CHARACTERISING THE SLEEP WAKE BEHAVIOUR OF LATE ADOLESCENTS LIVING IN RURAL AND TOWNSHIP AREAS SURROUNDING ALICE IN THE EASTERN CAPE OF SOUTH AFRICA

BY

PHELOKAZI DLEPU

THESIS

Submitted in fulfilment of the requirement for the Degree of Master of Science

Department of Human Kinetics and Ergonomics

Rhodes University, 2021

Makhanda, South Africa

ABSTRACT

Introduction: School going adolescents have been identified as a group that is at risk of obtaining insufficient sleep due to shortened and irregular sleep, all of which can affect the overall wellbeing of adolescents. While there has been extenstive research on adolescent sleep around the world, research in South Africa has been limited. Of the research performed in this context, most has been conducted in city or urban contexts, but there has been comparatively less research on sleep in adolescents from rural and township areas. Therefore, this study focused on characterising and comparing the sleep-wake behaviour of late adolescents from selected rural and township areas in Alice in the Eastern Cape of South Africa.

Methods: An adapted version School Sleep Habits Survey (SSHS) was included in the study and assessed demographic, academic, sleep-wake behaviour, lifestyle, and behavioural information of adolescents from rural and township schools in and around Alice. The survey was distributed physically to all the learners from four co-educational rural and township schools. The responses to the survey were analysed with descriptive and non-parametric inferential statistics, as all data were not normally distributed.

Results: A total of 123 learners completed the survey. All the participants were in Grade 12, aged 16 to 26 years (median =18, IQR= 18-19) from rural (n=28) and township (n=95) schools. Seventy-four female and 49 male learners participated in the study. Within the sample, there were also a group of participants who were not adolescents (n=22) whose age ranged between 20 and 26. Reported sleep during both the week and weekend (7hours) was lower than both the recommended duration for adolescents and their own self-reported sleep need of a median of 8 hours and 14 minutes. Bedtimes were significantly earlier on weekdays than weekends. The need to do homework and feeling sleepy were cited as the main reasons for going to sleep during the week and the weekends. Wake times on weekdays and weekends did not differ, with most learners citing being woken up by an alarm clock as the main reason for waking during both weekdays and weekends. Most learners (n=47; 38%) reported walking to get to school, while 41 (33%) relied on public transport to get to school. There were no significant effects of gender or of being rural and township scholars in

relation to their sleep variables. Comparisons between non-adolescents and adolescents revealed that non-adolescents reported sleeping longer (7 hours and 30 minutes) compared to adolescents (7 hours) than adolescents did on weekends. As a group, the learners in this sample were morningness-orientated in terms of chronotype, presented with low day time sleepiness, some evidence of sleep-wake behaviour problems and of depressive mood symptoms. Nearly half (n=53; 43%) the group reported napping occasionally on school days. In terms of caffeine consumption, just over half (n=64; 52%) of the learners reported never consuming caffeinated substances such as soda, coffee, or tea.

Conclusions: The reported sleep duration of learners in this study was consistent on both the week and weekend but was shorter than the recommended 8-10 hours for late adolescents. While learners in this sample reported early bedtimes, sleep was likely curtailed by the early rise times due to the contextual constraints where scholars had to commute, by either walking or taking public transport, to make the early school start times. There was a high prevalence of sleep disturbances in this sample however, the effects of this (increased daytime sleepiness) were lower which can be attributed to low reported prevalence of caffeine consumption combined with the high prevalence of reported day time napping on school days and weekends. While only a snapshot, the results of this study support previous research that has highlighted the challenges that many adolescents across the globe experience when it comes to obtaining enough sleep. The results of this study highlighted the need for more research to understand the sleep-wake behaviours of learners and their lifestyles more objectively. Given the early starts for many participants in this study, interventions such as delaying school start times may help to improve the amount of sleep that learners get during the week. However, extensive consultations would be needed to ensure that systemic changes that aim to improve sleep of adolescents are applicable for the context of rural and townships areas in South Africa.

ACKNOWLEDGEMENTS

I want to thank the God of Mount Zion for being my source of strength and for staying true to His word. I got to where I am because of the faithful God of Mount Zion. Words cannot fully express how grateful I am. Kea leboga Kgomo! Kea leboga Naledi!

