, global functioning, general health, sleep quality and anxiety, and children's psychological adaptation and sleep quality.

The leitmotif of the study remains the relational dimension of sleep: from the earliest phase of sleep development competence (in which the caregiver supports and facilitates the good falling asleep), up to the interpersonal dimension of sleep in chronically ill children and their caregivers.

CHAPTER 1: THE THEORETICAL BACKGROUND

1.1 Sleep

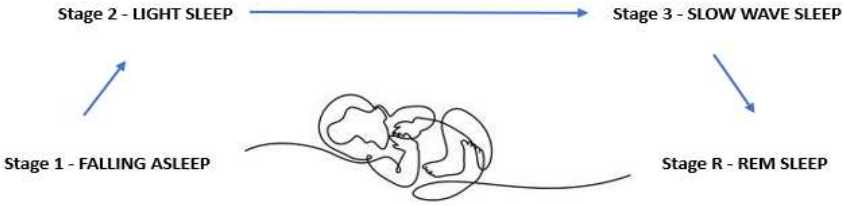
Sleep is defined by the American Psychological Association (APA) as "a circadian state characterized by partial or total suspension of consciousness, voluntary muscle inhibition, and relative insensitivity to stimulation" (APA). In their turn, circadian states are

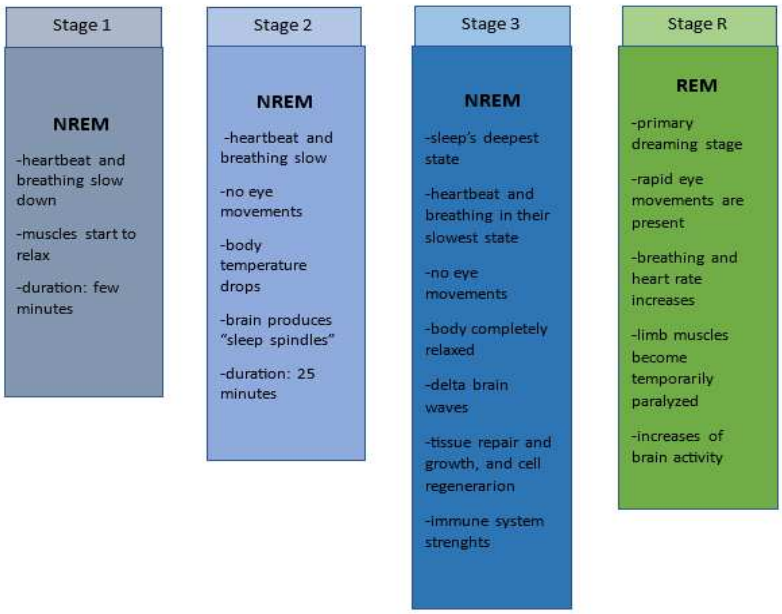
Sleep may be distinguished in two types:

- REM (rapid-eye-movements) sleep;
- non-REM sleep (N-REM).

These two typology of sleep have different characteristics: particularly they distinguish them-selves through different functional stages of consciousness.

In the following image (Figure 1) there are summarized the various phases that characterized REM and non-REM sleep.





A sleep panoramic seems to be necessary to be given in order to contribute into the present research to frame its importance in humans functioning. Knowing the typical developmental process of sleep, would help for sure to distinguish a typical phase of children evolution from the signals of a proper sleep disorder (Carter, K. A., Hathaway, N. E., and Lettieri, C. F., 2014). Some critical phases in sleep may occur during specific developmental windows of opportunity

Sleep is fundamental to reach a good level of well-being and a healthy quality of life (), being essential for life (Miletínová, E., and Bušková, J., 2021).

1.1.1 How does sleep evolves in different stages of life?

The developmental characteristics of sleep are important to taken into account in studying sleep. In certain moment of the development, children may need more hours of sleep: the total hours spent sleeping depends on children age (Stanford Medicine). Sleep, like other bodily functions, gradually changes, assuming different timings and functions.

Newborns necessitate of a great number of hours of sleep (Carter, K. A., Hathaway, N. E., and Lettieri, C. F., 2014). Their sleep is characterized by a non-continuative pattern of sleep wake (Carter, K. A., Hathaway, N. E., and Lettieri, C. F., 2014), but is segmented (Stanford Medicine). In fact, in the first moment of development, infants sleep about 16 hours divided in nighttime sleep and in daytime sleep (Stanford Medicine). The more proceed the development, the lower the infants sleep throughout the day and the more they sleep during the night (Dawson, P., 2014). Moreover, the two type of sleep (REM and non-REM) are both present in infants; the latter directly go through the sleep REM phase when they fall asleep (Dawson, P., 2014).

Newborns sleep the majority of the hours of their day (Dawson, P., 2014). Growing up, infants begin decreasing the duration of sleep period and shorter the number of hours slept in a day (thus, the total sleep time; Carter, K. A., Hathaway, N. E., and Lettieri, C. F., 2014).

Gradually, five-months infants reach the competence to sleep in a less fragmented way (Carter, K. A., Hathaway, N. E., and Lettieri, C. F., 2014). Up to six months, toddlers sleep around 13 hours per day, and for 7 hours their sleep may be continuative (Dawson, P., 2014). By two and four years, the amounts of hours spent sleeping in a day change by lowering respectively to 12 and 10 hours approximately, and including naps (Dawson, P., 2014); and, during childhood, children sleep around 10 hours during nighttime (Dawson, P., 2014).

Unlike infants, children have sleep patterns similar to adults: in fact, their sleep phases include fast passages from light sleep to the forth phase of sleep.

1.1.2 Sleep functions

Depending on age and developmental state, every sleep function assumes a different importance (Mindell J. A., 1993).

The fact that sleep is not only a regulated process, but also regulates some basic processes of human functioning, reveals the different importance of sleep and the processes it supports. In fact, sleep is not only a regulated process, but also regulates some basic processes of human functioning.

Some of the most important functions of sleep in humans regard the development of brain and its functioning and the regulation of homeostatic and physiological processes. This appears to be essential in the early phases of human development.

Particularly, promoting a healthy growth and development of the brain seems to be one of the crucial roles assumed by sleep (Mindell J. A., 1993).

The fundamental role of good sleep quality is also expressed in the enhancement of the efficiency and plasticity of brain synapsis (Mindell J. A., 1993): in this sense, sleep may assist in the final result of plasticity in brain (Miletínová, E., and Bušková, J., 2021).

The improvement of cognitive functions (as well as attention, memory and learning) is served by a good quality sleep (Mindell J. A., 1993).

Different types of metabolic regulation are supported by sleep (Mindell J. A., 1993). More basic function linked to physiologic needs regard for examples: appetite as well as feeding and body weight (Mindell J. A., 1993). Other comprehend regulations of both emotions and pleasure-seeking behaviors (Mindell J. A., 1993).

Sleep does not just support metabolic functions, but also it seems to be essential in the alteration of some of them (Miletínová, E., and Bušková, J., 2021).

A good sleep quality, also contributes to well-being (Miletínová, E., and Bušková, J., 2021). In parallel, loss of sleep affect well-being negatively: particularly, it has been shown that the absence of sleep may conduct to central nervous system structural changes (Miletínová, E., and Bušková, J., 2021).

Lack of sleep drives youths to different behavioral outcomes, depending from the age: in fact, sleepiness affects differently children and adolescents. Children, may show behavioral inconvenience (such as being irritable) but also difficulties in daily functioning (just as learning) (Carter, K. A., Hathaway, N. E., and Lettieri, C. F., 2014; Beebe, D. W., 2006; Beebe, D. W., et al., 2010). Meanwhile, sleepiness in adolescents is associated with roads accidents and a scarce school achievement (Carter, K. A., Hathaway, N. E., and Lettieri, C. F., 2014; Danner, F., Philips, B., 2008).

1.1.3 Caregivers and sleep: the interactive and relational dimension of sleep

Precisely because achieving sleep regulation is one of the evolutionary stages to be reached in development, such as eating (and weaning) and toileting, much attention is paid to these processes not only by pediatricians, but also parents pay close attention to this part, making sleep assessment a big point on which focused (Thiedke, C. C., 2001).

It has been showed how sleep immediately favors and supports the maturation of brain areas and supports the crucial functions of human development, and how this affects everyday life. A bad quality of sleep, however, affects not only the individual, but also those around him: it is clear and necessary to pay attention also to those who take care of the child, parents or those who perform parental functions for them, thus the caregivers. The role of caregivers in development and its functions (such as sleep) is supported by the literature (Ragni, B., and De Stasio, S., 2020): in this, sleep, as function to be learned to regulated and consolidate, represents a great stage of development to reach in the early years of children's life (Ragni, B., and De Stasio, S., 2020)

In fact, as previously discussed, sleep is a developmental function and, children consolidate the competence of autonomy in falling asleep during the growth: the independency in sleep onset and sleep initiating is acquired during the development (Lollies, F. et al., 2022; Camerota, M., Propper, C. B., Teti, D. M., 2019; Henderson J. M., France, K. G., Blampied, N. M., 2011). Sleep disturbances in infants and children in their first 3 years of life are not so rare: moreover, the values of children affected by problems in sleeping and its correlates is comprehended between the 20% and 30%, approximately (Lollies, F. et al., 2022; Gay, C. L., Lee, K. A., Lee, S. Y., 2004). This underlines the necessity of children to be accompanied during the earliest phases of their own sleep ability's acquirement: here, the relational dimension of sleep intervenes, together with its importance in the developing of sleep autonomy. The necessity of children in being supported by their own caregivers evokes the interpersonal dimension of sleep. Specific developmental phases require specific children's needs and elicit different requests to the relational environment, differing in both typology and intensity. It may be typical to incur frequent demands during the night in newborns and infants (Lollies, F. et al., 2022). This could lead to a not continuative sleep and, properly the sleep fragmentation (non-sufficient sleep duration, scarce quality of sleep, poor rest in sleeping)

may influence not only quality of sleep, but also may become a factor of stress in parenting functioning (Banks, S., Dinges D. F., 2007; Lollies, F. et al., 2022). The caregivers' scarce sleep quality affects their own general health (in fact they may experiencing fatigue; Loutzenhiser, L. McAyslan, P., Sharpe, D. P., 2015), daily functioning, global well-being (Banks, S., Dinges D. F., 2007). So, parents may be worried about both their own scarce sleep quality and the management of their children's sleep disruption (Lollies, F. et al., 2022): this shows how sleep can become a challenging evolutive stage of development to support by parents (Lollies, F. et al., 2022).

This is just one example of the many association between children's sleep quality and caregivers' well-being. Several studies indagated these: particularly, studies have shown how a scarce sleep quality and sleep difficulties in children were associated with stress, depression (at moderate and severe levels of symptomatology) and reduced global health (Chang, J. J. et al., 2010; Hughes, A., Gallagher, S., Hannigan, A., 2015; Lollies, F. et al., 2022).

In parallel, a healthy sleep quality in children seems to be linked and to predict a good mother's sleep quality (Meltzer, L. J., and Mindell, J. A., 2007).

Very few studies have involved fathers, and for this there is no uniqueness in the studies: generally, the health of fathers may be affected in a negative way by sleep disruptions of children (Martin, J. et al., 2007). What may explain this is that fathers are not as involved as mothers in children sleep settling in the first years of life (Peltz, J. S., 2016; Sinai, D., Tikotzky, L., 2012; Tikotzky, L., 2015). There are studies that support the idea of general health of fathers is affected by their children's sleep difficulties: in the post-natal period (and consequently, the high number of nocturnal requests of children) fathers resulted having problematic sleep and less sleep duration, that may be linked to a scarce sleep quality perceived (Condone, J. T., Boyce, P., Corkindale, C. J., 2004). Another study concerning fatherhood did not comprehended children's sleep difficulties as an influent factor in fathers well-being; although, in the same research, the fatigue in taking care of infants experienced by fathers was associated with sleep quality and their general well-being (Seymour, M., 2014).

It is evident that parents should provide support for children's sleep settling and in falling asleep in the early stages of life of the infants. In order to do this, they should ensure the

provision of a relational and emotional climate that should be perceived regulated and safe by children. In fact, since a poor quality of sleep may be linked to a scarce ability in emotional regulation (Baglioni, C., et al., 2010; Bower, B. et al., 2010; Goel, N. et al., 2009; Tucker, A. M., et al., 2010), an important factor to consider in parental functioning is their capacity in regulating emotions (Bariola, E., Gullone, E., Hughes, E. K., 2011). Being caregivers the "emotion socialization agents" of their children (Compton, K.et al., 2003; Buckholdt, K. E., Parra, G. R., Jobe-Shields, L., 2014), they should offer an adequate ability of regulating emotions in the relational environment. A good ability of emotional regulation comprehends correct and appropriate emotional answers and so, a proper control of emotions and an emotional analysis (Thompson, R. A., 1994). Moreover, a scarce parent-child relationship and an incomplete development of emotional competence in children may be linked to inappropriate interactions and inadequate expression of emotions (Dix, T., 1991; Garcia, O. F., Serra, E., 2019). From this it is clear the importance of the interpersonal and relational dimension in the developing of children. Studies regarding the functioning of caregivers, showed that children's sleep disruptions were linked to stress of parents (Sinai, D., Tikotzky, L., 2012). In their turn, the parenting stress may be connected with negative characteristics of parenting (Haskett, M. E., et al., 2006). Emotion regulation has been showed to be associated with sleep quality: particularly decreased sleep quality in mothers of children with sleep disruptions has been associated with a decreased regulation in emotions (Meltzer, L. J., Mindell, J. A., 2007). This evidence supports the idea that difficulties in sleeping in children may affect the competence of regulating emotions in parents and therefore reduce the efficacity of emotional responds, or even create inappropriate answers in supporting sleep in their children (Lollies, F. et al., 2022).

It seems clear that familial characteristics are associated with sleep difficulties.

As seen in the previous discussion, it appears evident how sleep in children and the dimension of the environment can't prescind from one to the other.

Sleep also takes place in the environmental dimension which in turn receives various influences, primarily that of the caregiver who is its guardian.

The relational dimension therefore becomes not only highly influential, but the place where a sleep routine is created and built. Hence, it derives the immediate relevance it assumes in the clinical (interventions, procedures) and research fields.

1.2 Sleep disorders in developmental age

The definition of problematics in sleeping is compound to focalize, since sleep is a process in development: different phases of human development are characterized by distinct sleep patterns and habits (Thiedke, C. C., 2001). Sleep behaviors which may appear disfunctional in itself, may be characteristic or considered typical for a certain developmental stage: for example, in newborns can be expected frequent nocturnal awakenings and usually are not to diagnosed as a sleep disorder. That is why, find out and learn the typical sleep's developmental stages help in the recognition of sleep's typicalness, disorders (Carter et al., 2014).

It is estimated that sleep difficulties affect down to the 50% of children and youths, but the percentage of those who receive a diagnosis of a sleep disorder is actually around the 4% (Carter, K. A., Hathaway, N. E., and Lettieri, C. F., 2014): for this, these problems are considered the most popular complainings in children (Sivertsen, B., 2009).

Since sleep is also a socially-modeled and culturally-shaped function, the problematic nature of a certain behavior related to sleep should be contextualized: which means, all different influences must be taken into account within the understanding the certain sleep problem (Adair, R. H., and Bauchner, H., 1993). In order to trace elements and the specific characteristics of influence that whether or not contribute to sleep hygiene, it would be essential to restore a meticulous history of the patient, describe a detailed framework and finally formulate a suitable diagnosis, if necessary (Fadzil, A., 2021).

1.2.1 Sleep influences

Adair and Bauchner (1993) described the possible major key points concerning sleep influences. The latter involve different spheres of life of the child and comprehend internal factors as well as environmental conditions. The following factors have been identified as the ones that affect sleep quality and habits from the first years of life yet. In listing and analyzing these elements, the authors (Adair, R. H. and Bauchner, H., 1993) adopt a perspective in which interpersonal interactions play a central role influencing the development of children's sleep hygiene, but also every-day routine activities.

Along with sleeping, feeding is one other basic function of infants strictly related to health and well-being. These two functions are very connected, especially in the first months of life of the child: this is because each feeding moment is paired with a sleep time. Initially, this short sleep moments do not correspond to the circadian rhythm (Adair, R. H. and Bauchner, H., 1993). It seems that the mode of nutrition of the child (breastfed or formula fed) may be associated with night waking, but not all studies converge with this data (Adair, R. H. and Bauchner, H., 1993). However, 6-month-old infants typically can face periods equal to 6-12 hours without be nourished (Adair, R. H. and Bauchner, H., 1993). Thus, approaching to a more typical nighttime period of sleep, fewer and fewer nocturnal awaken will be dedicated to feeding.