I would like to thank my Supervisor, Dr Jonathan Davy, for remaining kind, supportive, and guiding me consistently. Thank you for being patient, understanding, and always making time. You are what a supervisor is supposed to be. Thank you for your constructive dare I say gentle feedback that always pushed me in the right direction. Thank you from the bottom of my heart bhuti.

Thank you to the Department of Education in the Eastern Cape for allowing their learners to participate in the study. Thank you to all the school principals in Alice that made time for me in their busiest time to accommodate my data collection. I would like to express my deepest gratitude for your enthusiasm, involvement, and gatekeeping assistance in this research. I would also like to thank the participants who voluntarily participated in this study. This thesis would not have been possible had you not participated. Thank you to the parents who consented for their children younger than 18 years to participate in the study. I am eternally grateful.

I would like to thank my mother, Zukiswa Thelma Mabuto and my father, Kwedini Melvin Lonzi, my pillars, for always being there for me even though they did not understand my field of study, but the constant check ins, prayers and support carried me. Thank you for being with and for me until the completion of this thesis. Enkosi MaNala noBhayi, ndiyabulela bazali bam. This is for you both.

To my family and friends - thank you for caring and for your patience with me throughout this journey. Thank you for carrying me in prayers and for your gentle check ins. Ndiyabulela ngongazenzisiyo.

To Sizwe Blessing Cibane. Ngiyabonga Shongololo.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

1 INTRODUCTION

Adolescence is a critical developmental phase that is characterised by many changes that occur physically, emotionally, cognitively, and socially (Wolfson & Carskadon, 1998; Dahl et al., 2018; World Health Organization, 2019). These changes are triggered by the transition from childhood to adolescence (Dahl & Lewin, 2002; O'Brien & Mindell, 2005; Kaur & Bhoday, 2017). The phase of adolescence is characterised by personal identity formation, experimenting and changes in social roles and responsibilities (van den Bos, 2013; Dahl et al., 2018). The phase of adolescence is also characterised by the need for individuals to have status and prestige, which are also accompanied by changes in their sexual and romantic engagements (Dahl et al., 2004; van den Bos, 2013; Dahl et al., 2018). The process of transitioning to adolescence also results in changes in sleep-wake behaviour of adolescents, which in turn alters the amount of sleep adolescents obtain (Wolfson & Carskadon, 1998; Reid et al., 2002; O'Brien & Mindell, 2005; Knutson, 2005; Adam et al., 2007; Hysing et al., 2013; Owens, 2014; Chaput et al., 2018; Vidal & Shochat, 2017; Crowley et al., 2018; Gariepy, 2020).

Sleep plays an important role in the development and wellbeing of adolescents (Katz & McHorney, 2002; Roth et al., 2006; Touitou, 2013; Shochat, Cohen-Zion & Tzischinsky, 2014; Hirshkowitz et al., 2015; Hawkins & Takeuchi, 2016; Bruce, Lunt & McDonagh, 2017; Chaput et al., 2018; Crowley et al., 2018). While sleep duration differs between individuals, the recommendations for adolescents' range between 8-10 hours per night for optimal health and functioning (Wolfson & Carskadon, 1998; Shorts et al., 2015; Hirshkowitz et al., 2015; Paruthi et al., 2016). However, previous research has consistently shown that adolescents are obtaining suboptimal sleep (Wolfson & Carskadon, 1998; Wolfson, 2007; Hirshkowitz et al., 2015; National Sleep Foundation, 2015; Crowley et al., 2018; Sleep Foundation, 2020). Older adolescents, especially those in higher school grades, usually report later bedtimes and early rise times and overall, a reduction in the total amount and quality of sleep (Gau & Soong, 1995; Reid et al., 2002; Roenneberg et al., 2004; Crowley, Acebo & Carskadon, 2007).

This reduction in sleep, which can accumulate over time, affects the learner's ability to be attentive in class, can contribute to more disruptive behaviour, poor mood states, reduced academic and sporting performance and in some cases, reductions in wellbeing and general health (Katz & McHorney, 2002; Dewald et al., 2010; Meijer et al., 2010; Lee et al., 2012; Sargent et al., 2014). This has been shown consistently across different countries in Asia, Europe, North America, South America, Oceania, and Africa. However, in Africa there are few countries that covered sleep of adolescents and one of them is South Africa. The research that has been performed in South Africa with regards to the sleep-wake behaviour of adolescents found that adolescents in South Africa also obtain insufficient sleep (Reid et al., 2002; Mandondo, 2020). However, the research that was conducted was limited to urban, largely private, and high-income public schools of South Africa.

South Africa is a diverse country and differs from other contexts in several aspects, including, inter alia, the different living and the schooling conditions, which have and continue to differ across the population, driven largely by political and economic history of the country, linked to the legacy of the Apartheid regime (Bell & McKay, 2011; Gravin, 2014). The living conditions are divided into urban or city, peri-urban (referred to as township) and rural. The urban or city setting vary in size and population, have better resources and services, and are often more affluent than township and rural areas of South Africa. Township areas are often located between the rural and urban fringe (Atkinson, 2014). In comparison, rural areas may be former homelands, such as small towns, agricultural villages, or small farms (Atkinson, 2014). The schools that exist in all three places are different, private, and high-income public schools are located mostly in city or affluent towns and middle- and low-income public schools are mostly in rural and township areas. The middle- and low-income public schools in rural and township learners may be located further away from where the learners live and so they may need to walk or catch public transportation to get to school. On the other hand, literature has shown that commuting to and from school has an influence on learners' sleep (Pereira, Moreno & Louzada, 2014; Voulgaris, Smart & Taylor, 2019), however that has not been established in this context.

There may be other unique contextual constraints or factors that many of the learners that live and attend school in rural and township areas face, that may influence their

sleep. However, there has been comparatively less research in the rural and township contexts regarding the sleep-wake behaviour of adolescents and that warrants investigation.

1.1 Aim of the study

In light of the limited research in characterising the sleep-wake behaviour of adolescents from rural and township areas in South Africa. The aim of the study was to characterise the sleep-wake behaviour of adolescents using a sample of rural and township schools in and around Alice in the Eastern Cape of South Africa.

1.1.1 Objectives

- Characterise and compare the sleep-wake behaviour of adolescents on weekdays and weekends
- Understand the drivers or reasons of sleep wake behaviour in this context.
- Exploring the socio-demographic characteristics of adolescents that influence their sleep-wake behaviour

CHAPTER II

2 REVIEW OF LITERATURE

2.1 An overview of the structure of sleep

Sleep is a recurring state characterised by reduced consciousness and inactivity of nearly all voluntary muscles (Macmillan, 1989; Dijk & von Schantz, 2005; Zisapel, 2007). It is divided into two types of sleep, rapid eye movement (REM) and non-rapid eye movement (NREM or non-REM) (Dahl & Lewin, 2002; Carskadon & Dement, 2011; Kaur & Bhoday, 2017). The sleep stages occur in cycles of 90 minutes to 2 hours (Carskadon & Dement, 2011). Non-REM sleep comprises of three different stages (Dahl & Lewin, 2002; Carskadon & Dement, 2011; Kaur & Bhoday, 2017). The first stage of non-REM is characterised by light sleep (Zisapel, 2007), where there is a transition between waking and sleep, muscles are active, and eyes may open and close moderately (Kaur & Bhoday, 2017). The first stage lasts for a few minutes and transitions the individual into deeper stages of sleep, such as stage two of non-REM (Zisapel, 2007). Stage 2 occurs before a sleeper falls into a deep sleep; it is the middle stage where it may become slightly harder to awaken an individual (Kaur & Bhoday, 2017). Stage 3 is also called the slow wave sleep (SWS), and in this stage, the individual is in a deep sleep and is less responsive to the external environment (Carskadon & Dement, 2011; Kaur & Bhoday, 2017). Following the stages of non-REM sleep, the individuals enter REM sleep. REM sleep is characterized by mixed brain waves similar to waking. This is where the most vivid dreams occur and there is higher oxygen consumption. An individual may be harder to arouse as the muscles are paralyzed during REM sleep (Dahl & Lewis, 2002; Kaur & Bhoday, 2017). The length of sleep differs from individual to individual but is also dependent on the duration of wakefulness and their previous sleep-wake behaviour (Carskadon & Dement, 2011).