Another area linked to the proximity of caregivers refers in practicing the co-sleeping ("a practice in which one or both parents sleep in the same room with their infant, near enough for them to touch"; American Psychological Association, APA). Although this practice is frequently used to create a bound with the child and facilitate his sleep (American Psychological Association, APA), it seems to be linked to two negative sleep behaviors, which are the difficulties and the fatigues of children's bedtime and the night waking: these elements are associated but none of the cause-effect connection has been detected. Schacter and colleagues (Schachter, F. F., 1989) defined two types of profiles in reference to co-sleeping habits: the first one found children that sleep frequently and for the duration of the whole night with the relative parents and the second one observes children that share their bedrooms with the caregivers. Whereas for the first described problems were recorded, the second typology of co-sleeping did not show any correlation with sleep disturbances (Schachter et al., 1989; Adair, R.H. and Bauchner, H., 1993).

Also the quality of time spent in bedtime rituals seems to be associate with sleep problems. The moment of the day dedicated to the preparation to sleep (getting ready to go to bed through routine steps such as personal hygiene, relaxing, carrying out light activity) and the transition to lie down in bed is defined as "bedtime settling practice" (Adair, R.H. and Bauchner, H., 1993): one of the characteristics of this portion of the day is that is typically organized (in terms of timing and tasks to be performed) and followed by parents. Therefor "settling to sleep" is tightly configured as interpersonal situations, since the reference adults' interactions with the child should ease "sleep onset". At this point, the separation from parents for the night can be experienced as distressing (Adair, R.H. and Bauchner, H., 1993): in relation to this, studies regarding self-soothing behaviors in children underline that implement these conducts (such as thumb-sucking or the utilization of a transition object) promote an easier way to separate from adults for the nighttime (Adair, R.H. and Bauchner, H., 1993, Paret, I., 1983).

Particularly in the first years of children's life, behaviors related to sleep are highly influenced by more typically internal factors, such as child's temperament ("the basic foundation of personality, usually assumed to be biologically determined and present early in life"; American Psychological Association, APA) (Adair, R.H. and Bauchner, H., 1993). The latter is conceptualized as a style of behavior that characterizes each individual and configures itself in the variation (high or low) of the following factors: activity, adaptability, approach/withdrawal, distractibility, intensity, mood, persistence, rhythmicity, and sensory threshold (Adair, R.H. and Bauchner, H., 1993; Thomas, A. et al., 1963). Another specificity of this construct is its innate nature, but it also influenced by the external environment: and so, in order to this, it could be considered mouldable by the outside (Adair, R.H. and Bauchner, H., 1993). Literature shows different results as far as the associations between sleep quality and child's own temperament. One the one hand, no associations were found between temperamental features and sleep habits, especially for night waking (Adair, R.H. and Bauchner, H., 1993; Moore, T. and Ucko, L.E., 1957). On the other hand, Weissbluth (1981), analyzing the five characteristics which constitute the "Difficult Temperament Constellation", discovered that four of the previous mentioned factors were associated with sleep duration: specifically, with a shorter duration of sleep. Still in line with this study, associations were found only between the temperamental factor "sensory threshold" and night waking (Carey, W.B., 1974). From

another study, which included a sleep's video-recorded observation of two days in 6-months-old infants, emerged that the babies that drew the attention of parents at night were the most prone to putting in place shorter moments of self-containment conducts ("self-soothing behaviors"), compared with same-aged newborns who did not required care to parents (Keener et al., 1988). Paret (1983) analyzed self-soothing behaviors as a manifestation of support to children from the relative mothers and Benoit (et al., 1992) figured out that mother of children with nocturnal awakenings were characterized by an insecure attachment (Adair, R.H. and Bauchner, H., 1993).

In addition to post-natal elements that may be associated with sleep problems, perinatal factors (such as, asphyxia at birth) may be considered to get a detailed picture. In this field, researches are constantly developing and the continuous updating may make the results difficult to generalize. There are studies which do not confirm this influence between sleep difficulties and perinatal events (Vann Tassel, E.B., 1985; Anders, T. F. and Keener, M., 1985). However, some of the data regarded negative experiences around the perinatal period: the latter resulted be associated with night waking in children with an age comprehended between one and two years old (Adair, R.H. and Bauchner, H., 1993; Richman, N., 1981). Bernal (1973) conducted a study including 14-months-old children with no major perinatal situations: the ones who experienced longer labor and first cry at birth, were also the ones who had night waking (Adair, R.H. and Bauchner, H., 1993).

Focusing on external factors, the environment of growth of the child may create a positive ambience to the development of healthy sleep habits or make unfavorable situations, which may affect child's sleep quality. Various psychosocial stressors in familiar environment are discussed to be associated with sleep difficulties (Adair, R.H. and Bauchner, H., 1993), among them: the presence of economic difficulties (such as budgetary or unstable occupation) and illnesses. Several studies reported associations between these last factors and sleep disturbances, but did not establish a cause-effect relation. About economic instability, the last resulted present in families with children affected by night waking (Richman, N., 1981). As regards illnesses, one specific factor was deemed to be the maternal mental health. Indeed, the studies converge relative to this: in the study of Van Tassel (1985), maternal depression was correlated with the perception of sleep hardships and night waking in children aged between 4 to 27 months

old. In this study, besides mothers' poor mental health, sleep difficulties correlated significantly with other family's stressors. Other studies (Lozoff et al., 1985) found that maternal depression, together with other psychosocial stressors (such as family's diseases or injury and maternal unplanned absence), was associated with night waking (Adair, R.H. and Bauchner, H., 1993). Also, Zuckerman's study (et al., 1987) found associations between maternal depression and sleep disturbances in 8 months-old up to three years old children (Adair, R.H. and Bauchner, H., 1993).

So, the great amount of influences should contribute to the assessment of the degree of problematicity of a determined sleep pattern.

1.2.2 Sleep disorders and their classifications

It seems clear that the complexity in determining the presence/absence of a sleep disturb require specific guidances, which are able to group together maladaptive and disfunctional characteristics in sleep, as well as symptomatologic manifestations, and take account of individual characteristic in sleep behaviors (Carter, K. A., Hathaway, N. E., and Lettieri, C. F., 2014).

In 1979, the Association of Sleep Disorders Centers described specific criteria to accurately identify the diagnosis of sleep disorders and have been collected within the medical manual Diagnostic Classification of Sleep and Arousal Disorders (DCSAD; Adair, R.H. and Bauchner, H., 1993; Thorpy, M.J., 1990). In the present classification, there are four main categories to arrange sleep disturbances; particularly, this manual is organized by slitting basic symptoms of sleep disorders into these four groups: “disorders of initiating and maintaining sleep” (DIMS, insomnias), “disorders of excessive somnolence” (DOES, hypersomnias), “disorders of sleep-wake schedule” and “dysfunctions associated with sleep, sleep stages, or partial arousals” (parasomnias) (Adair, R.H. and Bauchner, H., 1993; Thorpy, M.J., 1990). These four sections, being categorized by symptomatic characteristics, may result repetitive as soon as a single disturb may be featuring by more than one single symptom, which in turn can be common to several sleep disturbances.

However, multiple manuals are there that aim to classify sleep disorders, each with their systems. Several may be mentioned, among them: the “International Classification for Sleep Disorders, Third Edition” (ICSD-3; Sateia, M. J., 2014), the “Diagnostic and Statistical Manual of Mental Disorders-5, Text Revision” (DSM-5-TR;), the “International Classification of Diseases, Tenth Revision, Clinical Modification” (ICD-10-CM;), and the “Diagnostic Classification of Mental Health and Developmental Disorders of Infancy and Early Childhood” (DC: 0-5; ZERO TO THREE;).

The International Classification of Diseases, 10th Edition, the Clinical Modification (ICD-10-CM) is a valid system of classification which supply in causes and outcomes, as well as, symptomatologic manifestation of disease (WHO), comprehending sleep disorders.

The Diagnostic and Statistical Manual of Mental Disorders-5 is an a-theoretical, multiaxial classification system which describes through inclusion/exclusion criteria, the presence/absence of symptomatologic characteristics that may refer to the manifestation of a certain disturb. The fifth edition of the DCM, classify the "sleep-wake disorders" as divided in eleven typologies: o insomnia disorder, hypersomnolence disorder, narcolepsy, breathing-related sleep disorders, circadian-rhythm sleep-wake disorders, parasomnias, restless legs syndrome (RLS), rapid eye movement (REM) sleep behavior disorder, other specified and unspecified insomnia disorder, other specified and unspecified hypersomnolence disorder, and other specified and unspecified sleep-wake disorder (APA).

The Diagnostic Classification, Zero to Three (DC:0–5) is a more typical classification for infancy, built on a multiaxial and descriptive optic. It offers a categorization of infants' disorder of behavior or related to emotional difficulties.

Differences in sleep classifications are summarized in Table 1.

DC:0-5™	**DSM-5**	**ICD-10**	**ICD-10 CODE**
Sleep Onset Disorder	Insomnia Disorder	Nonorganic Insomnia	F51.0
Night Waking Disorder	Insomnia Disorder	Nonorganic Insomnia	F51.0
Partial Arousal Sleep Disorder	Non-Rapid Eye Movement Sleep Arousal Disorders – Sleep terror type	Sleep Terrors	F51.4
Nightmare Disorder of Early Childhood	Nightmare Disorder	Nightmares	F51.5

Table 1. Sleep classifications in different psychological and medical manuals.

A more dedicated classification is properly represented by the International Classification of Sleep Disorders (ICSD) and its first publication dates back to 1990 (ICSD): here, the disturbs are named each only once (as illustrated in DCSAD), as this manual organizes its structure by dividing sleep disorders by their physiology (Adair, R.H. and Bauchner, H., 1993;). Its latest version (ICSD-3), published in 2014 (Sateia, M.J., 2014), is

composed by seven main categories that refer to: insomnia disorders, sleep-related breathing disorders, central disorders of hypersomnolence, circadian rhythm sleep-wake disorders, sleep-related movement disorders, parasomnias, and other sleep disorders.

Below are briefly described the some of the main disorders presented by the ICSD-3 classification.

Insomnia Disorder

The term insomnia is referred to the "difficulty in initiating or maintaining a restorative sleep" (American Psychological Association; APA). Mindell and colleagues (2006) defined insomnia in children as "a repeated difficulty with sleep initiation, duration, consolidation, or quality that occurs despite age appropriate time and opportunity for sleep and results in daytime functional impairment for the child and/or family". The ICSD-3 distinguish insomnia in "behavioral insomnia" and "psychophysiologic insomnia". The first one, in its turn, may be distinguished in three different types: one is linked to sleep settling, another to how limits are set and the last is a combined typology, which put together the previous two (Trosman, I., and Ivanenko, A., 2021). Behavioral insomnia is configured as the impossibility to fall asleep without certain conditions (Trosman, I., and Ivanenko, A., 2021). These regard non-completely adaptive behaviors, such as: rocking, sleeping with parents or a favorite toy, watching television (Owens, J. A., Moore, M., 2017). Its development may be connected to poor adjustment of the child or to a scarce competence of caregivers in setting limits (Trosman, I., and Ivanenko, A., 2021). Behavioral insomnia is more frequent in infants (Trosman, I., and Ivanenko, A., 2021). The second typology of insomnia recognized by ICSD-3 is the psychophysiologic insomnia. In this case, this type of insomnia is more common among older children and adolescents (Trosman, I., and Ivanenko, A., 2021). Youths who experience psychophysiologic insomnia report high arousals and negative outcomes linked to the sleep onset (Trosman, I., and Ivanenko, A., 2021). Generally, insomnia seems to be a risk factor associated with negative psychological outcomes: particularly, having insomnia is linked to the development of psychiatric conditions (e.g., internalizing disorders just as depression and anxiety) (Trosman, I., and Ivanenko, A., 2021).

Circadian-Rhythm Sleep Disorders

Circadian-rhythm sleep disorders are characterized by problems in chronophysiology (Thorpy, M. J., 2012): in fact, the sleep of the patients affected by this typology of disorders is not aligned with social norms, neither with their will or necessity to fall asleep (Thorpy, M. J., 2012). The delayed sleep phase disorder (DSWPD)

Parasomnias

Parasomnias are a group of sleep disturbs that configurate them-selves as "physical events or experience" (National Library of Medicine, NIH;) that may take place in all the moments of the sleep (while initiating or awakening or during sleep) (ICDS-3; Trosman, I., and Ivanenko, A., 2021). Physical events regard, for examples, complicated movements or actions (Trosman, I., and Ivanenko, A., 2021). The experiences may regard perceptions, dreams, emotions (), as well as autonomic nervous system functioning (Thorpy, M. J., 2012). These actions are lived as undesirable since they are abnormalities in sleep (Thorpy, M. J., 2012). Parasomnias are often in comorbidity with other sleep disorders (Thorpy, M. J., 2012) and are recurrent in children (Dollinger, S. J., 1982). Parasomnias can be classified in two different typologies: REM parasomnias and non-REM parasomnias (Trosman, I., and Ivanenko, A., 2021).

The first type of parasomnias includes, in its turn, other sleep disorders: one example is characterized by nightmares. The American Psychological Association (APA) describes nightmare as "a frightening or otherwise disturbing dream in which fear, sadness, despair, disgust, or some combination thereof forms the emotional content". These are very frequent in children ()Trosman, I., and Ivanenko, A., 2021: their peaks range between 5 and 10 years old in children (Simonds, J. F., Parraga, H., 1982). Nightmares often are associated to other sleep disturbs (such as sleep-walking and sleep-talking; Fisher, B. E., Wilson, A. E., 1987) and some studies found that they were more frequent in children with emotional difficulties (Terr, L. C., 1983; Dollinger, S. L., Molina, B. S., Monteiro, J. M., 1996; Finkelhor, D. et al., 1986). Another typology of REM parasomnia is the REM behavior disorder.

Non-REM parasomnia include a series of disorders such as sleep terrors, sleepwalking and nocturnal enuresis (Thorpy, M. J., 2012).

Thanks to these types of classifications, it is possible to recognize different sleep disturbs and, if necessary, resort to a formulation of a diagnosis.

However, infants and children's studies in literature do not report a great prevalence of neurological-based sleep disorders: neuropathology (such as narcolepsy) of sleep seems to be infrequent in child population (Adair, R.H. and Bauchner, H., 1993;). The majority of sleep problems are configured as difficulties and also constitute a general poor sleep hygiene: in this regard, an insufficient sleep care could lead to a worsening of a sleep habit, until becoming a not completely suitable practice and, for this, not tolerable by caregivers (Adair, R.H. and Bauchner, H., 1993;). Not only a limited sleep hygiene, but also external factor of stress or not typical sleep fact could get a normal sleep pattern to an aggravation (Adair, R.H. and Bauchner, H., 1993;). So, even if sleep neuro-pathologies are not so frequent in children, sleep difficulties in childhood are considered one of the most common problems in this typology of group.

Both the two described manuals, precisely because they are medical manuals, are referred to a more medical condition. These illustrate proper sleep disorders.

1.3 Sleep in children and in chronically ill children and adolescents

1.3.1 Chronic illnesses and sleep in youths

As previously treated, sleep problems are common in children's population. One of the factors that can put youths in a condition of vulnerability for the developing of sleep problems regards suffering from a chronic illness: in facts, children's sleep quality may highly be influenced by their medical conditions (Fadzil, A., 2021). This highlights how sleep disturbances may occur more frequently in clinical populations of children compared to the healthy peers (Lewandowski, A. S., Ward, T. M., & Palermo, T. M. 2011). The intensity, and therefore the gravity, of the latter mentioned medical condition generates an impact of different strength on sleep (Fadzil, A., 2021). The prevalence of sleep difficulties is found in both clinical acute and chronic conditions (Lewandowski, A. S., Ward, T. M., & Palermo, T. M. 2011).

Acute medical conditions generally comprehend one targeted zone of the body and typically these types of illnesses react to treatments and care (Murrow, E. J. and Oglesby, F. M., 1996). Typical clinical patterns are characterized by suddenly appeared symptoms of considerable intensity with a short term duration (American Psychological Association, APA). For examples, they regard infections comprising urinary tract, skin, ears and sinus (American Academy of Pediatrics, AAP). Sore throat, Bronchitis and bronchiolitis, as well as colds, gastroenteritis and flues are acute conditions too (Kernodle Clinic).