2.1.1 General importance of sleep

Sleep is important in maintaining physical, mental, social, and overall health (Katz & McHorney, 2002; Roth et al., 2006; Grandner et al., 2017; Matricciani et al., 2017). Sleep is key for growth, development, immune system function, synaptic consolidation, and energy conservation (Carskadon & Acebo, 2002; Wagner et al.,

2004; Brand & Kirov, 2011; Shochat et al., 2014). The characteristic of unresponsiveness of the body during sleep is the one that fulfils the function of restoration of the body and brain (Dahl, 1999). Furthermore, during sleep, the brain is uninterrupted by incoming sensory information and that aids in the integration and coding of information, converting short-term memories to long-term memories (Wagner et al., 2004; Lambert, 2005; Shochat et al., 2014). Sleep is also important for cognitive performance, such as executive functioning, including abstract reasoning, goal-directed behaviour, and creative processing (Dewald et al., 2010). An improvement in daily alertness, emotional regulation, and reaction time is also associated with sleep (Wagner et al., 2004; Dewald et al., 2010).

2.1.2 Sleep regulation

While the mechanisms that regulate sleep are complex and multifaceted, sleep is mainly regulated by two processes; circadian timing mechanism and sleep homeostatic process (Dijk & Lockley, 2002; Roenneberg & Merrow, 2016; Hershner & Chervin, 2014; Kabrita et al., 2014; Deboer, 2018). These two processes are described using the two-process model later in the review (Figure 1) (Borbely, 1982). The circadian and sleep homeostatic processes work alongside other processes to regulate sleep-wake behaviour (Dijk & Lockley, 2002; Hershner & Chervin, 2014; Kabrita et al., 2014; Roenneberg & Merrow, 2016; Deboer, 2018).

2.1.2.1 The circadian rhythm

The circadian rhythms are robust, self-sustained and oscillate for about 24 hours in length and are the product of the circadian clock's interaction with signals from the external environment (Borbely, 1982). The circadian process functions as a clock-like mechanism that is not dependent on prior sleep and waking (Deboer, 2018). The dominant circadian pacemaker, the suprachiasmatic nucleus (SCN), also known as the master circadian clock, coordinates various physiological rhythms that are synchronized with the daily changes in the environment (Dahl & Lewin, 2002; Dijk & von Schantz, 2005; Bernard et al., 2007; Wright et al., 2013; Tarokh et al., 2019). The SCN is a region of the brain near to the hypothalamus (Dahl & Lewin, 2002; Dijk & von Schantz, 2005; Bernard et al., 2007; Wright et al., 2013; Tarokh et al., 2019). It is referred to as the master circadian clock because neuronal clocks within the SCN form a heterogeneous network that must synchronize to the light-dark environment to

maintain timekeeping activity (Bernard et al., 2007; Kalsbeek et al., 2012). Many aspects of physiology and human behaviour show circadian rhythmicity, including hormone levels, body temperature, immune function, digestive activity, physical activity, alertness, and sleep (Bernard et al., 2007; Dahl & Lewin, 2002; Pan et al., 2020). There are also clock genes in individual cells that can affect the rhythms (Vitaterna, Shimomura & Jiang 2019).

The circadian clock is roughly 24 hours, and it follows the changes in day/night cycle through the process of entrainment that this connection has been established (Dahl & Lewin, 2002; Johnson et al., 2003). Entrainment is the alignment of internal biological regulators and external cues that affect the overall sleep and wakefulness regulated by the circadian clock (Kantermann, 2013). The circadian clock is sensitive to light and dark cues (Dahl & Lewin, 2002; Dijk &von Schantz, 2005; Roenneberg et al., 2007a) and responds to these cues by sending signals to the physiological and endocrine systems responsible for controlling hormones, body temperature and other systems that play a role in sleep-wake behaviour (Johnson et al., 2003; Dijk & von Schantz, 2005; Zisapel, 2007).

Upon awakening, with exposure to morning light from the external environment, the circadian clock will respond by suppressing the release of melatonin and raising body temperature to prepare for wakefulness (Dahl & Lewin, 2002; Crowley et al., 2007; Kabrita et al., 2014; Sleep Foundation, 2020). With the onset of darkness, the signals to the clock change and hormones such as melatonin begin to rise and simultaneously, the body temperature will drop to prepare the body to sleep (Dahl & Lewin, 2002; Dijk & von Schantz, 2005; Crowley et al., 2007). Darkness triggers the release of melatonin, which facilitates the transition to sleep and helps to promote consistent, quality sleep during the night (Crowley et al., 2007). The internal circadian clock regulates the timing of sleepiness and wakefulness throughout the day (Wright et al., 2013; Hershner & Chervin, 2014; Kabrita et al., 2014).

2.1.2.2 Sleep-homeostatic process

The second process that regulates sleep is the sleep homeostatic process, which was established as an independent system that works alongside, but often in opposition to, the circadian clock (Allada & Siegel, 2008; Hershner & Chervin, 2014; Kabrita et

al., 2014). The homeostatic process is responsible for the development of sleepiness the longer an individual is awake (Carskadon et al., 1998). Sleep pressure increases the longer an individual is awake and decreases as the individual sleeps. Sleep homeostasis creates a drive that balances sleep and wakefulness. The regulation of the sleep-wake system is captured in the two-process model, discussed below.

2.1.3 The two-process model

The sleep-wake system is intrinsically regulated by the interplay of two processes, one that promotes sleep (process S) and one that maintains wakefulness (process C) (Borbely, 1982). This model is referred to as the two-process model developed more than three decades ago (Borbély, 1982; Daan et al., 1984; Schmidt et al., 2007; Borbély et al., 2016).

In this model, Process S is the homeostatic drive for sleep while Process C is a wake promoting regulated by the circadian system (Borbély, 1982; Colten & Altegoyt. 2006). Process S, a sleep-wake dependent homeostatic process, increases during wakefulness, peaks just before bedtime at night, and dissipates during sleep (Borbely, 1982; Colten & Altegoyt, 2006). Process S dynamically interacts with Process C, a sleep-wake independent clock-like circadian process that builds across the day to counteract Process S and promote wakefulness and alertness (Colten & Altegoyt, 2006; Hershner & Chervin, 2014; Kabrita et al., 2014). However, this wake-promoting system begins to decline during the night hours, serving to enhance sleep consolidation as the need for sleep dissipates across the night (Gillette & Abbott, 2005). With an adequate night's rest, the homeostatic drive for sleep is reduced, the circadian waking drive begins to increase, and the cycle starts over (Colten & Altegoyt, 2006; Schmidt et al., 2007). Importantly, through synchronization of the circadian system, process C assists in keeping sleep-wakefulness cycles coordinated with environmental light-dark cycles (Colten & Altegoyt, 2006; Dijk & von Schantz, 2005). The shaded area in the figure below represents the optimal time for sleep (Borbely & Achermann, 1999; Samson & Blunden, 2013).

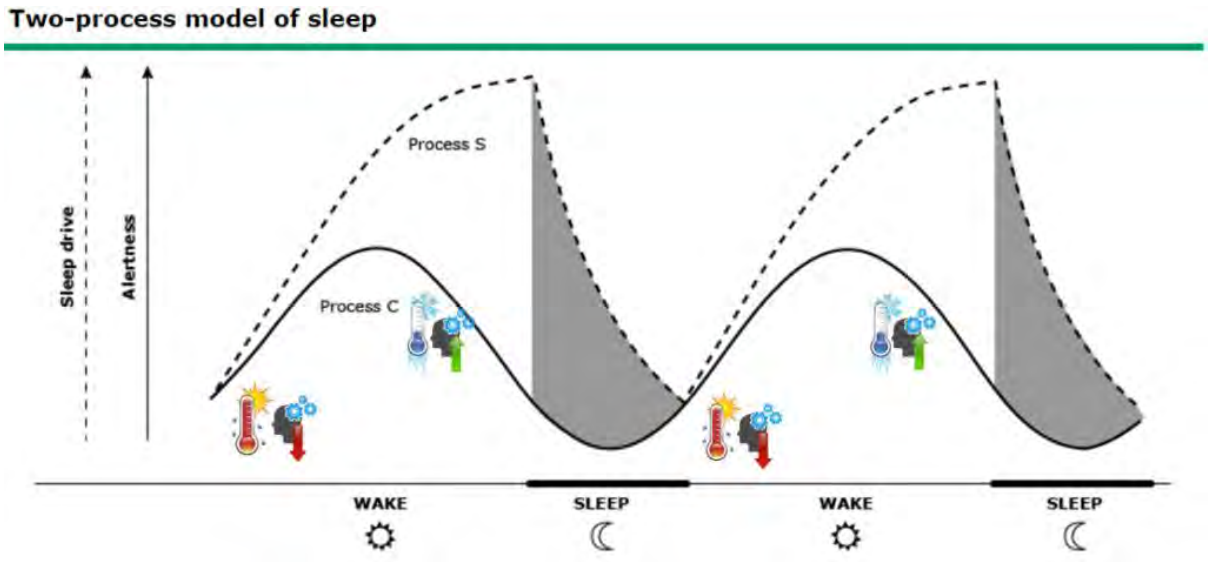


Figure 1. Representation of the two-process model of sleep regulation (adapted from Rose, 2017, July 27).