Chronic medical conditions concern more bodily systems and their response to treatments, as well as their course, are not so accurately predictable (Murrow, E. J. and Oglesby, F. M., 1996). Exactly because they are lasting clinical situations that remain for a long period (American Psychological Association, APA), it becomes fundamental to support the compliance and contribute to the maintenance a good level of life quality (American Psychological Association, APA), along with the preservation of a as closely as possible typical lifestyle (Murrow, E. J. and Oglesby, F. M., 1996). Chronic illnesses include clinical situations such as arthritis, diabetes, oncological and cardiac diseases (American Psychological Association, APA). More specifically, some symptomatologic pictures could refer to diseases such as cystic fibrosis, diabetes mellitus (type 1 and type

2), sickle cell and kidney disease, allergies and asthma, anemia and fetal alcohol spectrum disorders (FASDs) (American Academy of Pediatrics, AAP)

The severity of the medical condition may have a bearing on the importance of the sleep problems, and so does the typology of the illness. Depending on the chronic disease, there are different risks, severity and levels of chronicisation of sleep disturbances.

Youth people affected by illnesses may accuse a more intense weight of low sleep hygiene since the bidirectional relations that subtend sleep and health (Lewandowski, A. S. et al., 2011).

Several medical conditions are, then, associated with sleep problems, each with its own characteristics.

Allergic rhinitis

Allergic rhinitis is a frequent medical condition and frequently occurs in children: it is estimated that its incidence is around 13% in children (Melzer, E. O. et al., 2012), while it seems to range between 10% and 30% in the general population of the United States. (Lewandowski, A. S. et al., 2011; Schuler Iv, C. F., and Montejo, J. M., 2019). This common disease consists in an inflammation of the airway (Lewandowski, A. S. et al., 2011) and is primarily characterized by nasal symptoms (such as sneezing, rhinorrhea, nasal obstruction and itching), accompanied by ocular symptomatic signs (Dykewicz, M. S., et al., 1998; Schuler Iv, C. F., and Montejo, J. M., 2019). Allergic rhinitis is associated with children's sleep disturbances: in facts, generally chronic allergies are linked to this typology of problems and also with general sleep disordered breathing (SBD) (Lewandowski, A. S. et al., 2011; Bixler, E. O. et al., 2009; Redline, S. et al., 1999).

Asthma

Asthma is a breathing disease and is one of the most common chronic condition in children (WHO). Its symptoms primarily include shortness of breath, cough and wheeze (WHO). This chronic condition seems to be associated with many sleep difficulties, which regard the amount of time spent sleeping during the night: asthmatic children appear to report less time sleeping and more often night awaking (Lewandowski, A. S. et al., 2011). Asthma is also linked to sleep-disordered breathing, as well (Lewandowski, A. S. et al., 2011). It is known that asthmatic symptoms can increase during the night due to

circadian rhythm that involves lung variations: this worsening is configured as presence of physiological modifications (such as airway inflammation). Specifically, airway inflammation, minor volume of lungs and the other above-mentioned asthmatic symptoms seems to aggravate during nighttime (Lewandowski, A. S. et al., 2011). Also, in youths affected by asthma similar symptomatology seems to be reported in this population, as compared with healthy peers (Lewandowski, A. S. et al., 2011).

Craniofacial abnormalities

Craniofacial abnormalities often occur as in children with diagnosis of a genetic syndrome (such as Trisomy 21) as well as in the ones with muscular or cerebrals anomalies (such dystrophy or palsy) (Lewandowski, A. S. et al., 2011). These abnormalities of skull and face are configured as an atypical development of the craniofacial structure (in a major or minor direction) (Lewandowski, A. S. et al., 2011). Children with these features are likely to incur into a sleep disordered breathing (SBD) diagnosis (Lewandowski, A. S. et al., 2011): in fact, structural craniofacial anomalies have an impact on both sleep and airway (Lewandowski, A. S. et al., 2011). Moreover, it seems that surgical interventions to supply to these problems are not effective or beneficial regarding sleep problems (Lewandowski, A. S. et al., 2011).

Cystic fibrosis

Cystic fibrosis is a life-threatening disorder which appears with an incidence 1/2500 live births in Europe (Scotet, V., et al., 2020; Welsh, M., et al., 2001): it is a hereditary condition that target a protein in the body in order to produce a non-slippery mucus into airways, digestive tract and other various organs (National Heart, Lung, and Blood Institute, NHLBI). This specific disease, having these characteristics, is associated with airway restriction (Naqvi, S. K. et al., 2008): in this population frequent night waking, altered sleep patterns and sleep lamentations have been detected (Amin, R. et al., 2005). Not only these difficulties, but youths affected by cystic fibrosis report nocturnal hypoxemia and poor sleep effectiveness (Lewandowski, A. S. et al., 2011; de Castro-Silva, C. et al., 2009; Ramos, R. T. et al., 2009), as well as more strictly disorders (such as obstructive sleep apnea), due to their airways' structure (Ramos, R. T. et al., 2009). Moreover, it seems that the associations between sleep and side symptoms of cystic fibrosis are bidirectional (Amin, R. et al., 2005).

Epilepsy

Children affected by epilepsy often report sleep problematics: this chronic condition is a disease which affects the brain and manifests itself with involuntary movements in episodes of crisis caused by a brain cells' electrical discharging (WHO). The symptomatologic expression especially regards sleepiness linked to discontinuation of sleep patterns (Lewandowski, A. S. et al., 2011; Maganti, R. et al., 2006) and also to sleep disordered breathing (SBD) (Maganti, R. et al., 2006). All the associations between epilepsy (particularly its crisis) and sleep difficulties and disorders seem to have a bidirectional influence (Lewandowski, A. S. et al., 2011): indeed, in Parisi's study (et al., 2010) electroencephalographic (EEG) discharges of epilepsy influence the sleep of epileptic children; on the other side, sleep difficulties (such as deprivation or interruption) affect the manifestation of EEG discharges and crisis, in its turn (Parisi, P. et al., 2010). It is also to underline that epilepsy has a circadian a persistence and a crisis' distribution (Parisi, P. et al., 2010).

Gastroesophageal reflux

Gastroesophageal reflux disease (also called GERD) is a chronic condition, which comprehends the esophagus and regards 5% of 12-months-old infants (Leung, A. K., et al., 2019), and the incidence among youths (from 1 year old to the age of 12 years) is of 1.48 per 1000 person-years (Ruigómez, A., et al., 2010). Since this disease deals with the rise of acid content from the stomach (the reflux), it also concerns acid indigestion, heartburn, up to lesions of esophagus (Lewandowski, A. S. et al., 2011); particularly acid is more into contact with the esophageal wall during nighttime (Lewandowski, A. S. et al., 2011; Orr, W. C., 2003). Children affected by gastroesophageal reflux disease present associations with different sleep disorders: among the most common, the literature report apneas and hypopneas (the condition in which shallow breathing or non-normal low respiratory levels are verified) (Halpern, L. M. et al., 1991). Taking in exam infants, gastroesophageal reflux disease is linked to night waking in newborns (Lewandowski, A. S. et al., 2011). This chronic condition is also seen as a risk factor for the developing of obstructive sleep apnea (OSA) (Halpern, L. M. et al. 1991).

Problematic rheumatological conditions

Problematic rheumatological conditions include various diseases that especially aim the joints, but also muscles, tendons, ligaments and bones (Centers for Disease Control and Prevention, CDC) and include: juvenile idiopathic arthritis (JIA) and juvenile fibromyalgia (JF). Both of the latter mentioned disorders are associated with sleep difficulties in youths (Lewandowski, A. S. et al., 2011) with some peculiarities. The ones affected by juvenile idiopathic arthritis may experience, in youth age, scarce sleep quality and disorders of the sleep such as insomnia, parasomnias and sleep disordered breathing (SDB) (Lewandowski, A. S. et al., 2011). In this chronically ill population, daytime sleepiness is detected (Lewandowski, A. S. et al., 2011), and a general split sleep pattern is found (Lewandowski, A. S. et al., 2011) and it is often characterized by wake peaks (Lewandowski, A. S. et al., 2011), changing sleep phases (Lewandowski, A. S. et al., 2011) and longer naptime (Lewandowski, A. S. et al., 2011). Besides this, the pain connected to arthritis seems to be associated with sleep difficulties (Lewandowski, A. S. et al., 2011). Moving to juvenile fibromyalgia (JF), literature shows that sleep interruption is frequent in the patient affected by the last mentioned disease (Lewandowski, A. S. et al., 2011). Poorer total sleep time, prolonged sleep intervals, scarce sleep efficiency (Lewandowski, A. S. et al., 2011). Also, in this chronic condition, it is found that pain is associated with altered sleep, showing abnormalities (Lewandowski, A. S. et al., 2011).

Sickle Cell Disease

Sickle Cell Disease (SCD) is a hereditary disorder which regards red blood cells and comprehends various typologies of this condition (Centers for Disease Control and Prevention, CDC). This disorder is characterized by vaso-occlusive crisis (that is, of deep pain), infections, anemic events, injuries of blood vessels or that concerns the blood supply to the brain and split sleep (Lewandowski, A. S. et al., 2011). Secondary symptoms and symptomatologic manifestations relate with sleep difficulties: one of these is identified by the adenotonsillar hypertrophy, which is considered a risk factor for the developing of sleep disorders, such as obstructive sleep apnea and vaso-occlusive crisis linked to hypoxemia (Lewandowski, A. S. et al., 2011). Continuing, connected to this, nocturnal hypoxemia, sleep disordered breathing (SDB) and sleep disturbances linked to pain seems to be associated in youth subjects affected by sickle cells disease (SCD) (Lewandowski, A. S. et al., 2011). Parents of this children population describe symptoms

of different sleep difficulties, among them: sleep disordered breathing (SDB), nocturnal enuresis, night awaking and parasomnias (Lewandowski, A. S. et al., 2011).

Most of the described illnesses can make experience pain both as a symptom of the condition of disease, or a consequence of the problem which affect this population, or once more a discomfort/issue that concern precisely pain itself (Lewandowski, A. S. et al., 2011). Pain is frequently recorded in children and adolescents populations: it is estimated that the 25-40% of the latter subjects is impacted (Standford, E. A. et al., 2008) Feeling and experiencing pain may not enable chronically ill children being able to the preparation of the "sleep onset" (that is the settling to sleep) and to the maintaining of sleep (in order to remain asleep) (Lewandowski, A. S. et al., 2011). Youth affected by chronic disease and which experience chronic pain show various sleep difficulties: some of these are linked to the time dedicated to sleep, such as sleep duration (Passarelli, C. M. et al., 2006; Tsai, S. Y. et al., 2008; Valrie, C. R. et al., 2013) and the awaking during nighttime (Meltzer, L. J. et al, 2005); others are more spacious and regard a worse quality of sleep (Haim, A. et al., 2004; Palermo, T. M. et al., 2007) and poorer sleep efficiency (Palermo, T. M. et al., 2007), as against peers in health. A very frequent disorder that can be found in chronic pain youth patient is insomnia (Lewandowski, A. S. et al., 2011), so as to regard half of the children affected by pain (LaPlant, M. M. et al., 2007; Palermo, T. M. et al., 2011). Therefore, sleep problems seem associated with conditions of pain, but also with the intensity of pain experienced by youths, and with the possibly felt depressive symptoms (Palermo, T. M. et al., 2005). Furthermore, a study conducted with youth patients with different medical conditions of pain reported associations between scarce time spent sleeping at night and higher pain experienced the day after (Lewandoski, A., S. et al., 2010).

The majority of the above-mentioned conditions may include a period of hospitalization, while every single chronic illness requires a specific and proper treatment, which may also include invasive procedures. Spending time in the hospital due to medical causes (such as chronic illnesses) is linked to sleep problems in youths (Cureton-Lane, R. A. and Fontaine, D. K., 1997; Hinds, P. S. et al., 2007; Jacob, E. et al., 2007; Lewandowski, A. S. et al., 2011) and this may be caused by discomforts extremely connected with the hospital setting: changing or difficulty on maintaining a certain sleep routine, the experience of anxiety regarding separation from parents, the lack or deficiency of privacy

and the usual breaks of medical professionals (Lewandowski, A. S. et al., 2011). Sleep may also be made difficult by the positions in which clinicians place patients due to medical procedures (Lewandowski, A. S. et al., 2011). Various sleep difficulties may be connected with specific programs of treatment (such as dialysis; Davis, I.D. et al., 2005) (Lewandowski, A. S. et al., 2011).

Therefore, it is clear the demand of each type of sleep disturbances for specific cure and assistance (Dawson, P., 2014).

This review shows how sleep may be affected in different chronic disturbs in pediatrics. The relevance of studying these influences trace back to the deepening of these diseases and the way they function, not only at a physiological level, but also at a daily conduct of chronically ill children and youths.

Learning about the chronic illnesses and being able to recognize side effects and correlates may make professionals become aware of adverse experiences linked to the diseases. The exploration of all the areas of typical functioning in chronically ill children poses challenging in take caring of them: a focal point in the treatment of diseases, which affect patients for life-spanning periods, is the improvement of quality of life. This construct subtends a series of domains which contribute to well-being. In chronically ill children this acquire great value, since they already experience many compromises due to illness: consciousness of the side effects that may be developed should drive researches and interventions to improve their life quality. Every area should be taken into account; in the present case it will go through specific sleeping issues. As previously discussed, sleep is a basic and fundamental function and its correlations with chronic disease may open great scenarios of research and improvements in children's area.

The choice of taking a deep look at the sleeping processes connected to chronic illnesses derives from the versality of this function to support many others basic function and processes, especially in children. Moreover, in the present study the investigation of two main chronic illnesses will be examined; specifically, these two are at the antipodes by their characteristics, doing so to have a confrontation of two chronic condition but at different levels of features: cancer and diabetes. The relevance of reporting two chronic conditions so different from each other, grants the opportunity to build a useful starting

point, having well clear the range that chronic condition can cover and the differences they can assume, remaining both below the classification of “chronic condition”.

1.3.2 Cancer and sleep disruptions

Childhood cancer is a chronic life-threatening condition which greatly impact the health and the wellbeing of patients affected. Generally, it can be defined as a breakdown of the balance between two processes, on a biological level: on one side, the cellular renewal and, on the other side, the cellular apoptosis or the elimination into the body (Rosen, G. M. et al., 2008). This loss of balance seems to be resulting from a failure, a disequilibrium or a malfunction in the signaling to some processes their correct functioning; these functions concern in the growth, differentiation and survival of the cells (Rosen, G. M. et al., 2008; Song, Y. et al., 2008). This alteration of the pathways, which control these processes, may develop because of various factors, that are not mutually exclusive: one refers to hereditary determinants, and the other one concerns environmental characteristics (Rosen, G. M. et al., 2008; Weinberg, R.A., 2007). However, most of oncological diseases are due to alterations, or even mutations, of ways of molecules, which predispose to cancer (Rosen, G. M. et al., 2008).

Cancer in childhood include very many typologies of malignant tumors, attributable to a large spectrum of differences (Rosen, G. M. et al., 2008). They are distinguished in age, gender of the patient, histology, and origins (Rosen, G. M. et al., 2008).

It is estimated that 1 over 5000 children, with an age below 16 years, received a diagnosis of cancer (Wilne, S. et al., 2007). Having diagnosed a cancer in youths aged between 1 and 19 years old is considered one of the main causes of deaths in the United States (Cunningharn, M. R. et al., 2018; Sheikh, I. N. et al., 2021). Despites this, the rates of mortality in pediatrics affected by cancer have undergone major changes in the last years: in particular, it has been shown a decrease of 22% of the deaths due to oncological diseases in the United States (Reis, L. et al., 2005; Rosen, G. M. et al., 2008). The lowering of cancer mortality in children and adolescents may mostly due to the improves in treatments and care of this type of desease (Rosen, G. M. et al., 2008; Sheikh, I. N. et al., 2021).

So, if in one hand, the avant-garde and the progress in researches have led to more efficient treatments managing to an improved survival rate (Rosen, G. M. et al., 2008), in the other hand, new challenges arise for the maintenance of a good level of quality of life, but also the attention to the identifications of the side effects or comorbidities of cancer,

just as: (Rosen, G. M. et al., 2008). This latter may influence several basic functions of children functioning.