It is evident that regulating sleep through the circadian and sleep homeostatic process is complex and multifaceted. All human beings have different sleep duration recommendations according to their age, which is detailed in the following section.

2.1.4 Sleep duration recommendations

There are age-specific guidelines on the recommended amount of sleep needed for optimal health (Carskadon & Acebo, 2002; Hirshkowitz et al., 2015). Sleep need changes with age and varies with individuals, but the general recommendations are that children under the age of 12 get between 9-13 hours of sleep daily (Hirshkowitz et al., 2015). Sleep recommendations for adults and older adults (65) range between 7-9 hours (Hirshkowitz et al., 2015; National Sleep Foundation, 2016). The recommendations for adolescents' sleep hours are 8-10 hours for optimal health, functioning and to sustain daytime alertness (Hirshkowitz et al., 2015; Paruthi et al., 2016). The variability in sleep needs may be influenced by, inter alia, genetics, lifestyle behaviours, medical history, psychosocial, and environmental factors (Hirshkowitz et al., 2015; Matricciani et al., 2017; Hoyt et al., 2018; Chaput et al., 2018). During adolescence, there are many factors that drive changes in sleep wake behaviour, discussed in more detail below.

2.2 Adolescence

Adolescence is a critical developmental stage in life, where numerous changes occur during the transition from childhood to adolescence (Dahl et al., 2018; World Health Organization, 2019). The onset of puberty triggers some of these changes, which occur physically, emotionally, cognitively, and socially (Wolfson & Carskadon, 1998; Dahl et al., 2018; World Health Organization, 2019). During this phase, most adolescents embark on discovering their identity; experience an increase in sensation seeking, and a re-orientation of attention, and motivation, usually towards peers (van den Bos, 2013; Dahl et al., 2018). In this phase, adolescents experience the need to have status and prestige, and have sexual and romantic engagements (van den Bos, 2013; Dahl et al., 2018; WHO, 2019). Studies have also reported increased use of health-hazardous substances such as alcohol, tobacco, and drugs during adolescence and a high prevalence of automobile accidents occurring during this phase (Short et al., 2018; WHO, 2019). The emotional changes during the transition may also put adolescents at an increased risk of experiencing mental health issues, including depression, anxiety, self-harm, and suicide (Romeo, 2013; Jurewicz, 2015; Giedd, 2015). Studies have also reported a tendency for adolescents to be at risk of becoming addicted to electronic devices, having eating disorders and unhealthy sleeping patterns (Kaur & Bhoday, 2017; WHO, 2019). With all the changes mentioned above, there are also changes to adolescents' sleep-wake behaviour, which result from the interaction of various biological, social, and contextual factors.

2.2.1 Importance of sleep in adolescents

Sleep is a vital aspect of an individual’s overall well-being (Matricciani et al., 2017; Grandner, 2017). Sleep is essential both physiologically and psychologically for adolescents given its role in their physical, behavioural, emotional, and cognitive development (Touitou, 2013; Shochat, Cohen-Zion & Tzischinsky, 2014; Katz & McHorney, 2002; Roth et al., 2006; Touitou, 2013; Hirshkowitz et al., 2015; Hawkins & Takeuchi, 2016; Bruce, Lunt & McDonagh, 2017; Chaput et al., 2018; Crowley et al., 2018). Research highlights that adequate sleep can also help adolescents eat better and help manage the stress associated with being a teenager (Chen, Wang & Jeng, 2006; Sleep Foundation, 2020). Additionally, adequate sleep in adolescents is associated with improved academic performance, quality of life, attention, memory retention, behaviour, and reduced use of drug-related substances (Hofman &

Steenhof, 1997; Wolfson & Carskadon, 1998; Katz & McHorney, 2002; Roth et al., 2006; Oginska & Pokorsk, 2006; Paruthi et al., 2016; Bruce et al., 2017). Adequate sleep has also been associated with optimum daily functioning and improved mood in adolescents (Fuligni, Krull & Gonzales, 2019).

To derive the various benefits of sleep, adolescents need to obtain enough quality and quantity sleep. However, a number of researchers and organisations have raised concerns that adolescents have been and continue to be at risk of experiencing chronic sleep loss (Wolfson & Carskadon, 1998; O'Brien & Mindell, 2005; Wolfson, 2007; Hirshkowitz et al., 2015; National Sleep Foundation, 2015, Sleep Foundation, 2020; Zhou et al., 2020; Becker & Gregory, 2020).

2.2.2 Previous research on sleep in adolescents

Research in adolescent sleep has consistently reported that adolescents experience shortened sleep durations, increased daytime sleepiness, and irregular sleep patterns across the week and weekends (Carskadon et al., 1998; Marco et al., 2012; Gamble et al., 2014; Owens, 2014; Hirshkowitz et al., 2015). Adolescents would have later bedtimes and early rise-times during the week and sleep in late during weekends (Carskadon et al., 1998; Marco et al., 2012; Gamble et al., 2014; Owens, 2014; Hirshkowitz et al., 2015). The table below shows the duration of sleep adolescents get during the week and on weekends from different parts of the world from literature.

Table 1. Summary of sleep obtained by adolescents in different parts of the world

Author	Continent	Country	Age & Sample size	Study design	Measures	Sleep duration Weekdays	Sleep duration Weekends
Reid et al., 2002	**Africa**	South Africa	14-20 years 825	Cross-sectional	Self-developed sleep questionnaire	7.55 hours	8.4 hours
Mandondo et al., 2020			17-19 years 231	Cross-sectional	School Sleep Habits Survey Actigraphy	<8 hours	>8 hours
Maduabuchi et al.., 2014		Nigeria	13-19 years 443	Prospective	Epworth Daytime Sleepiness Scale (Johns, 1991). Pittsburgh Sleep Quality Index (PSQI) (Buysee, 1989)	7.84 hours	8.65 hours
Ohida et al., 2004	**Asia**	Japan	12-18 years 107 907	Cross-sectional	Self-developed sleep questionnaire	6 hours	8.5 hours
Ghanizadeh et al., 2008		Iran	15-18 years 1420	Cross-sectional	Self-developed sleep questionnaire	7.7 hours	
Kang et al., 2012		China	13-18 years 585	Cross-sectional	Self-developed sleep questionnaire	7.0 hours	9.0 hours
John et al., 2019		India	11–17years 501	Cross-sectional	Cleveland Adolescent Sleepiness Questionnaire (Mastin et al., 2006) Pittsburgh Sleep Quality Index (PSQI) (Buysse et al., 1989) Sleep Hygiene Index (SHI) (Spilsbury et al., 2007) Self-developed: The Socio-Demographic and Sleep Questionnaire	7.5 hours	8.8 hours
Kim et al., 2011		Korea	14-19 years 2638	Cross-sectional	Epworth Sleepiness Scale (ESS) (Cho et al., 2011) Korean version of the Beck Depression Inventory (BDI) (Hann, 1982) Korean Translation of Composite Scale (Yoon et al., 1997)	5.42 hours	8.24 hours
Huang et al., 2010		Taiwan	12-18 years 1906	Cross sectional	Pediatric Sleep Questionnaire (PSQ) (Chervin et al., 2000)	7.35 hours	9.38 hours
Shochat et al., 2010		Israel	12-15 years 470	Cross-sectional	The Modified School Sleep Habits Survey	<7.5 hours	10 hours

Loessl et al., 2008	**Europe**	Germany	12-18 years 818	Cross-sectional	Skightly translated School Sleep Habits Survey (SSHS)	7.83 hours	9.2 hours
Gariepy et al., 2020		Poland Latvia Greece Estonia	11-15 years 27 572	Longitudinal	Cross-sectional Health Behaviour in School-aged Children surveys	7.47-7.55 hours	9.35-9.56 hours
Leger et al., 2012		France	11-15 years 9251	Cross-sectional	Cross-national health behaviour in school-aged children survey (HBSC)	7.55 hours	9.44 hours
Hysing et al., 2013		Norway	16-19 years 10220	Cross-sectional	Ung@hordaland survey,	6.25 hours	>8 hours
Lima et al., 2020		Spain	11-16 years 497	Cross sectional	Self-developed questionnaire	<8 hours	>8 hours
Patte et al., 2017	**North America**	Canada	12-18 years 7394	Longitudinal	COMPASS student-level questionnaire (Cq)	7.34 hours	8.18 hours
Baiden et al., 2019		United States	14–18 years 10 952	Cross-sectional	Youth Risk Behavior Survey	<8 hours	
Lyall et al., 2020	**South America**	Scotland	10-14 years 69	Cross-sectional	Accelerometry Short Adolescent Sleep-Wake Scale (ASWS) (Essner et al., 2015). Health Behaviour in School-Aged Children (HBSC): Sleep questions.	7.3-7.7hours	8.4-8.8 hours
Santos et al., 2022		Brazil	11-16 years 1554	Cross sectional	Pediatric Daytime Sleepiness Scale (PDSS), Morningnesse/Eveningness Scale(M/E) & Pittsburgh Sleep Quality Index	<8 hours	>8 hours
Short et al., 2013	**Oceania**	Australia	13-18 years 385	Cross-sectional	Sleep diary Actigraphy A modified School Sleep Habits Survey The Pediatric Daytime Sleepiness Scale (Drake et al., 2003) The Flinders Fatigue Scale (Gradisar et al., 2007) Centre for Epidemiological Studies Depression Scale (Radoff, 1997)	8.17 hours	8.40 hours