Being the experience of having an oncological disease a highly stressful but also a potential traumatic event (Kazak, A. E, and Noll, R. B., 2015), it has strong repercussions on daily life and the conduct of a typical lifestyle: although this and all the difficulties in oncological care, it has been considered that three-fourths of children affected by cancer are long-term survivors (Kaleyias, J. et al., 2012). This leads to deepen the influences of cancer over the oncological pediatric patients' life. One of the functions, that seems to be altered in children with cancer, is sleep: the literature report that sleep may be disrupted in this type of population (Kaleyias, J. et al., 2012). Twofold factors may be influential in the manifestation of difficulties in these children's sleep: one refers to the direct impact of cancer on brain injury and the other concerns the indirect actions of cancer (Kaleyias, J. et al., 2012). Then, the first mentioned factor reflects brain injuries, such as brain tumors, but also surgery or other therapy (as cranial radiation therapy; CRT) of the brain, as well as the accumulation of cerebrospinal liquid in brain (hydrocefalus) (Kaleyias, J. et al., 2012). The indirect factors are connected to various medical complications that can occur in cancer handling. For examples, cancer-related fatigue (CRF), that is the experience of feeling really tired constantly or for a large part of the time (Scotland's National Health Information Service, NHS inform); and furthermore, treatment of the disease, such medical medications and medicines (Kaleyias, J. et al., 2012; Oeffinger, K. C. et al., 2006). Experiencing pain, as other secondary effects of cancer, known as "side effects of treatments" (epileptic crisis, overweight, endocrinopathies, cardiac decompensation, gastroesophageal reflux, and blindness), are considered indirect factor too (Kaleyias, J. et al., 2012; Oeffinger, K. C. et al., 2006). One other factor that may contribute to sleep difficulties in oncological children is the presence of elevated level of stress: particularly, its influence role is evident in exacerbating sleep difficulties (Kaleyias, J. et al., 2012).

The prevalence of sleep problems in pediatrics affected by cancer has grown (Kaleyias, J. et al., 2012) and with this, also the urgency of manage the general quality of life of oncological children.

Sleep dysfunction in oncologic children may influence their life quality. As previously discussed, invasive procedures often occur in the cure of children affected by cancer diseases. It has been found that higher level of fatigue and greater sleep difficulties were reported in oncological adolescents in the period of time after chemotherapy (Erickson, E. J. et al., 2011; Kaleyias, J. et al., 2012). The experience of fatigue and disturbs in sleep were linked each other, and the same were associated with some of the areas comprehended by the general quality of life. The same study considers different time for the assessment of these components. The first period refers to the time of chemotherapy's treatment, the construct of fatigue was associated with scarce quality of sleep and daily activities; these latter, were linked to aspects of quality of life concerning the body (Erickson, E. J. et al., 2011; Kaleyias, J. et al., 2012). The second period spans the weeks after the oncological treatment, associations were found between functions of the day, symptoms of cancer and the psychosocial area of quality of life (Erickson, E. J. et al., 2011; Kaleyias, J. et al., 2012). In the same period, associations emerged between the quality of sleep and symptomatologic manifestations of cancer (Erickson, E. J. et al., 2011; Kaleyias, J. et al., 2012).

Psychological difficulties and disorders may be common among children and youths affected by cancer: a quarter of this population and of the survivors show symptoms ascribable to diagnostic pictures of depression and anxiety, in a clinical way (Merz, E. L. and Tomfohr-Madsen, L., 2018; Sheikh, I. N. et al., 2021). The incidence of these problems in this chronically ill population make be focused on these psychological correlates and how they affect quality of life. In this sense, it has been found that the psychological mindsets of oncological patients may influence sleep after the diagnose of cancer. The influence between sleep and psychological symptoms may defined as bidirectional: in fact, sleep difficulties may affect psychological outcomes as well (Merz, E. L. and Tomfohr-Madsen, L., 2018; Sheikh, I. N. et al., 2021). There are studies that concentrated, for example, on leukemia in children: from these emerged that the cancer diagnosis has an impact on very many life areas on these patients, just as the skills to which resort to calm, and cope and also the temperamental characteristics of the children are affected (Daniel, L. C. et al., 2016; Sheikh, I. N. et al., 2021). These inconveniences may bring to exacerbations of psychological stress (Daniel, L. C. et al., 2016; Sheikh, I. N. et al., 2021). The last-mentioned may, in its turn, influence sleep patterns: for

examples, children affected by leukemia cancer have difficulty in sleep onset (fall asleep), nocturnal awakening, up to damage in sleep regularity (Daniel, L. C. et al., 2016; Sheikh, I. N. et al., 2021).

Medical treatments, as well as procedures, affect sleep. In van Someren's study (2004), it was found that cranial radiation therapy (CRT) may affected sleep of oncological children: actually, high dosages of CRT in childish age have repercussions (in both objective and subjective reports) on sleep in adulthood, especially on cycles of sleep-wake (Kaleyias, J. et al., 2012; Van Someren, E. J. et al., 2004). Not only treatments, but also some medicines may produce effects on sleep. The medical product which stand at the basis for the modern treatment of acute lymphoblastic leukemia (ALL), the dexamethasone, is related to impaired sleep pattern (Kaleyias, J. et al., 2012; Watanabe, T. K., Sylvester, C. E., Manaligod, J. M., 1994). In particular, Hinds and colleagues (2007) found that in oncological children affected by ALL, sleep and fatigue were behavioral outcomes of dexamethasone (Hinds, P. S., et al., 2007; Kaleyias, J. et al., 2012).

Many oncological children are affected by insomnia: many of them reconduct experiencing pain as the main cause of insomnia (Kaleyias, J. et al., 2012). Supporting this, it has been showed that the control over insomnia were improved managing the pain experienced in the oncological condition (Kaleyias, J. et al., 2012). However, children with an age below the 10 years are typically characterized by mild insomnia and attributable to a scare hygiene of sleep (thus, for example, a not constant routine of settling to sleep). Although insomnia generates discomforts (in addiction to a series of correlates of medical impairment), parents of oncological children do not require a specific treatment for its management (Kaleyias, J. et al., 2012). Most of the complaining of children with cancer, besides the take caring of insomnia, regard the sleep onset (Kaleyias, J. et al., 2012; Rosen, G. and Brand, S. R., 2011). The same study reported that children with hematologic cancer (comprehending leukemia) commonly presented insomnia: in particular 39% of children with hematologic cancer and 17% of pediatrics with brain tumor presented this sleep disorder (Kaleyias, J. et al., 2012; Rosen, G. and Brand, S. R., 2011).

Cancer-related fatigue is a condition that affect most of oncological patients of both children and adults' populations (Kaleyias, J. et al., 2012; Stasi, R. et al., 2003): it is estimated that between 50%-90% experienced this state and the most affected are the ones under cancer therapy (such as chemotherapy or radiotherapy (Kaleyias, J. et al., 2012; Stasi, R. et al., 2003). There are differences in the typology of cancer and the fatigue experienced: pediatrics with leukemia improve in fatigue, differently by brain tumors patients (Kaleyias, J. et al., 2012; Roscoe, J. A. et al., 2007). This condition can be described as the perception of tiredness related to cancer and its treatments, and not as simply sleepiness (Campos, M. P., et al., 2011; Flechtner, H. and Bottomley, A., 2003; Kaleyias, J. et al., 2012). Instead, sleep predicts the development of cancer-related fatigue (). This state is experienced physically, emotionally, and or cognitively and the feel is so exhausting that engrave with the daily life and activities (Campos, M. P., et al., 2011; Flechtner, H. and Bottomley, A., 2003; Kaleyias, J. et al., 2012). Fatigue is a frequent experience and it has been showed in 80% of oncological pediatrics (Dupuis, L. L. et al., 2010; Kaleyias, J. et al., 2012). Between the gravity of the sleep difficulties in pediatrics (intended as how many times they occur and how are severe) and the cancer-related fatigue there is a positive association (Dupuis, L. L. et al., 2010; Kaleyias, J. et al., 2012).

Sleep-disordered breathing (SBD; which regards difficulties in breathing during the night) can affect both healthy and chronically ill children's populations. Particularly, it has been found that the 40% of children with cancer of Rosen and Brand's study (2011) shows sleep-disordered breathing, and particularly: 6 out of twenty-eight had CSA (central sleep apnea), twenty out of twenty-eight had OSA (obstructive sleep apnea) and 2 out of twenty-eight had hypoxemia during night (Kaleyias, J. et al., 2012; Rosen, G. and Brand, S. R., 2011). These symptomatologic outcomes may be associated with the side effects of being affected by cancer. There are some illness' aspects that may influence the development of SDB: oncological children may be characterized by poor patency in airways, altered muscular tone (overweight, hypertonia, hypotonia), lower breathing boost and difficulty in controlling the dilators of pharynges (Kaleyias, J. et al., 2012; Rosen, G. and Shore, A., 2011).

1.3.3 Diabetes and sleep disruptions

Type 1 diabetes mellitus (T1DM) is an autoimmune disease, also known as juvenile diabetes and, in fact, it is a common chronic disease among children (Ilter Bahadur, E., et al., 2021) and its diagnose occurs in young age (Health Central). In general, both type 1 and type 2 diabetes affect the production of insulin: in particular, in the first-cited one, the pancreas produces too little insulin, or even it does not produce this hormone at all. Type 1 diabetes mellitus comprehend high levels of glucose into the blood of the ones affected (Mobasseri, M. et al., 2020); moreover, the deficiency in insulin's levels creates, as a result, hyperglycaemia (DiMeglio, L. A. et al., 2018).

Type 1 diabetes affects a great percentage of children, and moreover being one of the most common chronic condition in the USA ().

Being a chronic condition, children and youths affected by type 1 diabetes should not only taking care in the maintenance, the management and the control of therapy, but also learn to live with it.

Diabetes require a series of daily treatments and monitoring that must be adopted and sustained in order to live together and keep the disease under control. These procedures must become an integral part of life of diabetic-affected: so, it is tried to encourage as much as possible the autonomy in this take caring, also in pediatrics. Diabetes' tasks regard, for example, the supervise and the measurement of different medical standards, such as blood glucose, but also the dosing of insulin and the calculation of carbohydrate (Hazen, R. A. et al., 2015). As previously indicated, these treatments should be integrated in the conduct of a as much as possible typical life: this poses all diabetic youths in front of a great challenge of adjustment.

Besides medical cares, the diabetic condition require a series of adjustments in everyday life, since diabetes and its side effects may generate different difficulties. Among these, sleep disruptions are particularly evidenced in this type of population. The ever-growing focus posed in learning a living with illness has brought out the need to pay attention to life basic functions compromised by the disease, just as sleep. For this, The American Diabetes Association's Standards of Medical Care in Diabetes suggest to take into consideration sleep in medical evaluations, since literature highlights the possible associations between the quality of sleep and the control of glycemic parameters (2017).

This relation between the sleep basic function and type 1 diabetes mellitus' parameters seems to be "dynamic and bidirectional" (Abdel Aleem, H. H. et al., 2022): this means that the chronic diabetic disease may have an impact on sleep, but also sleep disruptions may alter physiologic indexes, typically measured and kept under observation in diabetes (Abdel Aleem, H. H. et al., 2022).

In diabetic population has been shown that an appropriate, or at least sufficient, number of hours dedicated to sleep was difficult to reach (Perez, K. M. et al., 2018). As in typical and healthy population, the scarcity of sleep could lead to negative results for the conduction of everyday activities, influencing daily functioning negatively (Perez, K. M. et al., 2018). In Hazen and colleagues' study (2015) demonstrated that youths with type 1 diabetes had difficulties in sleeping and its correlates: their parents reported that 15% had sleep disruptions and 22% were exhausted during the daily activities (Hazen R. A. et al., 2015). In the same study, different opinions were given by the parents: 29% considered their children to sleep more than healthy peers, while the 18% thought that they slept minor hours, always considering the comparison with healthy peers (Hazen R. A. et al., 2015). A different study underlined the perception of parents of their diabetic children as more problematic in sleep, as compared to healthy children: especially, the difficulties regarded the sleep onset, but also sleep maintenance, as well as the transition from sleep to wake phase (Caruso, N. C. et al., 2014). In the same research, sleepiness during the rest of the day was observed in diabetic children (Caruso, N. C. et al., 2014). The literature underlines that sleep difficulties (just as the previously-mentioned onset and initiation of sleep, and the awakenings during the night) correlated with the control of glycemia in all the diabetic population (Farabi, S. S., 2016; Hazen R. A. et al., 2015).

It has been discovered that "sleep variability" or changes in the time of setting to sleep and the number of hours dedicated to sleep (thus, the duration of sleep time) impact the diabetic teen population's sleep (Perez, K. M. et al., 2018).

So, as previously described, the associations between sleep and type 1 diabetes mellitus are bidirectional: thus, correlates of experiencing this chronic condition (such as psychological and behavioral characteristics) and its treatments may affect sleep patterns (Perfect, M. M., 2020), but, at the same time, a scarce sleep hygiene may modify the control and the resistance of the insulin hormone (Sinisterra, M. et al., 2020). Exactly

because the bond of influence between sleep and type 1 diabetes mellitus appears to be extremely important in the description of the present disease and in the possibility of improvement of typical conduct of life despites the chronic condition, here are reported the two dynamic and bidirectional influences.

Firstly, as many chronic conditions, diabetes is correlated to sleep disturbances. There are studies that examine the influences between diabetes' condition and its correlates and sleep difficulties. Some of these researches underline hypoglycemia during the night in diabetic children and adolescents' populations and the impact of the lower glucose levels on sleep (Perez, K. M. et al., 2018). The incidence of these episodes of hypoglycemia during nighttime has been registered in diabetic population and, from this it is possible to develop the fear of hypoglycemia in these patients (Perez, K. M. et al., 2018). This latter worry is common in this patients' population (Wild, D. et al., 2007): in order to this, studies have been investigated the correlations between fear of hypoglycemia and the effective nocturnal hypoglycemia in diabetic patients and its frequency. Diabetic and healthy children have been submitted to an observational sleep study to assess hypoglycemic events and sleep (Pillar, G. et al., 2003). This research, using polysomnographic registrations, showed that more nocturnal awaking occurred in diabetic children compared to the healthy peers (Perez, K. M. et al., 2018; Pillar, G. et al., 2003). A study in a group of 20 adolescents affected by diabetes showed that the 30% of these patients had nocturnal hypoglycemia, but these episodes were not programmed by the checks of glycemic levels, occurring the same night before sleep onset (Perez, K. M. et al., 2018; Porter, P. A. et al., 1996).

Also diabetes' correlates are important to take into account indagating its correlations with sleep. As described, the diabetic condition brings a series of necessary measures for the processing of symptoms and the disease itself. The diabetic management makes use of device to, for example, control glycemic levels in blood or the administration of insulin. The employments of new technologies on one side support the managing of type 1 diabetes mellitus, on the other side these devices may have an impact on sleep quality (Perez, K. M. et al., 2018). In Jaser and colleagues' study (2017), children aged between 2 and 12 years old the typology of device used for diabetic management was not associated with the sleep quality (Jaser, S. S. et al., 2017).

The other influence regards the impact of sleep on diabetes management and care. It seems clear the importance of the management of diabetes and the promotion of a general good level of quality of life, in addition to the fundamental medical procedures and daily-care tasks. Children and adolescents affected by type 1 diabetes, should be helped in understanding the connections between sleep and their chronic conditions: that is because a good sleep hygiene (from which it derives a good sleep quality) aids a great diabetes' management, in terms of glycemic control (Perez, K. M. et al., 2018). This connection may be made clear reasoning that sleep impacts the adherence to diabetes' treatments (Perez, K. M. et al., 2018). The following findings support this idea of sleep as a crucial construct for the comprehension and a better management of diabetes in youths. In children affected by type 1 diabetes, it has been underlined that changings sleep influence the take caring of the disease, in terms of management and adherence to treatments and medical routines (Perez, K. M. et al., 2018). Among parents of diabetic children, it seems that children with a glycemia's scarce control and elevated average levels slept more than children with different glycemic parameters, just as characterized by a less frequent and a minor number of checks of glycemia and scarce adherence to treatments (Hazen R. A. et al., 2015; Perez, K. M. et al., 2018). The compliance to medical necessary procedures for the maintenance of diabetes may result scarce in correspondence to an excessive number of hours dedicated to sleep: that is, diabetic children spending too much time sleeping may be asleep in the moment of time dedicated to the glycemic control or to the dosing of insulin (Perez, K. M. et al., 2018). In adolescence's period this type of association is not supported by literature. In fact, it seems that the trend follows differently: a small amount of time (even just 15-20 minutes) spent sleeping is associated to additional glycemic controls or administrations during the day after in adolescents with insulin pumps (McDonough, R. J. et al., 2017; Perez, K. M. et al., 2018). Along the same line, another study presented the positive association between glycemic monitoring and the time spent sleeping in diabetic youths (Jaser, S. S. and Ellis, D., 2016; Perez, K. M. et al., 2018). Not only single characteristics of sleep, but also quality of sleep is to be focused when taking into account its characteristics in the diabetic chronic condition and handling in adolescents (Perez, K. M. et al., 2018). Turner and colleagues' study (), conducted on diabetic youths, was based on the reports of a daily diary about information on sleep, diabetes management and its care, the registration of medical parameters (such

as glycemic levels and behaviors of control) but also failures in cognitive, emotional or behavioral actions for glycemic checks (Perez, K. M. et al., 2018; Turner, S. L. et al., 2016). From these registrations, it emerges that the more adolescents had a perception of their quality of sleep as poorer, the more adolescents had failures in self-caring, with a consequent greater risk of hyperglycaemia (Perez, K. M. et al., 2018; Turner, S. L. et al., 2016). The same reports showed how adolescents' good sleep quality was correlated to less failures in the managing of diabetes (Perez, K. M. et al., 2018; Turner, S. L. et al., 2016).

A very important focus has to be stressed talking about sleep and its psychosocial correlations with diabetes (Perez, K. M. et al., 2018). In adolescents, their scarce control over their diabetic chronic condition, their sleep alterations (just as excessive tiredness, oversleeping) and difficulties were associated with depressive symptoms (Hazen R. A. et al., 2015; Perez, K. M. et al., 2018). In line with this last study, a research conducted in children affected by type 1 diabetes mellitus were found that the behavioral difficulties (both internalizing and externalizing) were averaged by sleep difficulties (Caruso, N. C. et al., 2014; Perez, K. M. et al., 2018). Sleep disruptions are also linked to scholastic performance, for examples in terms of average of school's marks and absence from school (Perez, K. M. et al., 2018; Perfect, M. M., 2014). Linked to this last point, literatures underline that insufficient sleep during the school period was associated with more absences in school's lessons (Perez, K. M. et al., 2018). In their turn, academic absences were related to the diabetic adolescents' perception of a stronger impact of their chronic illness (Perez, K. M. et al., 2018). So, the managing of diabetic disease may also be impacted and increased by a scarce duration of sleep, and this may influence absences from school due to illness (Perez, K. M. et al., 2018).

CHAPTER 2: THE RESEARCH

2.1 Aims

Precisely because sleep problems and disorders are often associated with chronic condition, the urgency to take into account both sleep and illnesses may result fundamental in the structuring of treatments and management of chronic diseases; furthermore, this may lead to great benefits in pediatric patients. More at a general view, the urge of considering chronically ill patients not only for their own diseases, but the taking charge of medical care should not disregard the general health and the global well-being. This stands for the necessity to take a different look to specific treatments which should take care at a globally level the single areas composing well-being and health. And so, assuming sleep as an important function (which support development, other functions of human functioning and also health and well-being), its study and investigation in pediatrics that, properly for their chronic condition, live an increased risk situation, may result fundamental for the preservation of general well-being and for supporting growth.

So, as largely discussed, most of the literature concentrate on sleep disturbances among one single medical condition: very few is known about the comparison between chronic disorders and their associations with sleep. In the present study two chronic condition will be taken into account: cancer and diabetes in pediatrics.

The selection of cancer diseases and diabetes for the present study regard both their similarities and differences: the choice of properly choose these two typologies of clinical populations derived by the idea of confronting two chronic situations, which differ in various aspects. In fact, both of these two are chronic conditions. The most defining feature that makes diabetes and cancer different is the level of control that patients and professionals have among the disease.

Both introduce a certain grade of challenging difficulties in everyday family life, as well as a great amount of stress and changings, which require a great commitment of adjustments by each member involved.

Differences in the intensity of the pain and invasivity of the procedures of care and treatment.

Although diabetic patients have to follow a very strict therapy regarding both measurements and treatments, typically their level of adjustment permit to carry out their own activities and their developmental tasks.

Diabetic patients live with chronicity, maintaining a fairly typical lifestyle compared to both healthy peers and with pediatrics affected by more invasive chronic illnesses.

Oncological youth, in the majority of cases, especially in the acute phase of the cancer's treatment, are not able to sustain a normal life rhythm because of several difficulties. Children affected by cancer often are hospitalized patients and require treatments. In addition to this, their immunodepression due to treatments that they often may need, means that these patients should be maintained in isolation from others to avoid infections.

Moreover, very little is given by studies about associations between sleep's chronically ill children and youths and their parents' sleep. As previously treated, the relational dimension of sleep is very important to be taken into account when sleep is examined: in fact, between the influences which affect sleep, parental handling of sleep hygiene is crucial.

The present study contains and is driven by the previously conditions.

So, the first aim of the study regarded the exploration of the possibly associations between sleep and psychological features in the two clinical samples (the oncological and the diabetic ones) and their caregivers, comparing them with the control sample composed of healthy population, respectively.

The second aim of the study propose to explore the associations between parents and children's sleep quality in all the three groups: in particular, it regards the investigation of the possibly influences between children's sleep patterns and psychological features and caregivers' quality of sleep. Specifically, these influences are assumed considering the chronical condition and the time since the diagnosis.

2.2 Hypothesis

First Hypothesis. As to the first hypothesis, it expected that a lower sleep quality would be registered in the clinical samples. In fact, exploring sleep patterns and psychological characteristics among the three children groups, it is hypothesized that clinical sample may experience worse psychological outcomes and greater sleep disruptions, connected to their chronic conditions. Moreover, connections between psychological difficulties and sleep problems may occur.

Second Hypothesis. Reconnecting with the previous hypothesis, it is supposed that, investigating sleep patterns, the caregivers of the clinical samples may experience a worse sleep quality, liked to their chronically ill children condition. It is expected that worse psychological outcomes (measuring stress) and a poorer general health would be experienced by caregivers of the clinical groups, comparing with the healthy ones. And, also in this case, associations between psychological outcomes and sleep difficulties may be observed.

Third Hypothesis. Reflecting the second aim of the study, associations between children and caregivers' sleep quality are expected. Specifically, the more sleep problems in children, the poorer quality of sleep in caregivers. Moreover, it is hypothesized that the possible connection that may occur in the sleep quality of the caregivers may be influenced by the chronic condition the time passed since the diagnosis of the disease in the ones of the clinical sample.

2.3 Method

2.3.1 Participants

The present study comprehended three different groups (two clinical samples and one control group): the sample of children affected by cancer, the sample of diabetic children, and the control sample, formed by healthy children. For every child in each group was expected the participation of their relative caregivers.

As previously commented, the choice of selecting.

The total number of participants of the present research was of one hundred and fifty children, aged between 7 and 15 years old. As previously mentioned, their relative caregivers were taken into account in the study.

The oncological sample consisted of thirty-three children, with an age ranging from 7 to 14 years old (*M*=11.12, *SD*=±3.15). Pediatrics patients affected by cancer were almost equal in the number of male (N=16) and female (N=17) children. For these participants, the time passed from the diagnosis was considered: it ranged from a minimum of 2 months to a maximum of 66 months (around 5 years) old (*M*=22.32, *SD*=±12.36). The oncological diseases regarded: for a 45.5% of hematologic malignancy, a 39.4% of solid tumor, and a 15.2% of other hematological pathologies.

The samples of children affected by type 1 diabetes mellitus (T1D) was composed of fifty-six patients, aged between 9 and 14 years old (*M*=11.64, *SD*= ±2.46). Participants were mostly male (N=35) compared to female (N=21). As well as the other clinical sample, the time since diagnosis was examined: in this sample, diabetes was diagnosed from an age ranging from a minimum of 6 months to a maximum of 168 months (14 years) old (*M*=67.14, *SD*=±40.59), respecting the moment of the research. From the clinical values regarding the glycemic levels, a good level of diabetic control was registered: in fact, the TIR%, thus the mean percentage of time that the level of glucose was in range, presented normative values (*M*=60.42%, *SD*=± 13.29).

The control sample included sixty-one healthy children, with an age comprehended between 8 and 13 years old (*M*=11.36, *SD*=±2.52). The majority of the participant were male (N=32) comparing to female (N=27). Among the recruited participant who complied with the inclusion and exclusion criteria, a percentage ranging from 91% and 97%

accepted to participate in order to be the control sample of the two clinical samples. The ones who did not agreed to the participation declined for time constraints or were not interested in the study.

2.3.2 Procedures

The present research was approved by Ethics Committee for Clinical Trials (CESC) (Observational study n. 977/CE) and by the Institutional Ethical Committee of Verona, Italy (Prot. n. 29,097). The Ethical and Deontological Codes of Italian Psychologists was respected in the present research.

The data used in the present study comes from different centers of Italy.

The recruitment of diabetic children was conducted in the Regional Center for Pediatric Diabetes, University Hospital of Verona (Italy).

The children affected by cancer were selected at the Pediatric Oncology Units of Taranto (Italy) and Treviso (Italy).

The clinical samples' inclusion criteria regarded firstly the age, that had to range between 7 and 15 years, and also the diagnosis of one of the chronic diseases (cancer or type 1 diabetes mellitus). In addiction to these, a particular specification was made for the oncological sample: the diagnosis of cancer should have been formulated at least two months to fit in the sample. Two months should be spent from the diagnosis because patients for patients that receive the diagnosis of cancer a phase characterized by high stress due to the distressing event may incur (Sawyer, M. et al., 2000).

In addition to the age range, the exclusion criteria regarded the absence of any psychopathology (psychiatric or emotional disorders). Another exclusion criterion was represented by the unknown of the Italian language: in fact, non-Italian speaking were excluded from the study.

For the recruitment of the clinical samples, the ward's doctors proposed the participation to the study. The selection of the pediatrics followed the inclusion and inclusion criteria. All the ones selected according to the criteria and interested in the present research were asked to take part in the study. The caregivers of the ones who agreed to the collaboration were requested to sign an informed consent. Participant with an age less than 12 were asked to get involved verbally, in order to have their personal agreement; meanwhile,

youths with an age comprehended between 12 and 15 were requested to participate signing an informant consent that was specifically created for their age, to align with the requests of the Ethics Committees.

The data that regarded the medical values and information of the oncological and diabetic pediatrics were registered in the ordinary visits to the reference hospital. These registrations took place between November 2020 and May 2021. The administration of the questionnaires was a little differenced for the three samples due to their specific characteristics. Oncological patients and their relative caregivers completed the various questionnaires online (thanks to a link sent by e-mail). The diabetic sample, along with their caregivers, administered the questionnaires under the direction of the ward's psychotherapist. The collection of information took place before or after a routine medical visit.

The duration of the sessions of administration was about of 30 minutes.

In order to respect every medical necessity, the methods of the present study were delineated to preserve and not impact medical treatments of the pediatric patient.

Moreover, the study respected the safety guidelines for the Covid-19 pandemic.

The control sample was enrolled through the snowball paradigm of sampling. The caregivers of the healthy children were met and have become aware of the study. The ones who agreed to the participation of the research, were asked to sign the informant consent. The data were registered during the same period of time of clinical samples. Also, the administration procedure was analogue to the clinical group. As well as procedure, also the survey and the questionnaires were the same of the clinical groups: the only variations regarded the absence of registrations of medical values and of the items regarding the chronic illnesses (e.g. "time passed since diagnosis").

The control sample conformed to the ethical guidelines for the conduction of the study (comprehending also the administration and the recruitment's criteria).

The enrollment did not comprehend the offering of a reward.

2.3.3 Measures and psychological tools

Participants were asked to complete an online survey, customized in the version for parents and one other for children.

2.3.3.1 Children's versions of questionnaires

The Sleep Disturbances Scale for Children (SDSC; Bruni et al., 1996) is the tool used to assess the quality of sleep in children: it is composed by 26 items administered to children's parents and organized in six different factors in order to comprehend all the most common sleep areas to considerate in order to evaluate it. The latter-mentioned factors calculated by the SDSC are represented by: Disorders of initiating and maintaining sleep (DIMS; "The child has difficulty getting to sleep at night"), Sleep breathing disorders (SBD; "The child has difficulty in breathing during the night"), Disorders of arousal nightmares (DA "The child has nightmares which he/she doesn't remember the next day"), Sleep-wake transition disorders (SWTD "The child shows repetitive actions such as rocking or head banging while falling asleep"), Disorders of excessive somnolence (DOES; "The child is unusually difficult to wake up in the morning"), and Sleep hyperhidrosis (SHY; "The child sweats"). The 26 items of the present questionnaire offer a total score that ranges between 26 to 130 and is obtained summing the pointing of each item: eventual sleep disturbances may occur when the scoring is higher than 39. Items 1 ("How many hours of sleep does your child get on most nights") and 2 ("How long after going to bed does your child usually fall asleep") request to choose numbers of hours/minutes, while items 3 to 26 require to respond using a 5-point Likert-type scale (1="never", 2="occasionally [once or twice per month or less]", 3="sometimes [once or twice per week]", 4="often [3 or 5 times per week]", 5="always [daily]"). This easy-to-fill questionnaire can be administered to children and youths with an age comprehended between 6 and 15 years old: in fact, the validation of the Italian version comprehended children with an age ranging between 6.5 and 15.3 years. The property of the Italian SDSC regard a good validity and a good reliability. The total score presented a Cronbach alpha off .82 and for its subscales was respectively: .72 for DIMS, .30 for SBD, .47 for DA, .48 for SWTD, .62 for DOES, and .73 for SHY. This form is adequate to evaluate sleep-related disorders in children and adolescents.

The Strengths and Difficulties Questionnaire – children's version (SDQ; Goodman, 2001; Italian version: Di Riso et al., 2010) is a psychological tool aimed at assessing the psychological adjustment of children and adolescents. It is a self-report questionnaire organized in a five factors structure, also intended as subscales. Each subscale includes 5 items: Emotional Symptoms (EMO), Conduct Problem (COND), Hyperactivity-Inattention (HYPER), Peer Problems (PEER) and Prosocial Behavior (PROS). The first mentioned scales generate a difficulties scale: in fact, a Total Difficulties Scores can be measured by summing the items of the subscales that compose the difficulties scale. The last scale (PROS) consists in the prosocial behaviors, and for this, considered adaptive. This instrument is composed of a total of 25 items, each measured on a 3-point Likert scale (0="not true", 1="somewhat true", 2="certainly true"): scores from 0-2 are assigned to negatively-worded items, while 2-0 to positively-worded items. This list of 25 attributes describes both strengths and difficulties that may occur in children and adolescents. The SDQ was translated in Italian and, furthermore, it is also validated for a larger range of age, comprehending children aged from 8 to 10 years old (Di Riso et al., 2010).

2.3.3.2 Caregivers' versions of questionnaire

Initially, all caregivers filled out a sociodemographic survey, which comprehended questions about them and also regarding their children. Some of the items obviously regarded age and occupation of caregivers.

In addition to this, caregivers of clinical samples were asked also to complete items about clinical information: for examples, questions regarded the typology of chronic disease, the time passed since the diagnosis of cancer/diabetes, the type of cancer.

The other questionnaires assessed both psychological correlates (parenting stress, general health, anxiety) and sleep quality or difficulties.

The Parenting Stress Index-Short Form (PSI-SF; Abidin, R., 2012; Guarino, A., et al., 2016) was choose to assess parenting stress. This instrument is a brief version that is particularly adapt to evaluate the construct of "parental stress", that is the stress that may occur in the interaction parent-child. It comprehends 36 items, organized in three subscales: Parental distress (which refers to how parents judge themselves as caregivers; "I often have the feeling that I cannot handle things very well"), Parent-child dysfunctional interaction (this scale makes reference to the degree to which caregivers are satisfied with their interactions between them and their children; "My child rarely does things for me that makes me feel good"), and Difficult child (that indicates behavioral difficulties of the child and the difficulties of the caregivers in coping with these; "My child seems to cry or fuss more often than most children"). The last-mentioned scale, showing the behavioral difficulties in children and the consequent parents' difficulties in managing them, suggests that higher scores in this subscale may display the necessity to require an intervention to implement parenting skill and in order to support the parenthood. Every item is rated on a 5-point Likert scale (from 1="strongly agree" to 5="strongly disagree"). Scorings are evaluated for each subscale (whose Cronbach alpha is 0.85 for the Parental distress, 0.84 for the Parent-child dysfunctional interaction, and 0.85 for the Difficult child) and for a total score (whose Cronbach alpha is .91). Higher values represent greater levels of parenting stress and the total score generated stand for the general level of stress experienced in the role of being a caregiver.

The Pittsburgh Sleep Quality Index (PSQI; Curcio, G. et al., 2013) has been administered to indagate the quality of sleep of caregivers during the past month in the present research. In fact, this instrument assesses the quality of sleep or its disruptions. The PSQI is a self-report composed by 18 items, divided into 7 subscales: subjective sleep quality (indicating the own perception of sleep quality; "During the past month, how would you rate your sleep quality overall?"), sleep latency (that is the amount of time spent in sleep initiating; "During the past month, how long [in minutes] has it usually taken you to fall asleep each night?"), sleep duration (thus, the quantity of time spent sleeping; "During the past month, how many hours of actual sleep did you get at night? [This may be different than the number of hours you spent in bed]"), habitual sleep efficiency (that can be obtained by making the ratio of time of sleep duration to the time spent in bed; "During the past month, what time have you usually gone to bed at night?"), sleep disturbances (that may indicate the presence of sleep disturbances' symptoms; "During the past month, how often have you had or trouble sleeping because you… Wake up in the middle of the night or early morning"), use of sleeping medication (that show the necessity or not of make use of medicines to fall asleep; "During the past month, how often have you taken medicine to help you sleep [prescribed or "over the counter"]?"), and daytime dysfunction (that stand for the potential difficulties in conducting daily functions correlated to a scarce sleep quality; ". During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?"). Moreover, there are five additional items which regard the report of a roommate and are not counted in total score and have only clinical aims ("If you have a roommate or bed partner, ask him/her how often in the past month you have had: Loud snoring"). The items are a combination of 3-point Likert scale and open answers. The total score is comprehended between 0 and 21, where a lower scoring indicates a better sleep quality and, consequently, a higher score represent poorer quality of sleep. The presence of sleep disruptions is revealed by a cut-off major than 5. The Cronbach's alpha is .70.

The General Health Questionnaire-12 (GHQ-12; Goldberg, D. P. et al., 1997) is a psychological tool created to assess the general health and functioning of individuals. Moreover, this instrument reveals the global well-being and also the severity of possible mental problems. The GHQ is a self-report composed by 12 items ("Have you recently: been able to concentrate on whatever you're doing?") rated on a 4-point Linkert scale

(from 0 to 3). The total score is comprehended between 0 and 36, where higher scorings indicate a worse general health: particularly the cut-offs are 0-14 indicating a normal score, 15-19 standing for difficulties in global functioning and 20-36 showing a clinical level which may need a possible intervention. There are positive items that must be taken into account considering from 0 (always) to 3 (never) and negative items assuming from 3 (always) to 0 (never).

The State-Trait Anxiety Inventory-Y (STAI-Y; Spielberg, C. D., 2012) is a psychological instrument used to measure anxiety of state (considered as an emotional non-lasting state) and of trait (deemed as a lasting state, a stable modality of answering to different situations). Furthermore, this scale is also use to give a measure to caregiver distress (Greene, J. et al., 2017; Ugalde, A. et al., 2014). This self-report is composed of 40 items which can provide a distinct evaluation of state and trait anxiety, each composed by 20 items. The participant of the present study administered only Trait scale (STAI-Y2) of the Italian version of the STAI-Y has been utilized to properly evaluate the trait anxiety. So, in the present scale, it is assessed if the individual has the perception of feeling some situations as stressful events. In the STAI-Y2 the subjects have to indicate the habitual emotions in correspondence to stressful factors or situations ("I worry too much over something that really doesn't matter"). Every item is rated on a 4-point scale (from 1= "Almost never" to 4= "Almost always"): so, the higher the scores, the greater the anxiety of trait. The cut offs of the STAI-Y2 range from the normality 20-52, to the clinic 53-80. The Cronbach's alpha is .96.

CHAPTER 3: RESULTS

3.1 First Hypothesis: Sleep and psychological characteristics of the three children's samples

Primarily, the data were observed and described through a descriptive analysis: there, values as means and standard deviations of the children's variables were collected.

The three groups do not differ in age and gender distribution ($\chi 2=2.111$, $p=.348$).

The two clinical groups were compared also in the survey variable "Time since diagnosis", showing a strong difference ($t85=-5.983$, $p < .001$, Cohen's $d=-1.329$) since the diagnosis of the oncological groups have been formulated earlier than the detection of diabetes in the other group of patients affected by T1D.

Children		**Cancer N=33**	**Diabetes N=56**	**Control N=61**	***F***	***p***	***ES***
		Mean (SD)	**Mean (SD)**	**Mean (SD)**			
Age		11.13 (3.15)	11.64 (2.46)	11.36 (2.52)	0.376	0.688	<0.001
Gender	**Male**	17	35	32			
	Female	16	21	27			
Time from the diagnosis (in months)		22.32 (12.36)	67.14 (40.59)	-			
Hb1Ac (%)	-	-	7.28 (0.75)				

Table2. Socio-demographics information of the children for each group.

Significant differences between the three samples were found in the total score of SDSC: a lower sleep quality has been observed in the oncological patients' group by comparing with the diabetic patients and the control group. Particularly, the 67,7% of participants affected by cancer displays higher scores above the limit, while the other two samples show very similar values (41.1% for the diabetics, 41% for the controls): therefore, these proportions are not equal among groups.

Children	Cancer N=33	Diabetes N=56	Control N=61	F	p	ES	Control Vs Cancer	Control vs Diabetes	Cancer vs Diabetes
	Mean (SD)	Mean (SD)	Mean (SD)				p (ES)	p (ES)	p (ES)
SDSC									
DIMS	11.69 (4.84)*	11.79 (3.52	11.92 (2.86)	4.850	0.011	0.083	0.013 (-0.768)	0.973 (0.037)	0.012 (0.805)
SBD	4.16 (1.17)*	3.86 (1.02)	3.79 (1.05)	1.141	0.325	0.004			
DA	4.09 (1.30)*	3.64 (1.03)	3.51 (0.81)	2.683	0.075	0.033			
SWTD	11.00 (3.19)*	9.09 (2.62)	8.26 (2.14)	4.488	0.014	0.067	0.022 (-0.675)	0.920 (0.067)	0.016 (0.742)
DOES	8.63 (2.70)*	8.39 (2.72)	7.85 (2.22)	1.255	0.291	0.003			
SHY	3.47 (1.87)*	3.32 (1.42)	2.84 (1.19)	2.774	0.069	0.021			
SDSC Total Score	46.03 (11.23)*	40.10 (8.61)	39.16 (5.96)	5.170	0.008	0.082	0.007 (-0.825)	0.781 (0.111)	0.033 (0.714)
SDQ									
EMO	2.23 (2.44)	2.00 (2.19)	3.14 (2.28)	3.973	0.023	0.039	0.963 (0.062)	0.022 (0.500)	0.158 (0.439)
COND	2.23 (1.36)	2.02 (1.68)	2.53 (1.64)	1.311	0.275	0.006			
HYP	3.00 (2.37)	3.35 (1.86)	3.70 (2.18)	0.992	0.376	0.002			
PEER	1.68 (1.72)	1.52 (1.68)	1.90 (1.83)	0.634	0.533	<.001			
PROS	7.87 (1.82)	7.82 (2.21)	7.23 (1.92)	1.647	0.199	0.008			
SDQ Total Score	10.03 (5.89)	8.89 (5.29)	11.26 (5.86)	2.494	0.089	0.020			

Table3. The statistics of the ANOVAs. The analysis of the SDSC and SDQ. ***Note****. ES: effect size. *: N=32 for the SDSC of the oncological sample; N=31 for the SDQ of oncological sample, N=57 for control sample, N=54 for diabetic sample.*

Two specific subscales of the SDSC demonstrated significant group differences, and are: the "Disorders of Initiating and Maintaining Sleep" scale and the "Sleep-Wake Transition

Disorders" scale. The first scale demonstrated that higher values characterized oncological children, regarding diabetic and healthy peers. In the second scale, in the oncological children higher rates were found comparing them with the ones affected by cancer and the healthy children, but no differences were revealed between diabetic and control participants.

Investigating each SDSC items, the first one "How many hours of sleep does your child get on most nights" has been deepened through the Kruskal-Wallis test. The choice of this test is due to the ordinality of the variable (which could be answered by 5 options: 9-11, 8-9, 7-8, 5-7, less than 5 hours): therefore, placed the group as the only factor, the results obtained headed for a significant group effect ($\chi 2$=6.696, p=.035, ε^2=0.045); precisely, oncological patients presented a minor number of sleeping hours comparing with the controls (pDSCF=0.047).

Examining the SDQ subscales, a significant difference among the samples was recorded in the Emotional subscale, revealing lower emotional symptoms in the diabetic children compared with the ones of the control group.

A mild association between the SDQ total score and SDSC total score was found: with the increasing of the values of SDQ's psychological adaptation was observed the decreasing of the values of sleep problems (and so an increasing of sleep quality) in the whole sample (r=.258, p=.002). This association appears moderate and significant in the oncological (r=0.428, p=.001) and in the diabetic (r=0.399, p=.029) samples, but differently in the control sample (r=0.034, p=.803).

Exploring the medical values relating with the two psychological measures of adjustment and sleep, no significant correlations were found between the Hb1Ac levels and both SDSC and SDQ total scores (r=.-052, p=.704; r=0.067, p=.632).

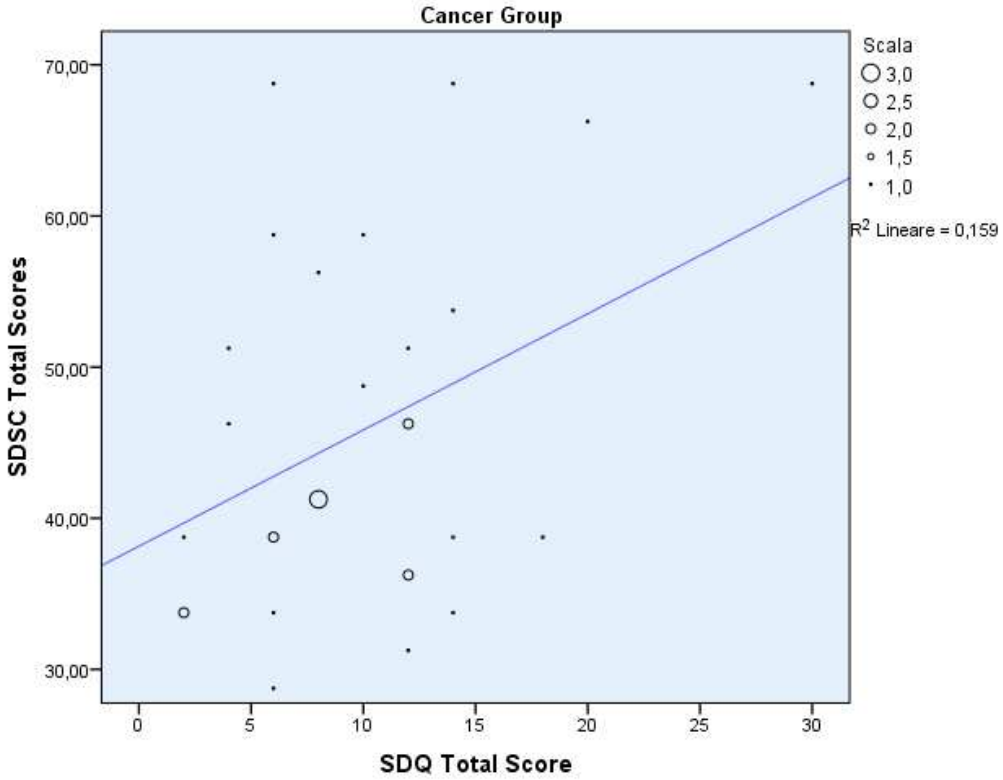


Figure2. Relationship between children's psychological adjustment (SDQ Total Score) and their sleep disturbances (SDSC Total Score) in the cancer group.

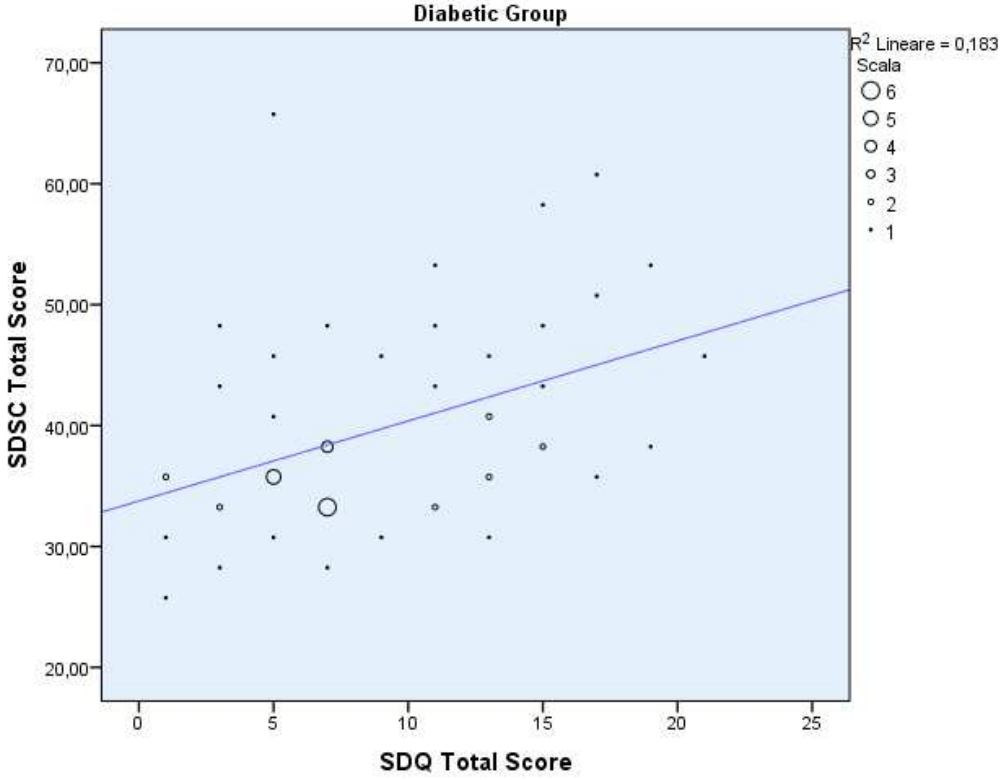


Figure3. Relationship between children's psychological adjustment (SDQ Total Score) and their sleep disturbances (SDSC Total Score) in the diabetic group.

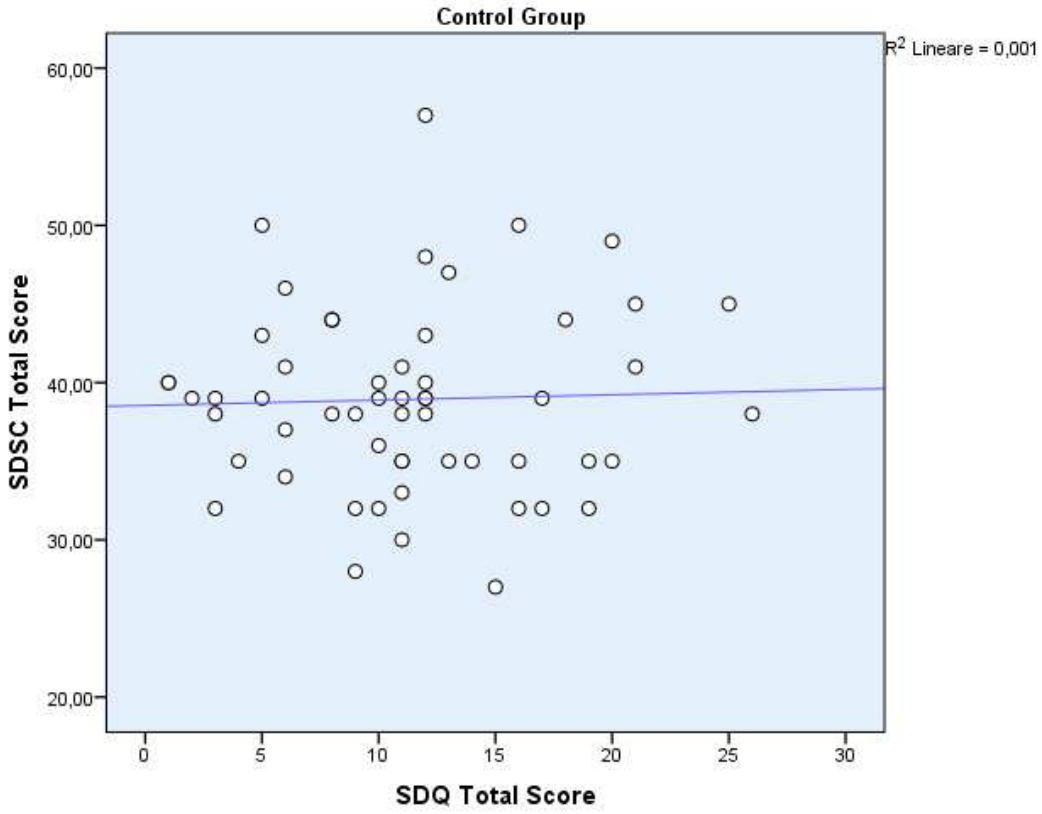


Figure4. Relationship between children's psychological adjustment (SDQ Total Score) and their sleep disturbances (SDSC Total Score) in the control group.

3.2 Second Hypothesis: Sleep and psychological characteristics of the caregivers

A descriptive data analysis was conducted also for the three samples of caregivers. No differences were reported in gender, since all the caregivers were female. On the other hand, a significant group difference was presented in age (F2,147=3.391, p=.036, h2 p =.044): specifically, the mothers of the oncological group were significantly younger than the mother of the control sample (pholm=.031, Cohen's d=-0.561).

Caregivers	**Cancer N=33**	**Diabetes N=56**	**Control N=61**	***F***	***p***	***ES***
	Mean (SD)	**Mean (SD)**	**Mean (SD)**			
Age	41.76 (6.21)	44.05 (5.74)	44.97 (5.43)	3.095	0.051	0.031
Occupation						
Full-time worker	7 (21.9%)	27 (38.9%)	24 (39.4%)			
Part-time worker	8 (25%)	13 (23.2%)	26 (42.6%)			
House-wife/Unemployed	17 (43.1%)	16 (28.6%)	11 (18%)			

Table 4. Socio-demographics information of the caregivers for each group.

Lower values of sleep quality were observed in the caregivers' oncological sample, showing a significant difference comparing with the control sample, but not significative respecting the T1D ($\chi 2$=5.050, p=.080).

Taking into account the PSQI and especially the scores higher than 5, assessing the poor sleep quality of the three samples' caregivers, no significant difference was found in the three groups: however, the 62.5% of the caregivers of the oncological group, 53.6% for the T1D and 39.3% for the controls.

Other sleep characteristics collected regarded the amount of time spent sleeping: the results indicated that the two clinical samples slept a minor number of hours comparing to the controls; in addition to this, caregivers of children affected by cancer take longer to fall asleep respecting to the other clinical sample and the controls, but not in a significative way for the last group.

Among groups, no differences were identified in the variables parenting stress or general health; besides this, higher level of stress were registered in the parents of clinical participants than in controls.

Examining the two questionnaire PSQI and STAI-Y2, major levels of anxiety were found associated with a worst quality of sleep in the whole sample ($r=0.479$, $p < .001$). This same association appears to be significant for the caregivers' T1D group ($r=0.498$, $p<.001$) and in the controls ($r=0.414$, $p=.001$), but just in the trend of the group of the caregivers of the oncological children ($r=0.347$, $p=.052$).

Maintaining the focus on the STAI-Y2 and deepening its relations with the PSI-SF total score, it was collected that there was a strong association between the two questionnaires in the whole group ($r=0.588$, $p < .001$), but also in all the three samples: in the control group ($r=0.551$, $p < .001$), in the clinical oncological group ($r=0.575$, $p < .001$) and in the clinical group of the diabetics ($r=0.737$, $p < .001$).

Children	Cancer N=33	Diabetes N=56	Control N=61	*F*	*p*	*ES*	Control Vs Cancer	Control vs Diabetes	Cancer vs Diabetes
	Mean (SD)	Mean (SD)	Mean (SD)				p (ES)	p (ES)	p (ES)
PSQI									
Bedtime (hh:mm)	23:11 (00:59)*	22:54 (01:16)	22:36 (00:45)	5.376	0.007	0.045	0.012 (-0.608)	0.088 (-0.401)	0.664 (0.207)
Rise time (hh:mm)	06:34 (00:41)*	06:38 (01:10)	06:32 (00:36)	0.034	0.967	<.001			
Sleep Duration (h)	6.11 (0.98)*	6.46 (1.10)	7.01 (1.12)	8.627	<.001	0.090	<0.001 (0.852)	0.025 (0.500)	0.222 (-0.352)
Sleep Onset Latency (min)	27.08 (23.30)*	15.89 (13.98)	16.53 (15.02)	3.172	0.048	0.055	0.063 (-0.628)	0.965 (0.041)	0.044 (0.669)
PSQI Total Score	8.28 (4.28)*	6.39 (3.28)	5.21 (2.70)	7.440	0.001	0.100	0.001 (-0.940)	0.132 (-0.330)	0.059 (0.610)
PSI-SF									
Parent Distress	29.82 (8.21)	26.91 (8.21)	26.91 (7.20)	1.606	0.207	0.010			
Parent-Child Dysfunctional Interaction	22.67 (7.29)	22.63 (7.80)	22.55 (7.04)	0.03	0.997	<.001			
Difficult Child	27.53 (8.06)*	28.55 (8.56)	27.72 (6.19)	0.220	0.803	<.001			
PSI-SF Total Score	79.94 (19.30)*	78.09 (21.24)	77.26 (17.22)	0.215	0.807	<.001			
STAI-Y2	47.76 (11.26)	41.73 (7.89)	38.80 (9.47)	7.528	0.001	0.105	<0.001 (-1.070)	0.006 (-0.525)	0.114 (0.545)
GHQ	18.36 (4.89)	16.80 (4.15)	16.25 (4.75)	2.057	0.134	0.017			

Table 5. The statistics of the ANOVAs. The analysis of the following questionnaires: PSQI, PSI-SF, STAI-Y2, GHQ.

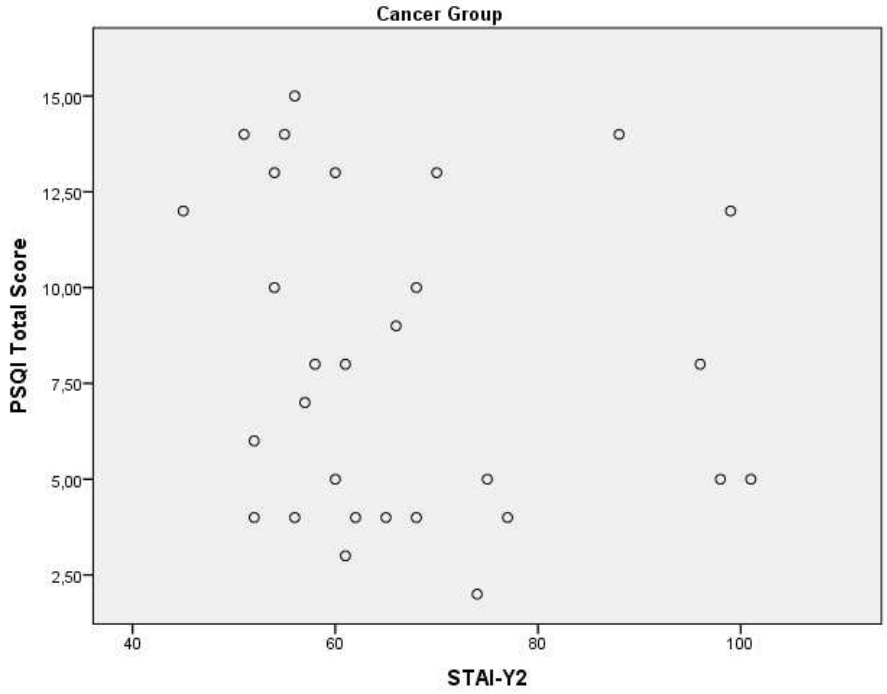


Figure5. Relationship between caregivers' anxiety level (STAI-Y2) and their sleep quality (PSQI Total Score) in the cancer group.

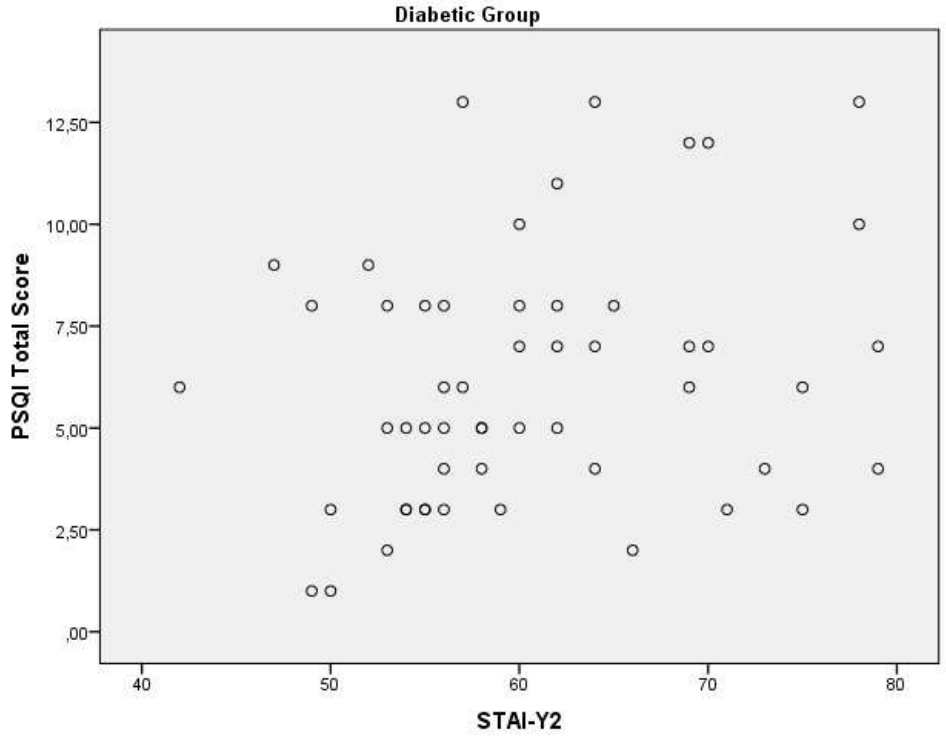


Figure6. Relationship between caregivers' anxiety level (STAI-Y2) and their sleep quality (PSQI Total Score) in the diabetic group.

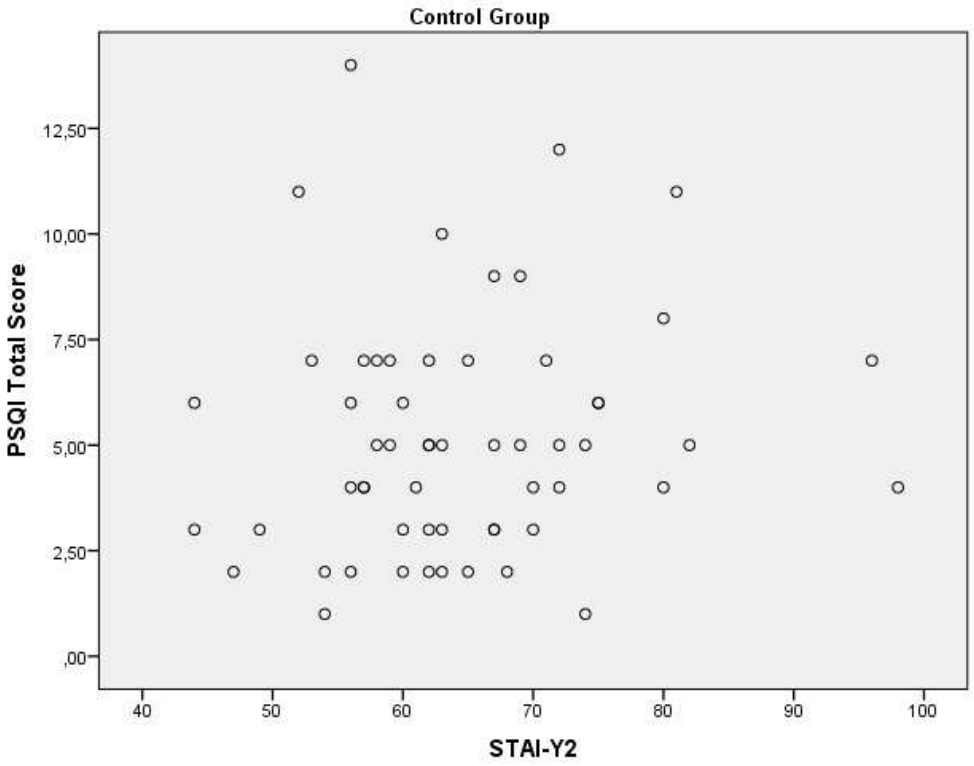


Figure7. Relationship between caregivers' anxiety level (STAI-Y2) and their sleep quality (PSQI Total Score) in the control group.

3.3 Third Hypothesis: Possible relations between sleep in children and their caregivers

Moderated association were found between children and caregiver's sleep in the whole samples, using for the first mentioned the total score of SDSC, and for the second ones the total score of PSQI ($r=0.401$, $p < .001$). The poorer quality of sleep in children, the poorer quality of sleep in their relative caregivers. Taking into account the single three group, different observations were detected: in the diabetic sample significative strong associations were found ($r=0.592$, $p < .001$). Besides this, the other two group, the oncologic one ($r=0.207$, $p=.255$) and control one ($r=0.142$, $p=.276$), did not show significant associations, considering the samples separately. Sleep duration of both caregivers and children among the three samples were investigated, respectively measured through the PSQI and the SDSC (precisely, by its first item). A mild positive association was found between the caregivers and their respective children' sleep duration ($r_{spearman} =.174$, $p=.034$). Separating the three groups, only the control group showed a significant moderated association ($r_{spearman} =.410$, $p=.001$). In this case, no significant associations were found in the two clinical groups, neither the sample of cancer ($r_{spearman} =-0.040$, $p=.829$) nor the sample of diabetes ($r_{spearman}=-0.101$, $p=.461$).

3.4 Third Hypothesis: The regression analysis

Three linear were conducted in order to. The control group showed associations in a significant way between the caregivers' sleep quality and their respective level of anxiety. In the oncological sample the sleep quality of caregiver was significantly associated with anxiety levels, but also with the construct "Time passed from the first diagnosis of their children". In the diabetic group, the quality of sleep of the caregivers was significantly associated with both anxiety levels and the quality of sleep of their children.

	Cancer			**Diabetes**			**Controls**		
	b(95%CI)	std. β	*p*	b(95%CI)	std. β	*p*	b(95%CI)	std. β	*p*
Intercept	1.102 (-8.99, 11.97)	0	0.823	-8.07 (-16.97,0.83)	0	0.075	-3.12 (-9.48, 3.24)	0	0.330
Age	-0.01 (-0.47, 0.47)	-0.01	0.994	-0.088 (-0.44, 0.25)	-0.07	0.602	0.15 (-0.02, 0.42)	0.14	0.258
SDSC	0.08 (-0.04, 0.21)	0.22	0.191	0.205 (0.087, 90.32)	0.53	0.001	0.01 (-0.11, 0.13)	0.02	0.895
SDQ	-0.23 (-0.47, 0.02)	-0.34	0.072	-0.062 (-0.22, 0.10)	-0.10	0.430	0.10 (-0.02, 0.21)	0.21	0.088
STAI-Y2	0.16 (0.04, 0.29)	0.44	0.011	0.11 (0.01, 0.21)	0.28	0.043	0.13 (0.06, 0.20)	0.45	<0.001
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(5, 21)= 4.455 *p*=.006			F(6, 47)= 4.814 *p*<.001			F(4, 52)= 4.523 *p*=.003		
Adj. R2	0.399			0.302			0.201		

Table 6. The three linear regressions.

CHAPTER 4: DISCUSSION

4.1 Data Discussion

In order to generate this analyzation, first of all sleep patterns and psychological characteristics of the two clinical samples of children were confronted with the healthy peers' sample, as in line with the first formulated aim. The children that experienced more sleep disruptions were the ones belonging to the oncological samples; their difficulties comprehended various sphere of sleep and regarded: more disturbed sleep, featured by greater difficulties in initiating and maintaining sleep (so, the sleep onset and the sustainment of sleep all night-lasting), a lower sleep duration (a minor number of hours spent sleeping), and a larger number of parasomnias (as previously mentioned, more episodes of sleepwalking, nightmares, bruxism, sleep talking). The SDSC, submitted by all the three groups of children, indicated a pointing of 39 as a significant value to considerate in order to a clinical account. Most of oncological children (67%) were included in the possibly clinical range: in fact, the group of children affected by cancer showed scores higher than 39. These results may indicate that this clinical sample may easier develop disorders linked to sleep compared with control and diabetic samples. Scores ranging below 39 were detected in 41% of patients affected by diabetes but also in the 41% of healthy peers, showing that potential sleep disruptions may occur in this population too. The fact that only the oncological group of children demonstrated the presence of important sleep difficulties makes these results only in part adhering to the studies in literature. Indeed, researches show that sleep problems occur with more probability in children affected by cancer and affected by diabetes (Rosen, G., Brand, S. R., 2011; Hysing, M. et al., 2009), comparing with healthy population.

These types of findings can be linked to the samples selected for the present study. One of the characteristics regarded the time of diagnosis: particularly, the amount of time elapsed between diagnosis and the current study was less in the oncological samples compared to the diabetic one. The literature reports a phenomenon of important stress, which may take place after receiving the diagnosis of an illness: this amount of distress may affect different areas of human functioning, from which sleep (Sawyer, M. et al., 2000). The moment of the diagnosis is such stressful that not only is described as the one of the most difficult stage in the all the course of the disease, especially for cancers (Marky, I., 1982; Magni, G. et al., 1983; Schuler, D. et al., 1985; Greenberg, H. S., Kazak,

A. E., Meadows, A. T., 1989), but also it has been demonstrated that after 6 months since the diagnosis the level of emotional distress in caregivers were still high (Sawyer, M. G. et al., 1993).

Although type 1 diabetes mellitus may be diagnosed at all ages through life, it is also known as "juvenile diabetes" (Ilter Bahadur, E., et al., 2021), pointing out that is often identifiable and diagnosed at early ages. Specifically, there are two peaks (Mayo Clinic): one between the ages of 4 and 7 years old, and one other occurs between 10 and 14 years of age. The present study comprehended a 38.6% of diabetic children, who received their diagnosis at an age of 4 year or even previously. Exactly because 22 out of 57 diabetic children was diagnosed affected by type 1 diabetes mellitus in infancy, a sufficient period of time may have elapsed for the recovery of adequate sleep patterns, the settle of new sleep habits and routines, and the resetting of a healthy sleep hygiene. In oncological populations the amount of stress, and more in general, psychological correlates, after receiving their diagnosis appear to be significant, but seem to improve through time (Sawyer, M. et al., 2000). So firstly, the more time pass, the more probability to adapt, get used and learn to deal with the chronic condition: children affected by cancer received their diagnosis more recently, comparing with most of the diabetic patients, and this may explain the presence of more sleep problems. In addiction to this, a diagnosis of cancer may create a more stressful situation to be experienced, being oncological illnesses a life-threatening condition (Lähteenmäki, P. M. et al., 1992). Comparing cancer and diabetes, it is clear that the first one brings with it a series of preoccupations also linked to the possibility or the uncertainty to survive or to heal (in addiction to all the invasive treatments and the several side effects), while the second has a clearer direction and medical perspective in its management, although it is a chronic illness. Furthermore, the medical values collected in the clinical diabetic sample showed that these children reported a good level of glycemic control: in fact, the glucose's time in range (TIR%) variable demonstrated to have normative values. In this sense, a good level of glycemic control may be considered a good protective factor against sleep problems ().

These results show how a disease-driven approach to sleep disturbances and problems would represent an essential contribute to the well-being of clinical populations.

Furthermore, oncological children may experiment or long periods living in hospital. Prescinding from the time, sleeping as hospitalized pediatrics could lead in an artificial situation in which the room is not the original room of the child, hospital is not his home, the posture in the bed may not be as comfortable due to medical equipment and devices. Moreover, the environment of hospital often does not offer a personal space: oncological children may also sleep in sharing rooms, and consequently, they would not have privacy for an adequate sleep onset and a good sleep hygiene (Daniel, L. C. et al., 2016; Lewandowski, A. S. et al., 2011; Rosen, G. and Brand, S. R., 2011; Sheikh, I. N. et al., 2021). Others disruptions may be represented by treatments during night or early morning routine visits. Also the continuative exposure to medical environment (characterized by noise of medical devices, emergency) may not help to re-create a comfortable place to the establish new sleep routines. All this, in addiction to stressful and exhausting medical conditions, may lead to a first loss of routine in sleep onset and habits, up to the establishment of a poor sleep hygiene and following sleep disruptions.

Another explanation may be given by the experience of pain (Kaleyias, J. et al., 2012; Oeffinger, K. C. et al., 2006). Pain is very common to detect in oncological patients. This condition is more currently experienced in oncological patients and it is strictly connected to sleep and its problems (Kaleyias, J. et al., 2012; Oeffinger, K. C. et al., 2006): in fact, pain may negatively influence sleep quality in children (Kaleyias, J. et al., 2012; Oeffinger, K. C. et al., 2006).

Regarding SDQ's results, the present study did not point out a so well-defined difference between groups, analyzing emotional symptoms and behavioral ones. The hypothesis regarded the possibility of worse psychological outcomes in children affected by chronic diseases.

A significant association was revealed between SDQ's scores and sleep problems in the clinical groups, but not in the control one. In particular, the lower psychological adjustment, the lower sleep quality. In other words, higher levels of SDSC total score (reflecting sleep disruptions) were mildly associated with higher scores of SDQ total score (showing worse psychological and behavioral features). This association was significant in the oncological and in the diabetic sample.

The lack of differences that was expected among the three groups may be explained by remembering that SDQ is a psychological tool, which aims to detect the presence emotional and behavioral difficulties (but also strength points). In this case, from all the selected participants of the three groups were excluded participants with the possibility of having severe psychological difficulties. In fact, one of the exclusion criteria regarded the absence of psychiatric or emotional disorders.

Moreover, the two clinical samples were followed at a psychological level: both oncological and diabetic samples of children were part of a psychological equip. the last-mentioned had the role of sustain the psychological fragilities (such as emotional and behaviors difficulties) in clinical patients. It is evident that this kind of support may sustained chronically ill children's psychological part and promoted their well-being in this area.

Passing to the results concerning caregivers, the data detected through PSQI seem to be in line with the findings of the children samples: in fact, the group of caregivers of the children affected by cancer reported a worse sleep quality and a longer time required to fall asleep ("sleep onset latency") comparing to the two other groups.

Both groups of caregivers of the clinical samples were resulted have a shorter sleep duration: thus, they sleep less comparing with the healthy participants.

These results are not completely in line with the literature, which shows that disruptions in sleep may affect both caregivers of oncological children and diabetic ones (Matthews, E. E., et al., 2014; Landau, Z., et al., 2014) comparing with those of children in health. Parents exposed more recently (thus, for less time) to the stressful experience of the diagnosis of cancer, may still be characterized by great worries (Lähteenmäki, P. M. et al., 1992). As previously discussed, literature present high values of emotional distress in caregivers with children that received the diagnosis of cancer 6 months later (Sawyer, M. G. et al., 1993). In addition to the possibly controls made by parents during the night, several hospitalizations may take place, creating not only a further state of stress (both staying in hospital and spending the night at home), but also breaking a possible recovery of sleep onset's habits and routines (Ljungman, G., et al., 2003).

So, supporting this, in addition to the moment of stress of the diagnosis, the periods of treatments of oncological situations are characterized by great hardship, because of the uncertainty of procedures' efficacy (Lähteenmäki, P. M. et al., 1992) being cancer a potentially deadly condition. This condition may affect life quality (Sawyer, M. G. et al., 1993), and negative psychological outcomes may occur not only in children, but also in parents (Sawyer, M. et al., 2000). Furthermore, parents experience also a series of changings in lifestyle, to which they must adapt (Ljungman, G., et al., 2003). In addition to the caregiving's responsibility, these parents may take charge of medical cures and treatments, becoming "medical caregivers" as well (Meltzer, L. J. and Moore, M., 2008).

The shorter sleep duration of both oncological and diabetic samples of caregivers comparing with the healthy ones is aligned with literature studies (Meltzer, L. J. and Moore, M., 2008). As reported in literature, sleep difficulties in caregivers of chronically ill children mostly regard the scarce sleep quality and a shorter sleep quantity (thus, a shorter duration of total sleep; Meltzer, L. J. and Moore, M., 2008). Caregivers that provide for medical issues for their children, may also experience nighttime caregiving: from this, it is clear that caregivers, providing night-time assistance to their children, may not conduct a typical sleep (Meltzer, L. J. and Moore, M., 2008). Furthermore, these caregivers' nocturnal moments spent assisting their chronic children, are obviously not dedicated to sleep. This, in addition to create an unhealthy sleep hygiene and, consequently, to not contribute to a general adequate sleep quality, does not bring numbers of hours for an appropriate sleep duration. Not only medical cares or assistance, but also worries about their children's chronicity (Meltzer, L. J. and Moore, M., 2008). Caregivers sleep discomforts are also connected with children's nighttime awaking (Meltzer, L. J. and Moore, M., 2008).

Through the use of the psychological questionnaires, levels of anxiety were detected among the three caregivers' groups. Caregivers of oncological children were resulted being experiencing more symptoms concerning anxiety. This result is aligned with Boman and colleagues' study (2004), that revealed greater levels of anxiety in caregivers of oncological children, regarding parents of diabetic children. Another time, what makes this underlined is the uncertainty of surviving and the lack of a specific trajectory to follow in the treatment and the possible evolutions of the oncological symptoms (Sawyer, M. G. et al., 1993).

They showed also lower general health comparing with the two other groups, but not in a statistically significant way. No differences were found in parental stress among all the three groups of caregivers. These results are not supported by literature. Since chronic conditions are stressful and frightening by definition (Sawyer, M. G. et al., 1993), it was expected a significant worse psychological health in terms of parenting stress in caregivers of children affected by cancer or diabetes. In fact, the literature supports evidences that show that great levels of parenting stress () and scarce health in caregivers of chronically ill children (), in addition to anxiety () and depression (). Although literature reports that these caregivers demonstrate these negative psychological outcomes, most of parents of children that are actually affected by a chronic disease were well-adapted and functioning in the past (Kazak, A. E., 2001; Meltzer, L. J. and Moore, M., 2008). It is also known that high levels of negative psychological outcomes (just as stress, scarce general health, and bad mood) may be channeled and expressed through sleep difficulties (Meltzer, L. J. and Moore, M., 2008). So, since the clinical caregivers demonstrated suffering of sleep difficulties a various and different levels, in the present research parenting stress in caregivers may have been expressed through sleep disruptions. While parenting stress in healthy caregivers may be linked to typical tasks of parental functions.

The other main aim of the present research was to indagate the possibly relations of sleep quality in the caregiver/child dyad in the three samples. The hypothesis formulated expected that the more sleep problems in children, the poorer quality of sleep in caregivers. This type of expectation is support only considering the whole sample and concentrating on the diabetic sample.

It seems to exist a strict bound between caregivers and their relative diabetic children in the managing of diabetes. It is a disease that needs continuative checks and monitoring. Although autonomy is often supported in these pediatrics populations, it is only at a certain age that it would be possible to maintaining diabetes in complete autonomy. The literature supports this result, since evidences regarding caregivers of diabetic children suggest their alerting behaviors during nighttime in order to monitor possibly nocturnal hypoglycemia crisis (Van Name, M. A. et al., 2018). Caregivers of diabetic children and youths may attribute their children's lower sleep effectiveness to glycemic control's impairments (such not conform glycemic levels and or the administration of insuline):

these worries may negatively influence parents' quality of sleep. Exploring a PSQI's item characterized by an open question about other reasons of caregivers' difficulties in sleep, the 19.6% of diabetic caregivers report their frequent waking during nighttime in order to measure glucose in their children. These 11 caregivers resulted also being the ones with a worse quality of sleep, among the diabetic samples of caregivers (PSQI total score: M=8.73, SD=± 3.64 vs M=5.82, SD=± 2.96; p=.007).

The possibly influence that children's sleep and psychological characteristics may have on their caregivers' sleep was indagated through the Pearson's correlation.

The present study did not reveal the age and the behavioral and emotional symptoms of children as significant predictors of the sleep quality of their caregivers. Levels of anxiety showed to be a predictor of sleep quality in the whole sample. Sleep problems in children were found being significantly predictors of sleep quality only in the diabetic sample. The time passed from the diagnosis proved to be a significant predictor of sleep quality in the only oncological group. This result offers another time the idea that the stress procured by finding out a diagnosis of cancer may affect caregivers' sleep quality in a negative way: specifically, the time elapses since the children's cancer diagnosis predicts the quality of caregivers' sleep.

4.2 Limitations and future developments

Regarding medical measures, no measurements of the grade of severity of the chronic diseases were available. In correspondence to this, a different physical well-being in the clinical sample can't be considered.

The information revealed by the study come from self-report questionnaires. All the sleep quantifications were collected through self-report instruments. Many sleep studies include objective measurements (just as actigraphy and polysomnography) and these latter may not correlate with subjective information. As well as sleep data, also psychological values were collected directly with self-report questionnaires. The risk that may incur with such this measurement regard the social desirability bias (and so respondent may provide answers deemed more favorably by other people. Moreover, the primary limit of self-report is that the answers reflect subjective impressions of internal states. Although this, self-measurements are agile instruments that provide important information for researchers.

Generalization of the data may be made more difficult for some sample's characteristics: first of all, the gender of the caregivers (adult participants were only females), the wide age range (which comprehended both childhood and adolescents).

The fact that all the caregivers were female points out a limit regarding the exclusion of a large part of information of the relational environment.

The age of participant was so wide that sleep characteristics between children and adolescents would have been taken into account in the study. As discussed, children and adolescents have different sleep characteristics, also due to different moment of life in which they found themselves.

Differences in the time passed since the diagnosis of the chronic condition may have affect results: as largely discussed in the previous chapters, higher rates of stress are frequent after a diagnosis of a chronic illness ().

Moreover, differences in the administration of the questionnaires may have affected the results: for examples, the patients with type 1 diabetes mellitus, were asked to complete the questionnaire with the ward's psychotherapist and this may have influenced their responses.

No specific diseases-determined instrument was used in the present study. Specifically, the PSI-FS, which regarded parenting stress, was administered in the research, but no specific discrimination was present, concerning chronic conditions and consequently, the parenting stress of caregivers with a chronically ill child.

Future studies may take into account not only the female caregivers, but also the male ones. The present research presents the relational environment as one of the factors that may influence sleep quality or disruption. The interpersonal dimension results to acquire a great value in sleep studying: that is why future researches may include fathers, as well as mothers.

Moreover, future studies may compare different chronic pathologies having the same time passed since their diagnosis. This could lead to understand not only the different grade of impact of different diagnosis, but also how this stress impact sleep, considering the impact of the different pathology diagnosed.

CHAPTER 5: CONCLUSIONS

The present study aimed firstly to explore associations between sleep and psychological features in the two clinical samples and their caregivers, comparing them with healthy populations. Particularly it was hypothesized that clinical sample may experience worse psychological outcomes and greater sleep disruptions, connected to their chronic conditions. In part this hypothesis was confirmed by the present study because the children that experienced more sleep disruptions were the ones belonging to the oncological samples and this may be associated with the great amount of stress that cancer condition bring with itself. Psychological outcomes did not presented differences among children's groups, highlighting how specific programs to follow clinical children at psychological level are important to provide. Associations between psychological adjustment and sleep quality were registered, significantly in the two clinical sample: particularly, higher levels of SDSC total score were mildly associated with higher scores of SDQ total score. The second hypothesis, regarding caregivers, were supported by the data, and were in line with children's findings.

The other aim of the study regarded relations of sleep quality in the caregiver/child dyad, showing another time the relevance for the present study assumed by the interpersonal dimension of sleep. The third hypothesis reconnected with associations between children and caregivers' sleep quality. The findings of the present research demonstrated that the more sleep problems in children, the poorer quality of sleep in caregivers, considering the whole sample and concentrating on the diabetic sample.

The present study brings several focal points from which depart to researchers in which specific and diseases-driven approach should be encouraged: this not only to categorize typical psychological profiles connected with certain sleep patterns, but also to build a network of knowledge in which to welcome and care for every pediatric patient, and his relational environment.

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