With reference to Table 1, it is evident that adolescents do not obtain sufficient amounts of sleep on weekdays or school nights and may end up oversleeping on weekends, in an attempt to make up for the truncated sleep during weekdays (Carskadon et al., 1998; Owens, 2014). Therefore, adolescents may get up to 2 hours more sleep on weekend nights (Giannotti et al., 1997; Wolfson & Carskadon, 1998; Gau & Soong., 2003; Huang et al., 2010; Paiva et al., 2015). The discrepancy between week and weekend sleep duration and bed and wake times may contribute to cumulative sleep debt and social jetlag (Wolfson & Carskadon, 1998; Van Dongen et al., 2003; Roenneberg et al., 2004; Touitou, 2013). Sleep debt refers to the cumulative hours of sleep loss (Van Dongen et al., 2003), while social jetlag, on the other hand, refers to the misalignment between biological times, as influenced by the circadian pacemaker and social time (Roenneberg et al., 2004; Kalsbeek et al., 2012; Touitou, 2013; Kelley et al., 2017).

An important step to address this concerning trend is to understand the factors that may influence sleep-wake behaviour in this group, some of which are modifiable while others are not (Crowley et al., 2018).

2.2.3 Factors affecting sleep in adolescents

Several factors contribute to sleep loss in the adolescent population, which can broadly be categorised into bioregulatory, psychosocial and environmental factors (Wolfson & Carskadon, 1998; O'Brien & Mindell, 2005; Owens, 2014; Chaput et al., 2018; Crowley et al., 2018).

2.2.3.1 Bioregulatory factors

Circadian rhythm: an overview of changes during adolescence

The onset of puberty triggers changes in adolescents' sleep timing and circadian regulation system (Dahl & Lewin., 2002; Carskadon et al., 1993; Jenni & Carskadon, 2004; Crowley et al., 2007; Hershner & Chervin, 2014; Dahl et al., 2018). The changes in the circadian rhythm of adolescents are characterized by a phase delay in the circadian clock (Carskadon et al., 1993; Carskadon et al., 1998; Wolfson & Carskadon, 1998; Crowley et al., 2007; Kelley et al., 2017). Thus, adolescents tend to have a delayed circadian preference (Jenni & Carskadon, 2004; Kelley et al., 2017; Chaput et al., 2018). This results in adolescents feeling more awake in the evening and

experiencing difficulty falling asleep (Crowley et al., 2007; Hershner & Chervin, 2014; Kelley et al., 2017), which, by extension, results in a preference for waking later.

Adolescents may also have an increased sensitivity to evening light (Carskadon, 2004; Bartel et al., 2015; Sampasa-Kanyinga et al., 2018). Increased sensitivity to evening light results in later bedtimes and shorter sleep durations (Bartel et al., 2015; Sampasa-Kanyinga et al., 2018). The circadian rhythm responds by adapting to the changes in the sleep-wake schedules of adolescents, thus allowing them to shift their sleep-wake schedules between weekdays and weekends (Dahl et al., 2002; Kelley et al., 2017).

Sleep homeostatic changes during adolescence

In addition to the circadian phase delay, there are changes in the sleep homeostatic process. The sleep homeostatic process is the internal biochemical system that increases sleep pressure as the period of wakefulness lengthens (Carskadon & Acebo, 2002; Hershner & Chervin, 2014). The accumulation of sleep homeostatic pressure slows down during adolescence (Carskadon, 2011). This means that adolescents take longer to get sleepy than when they were younger (Carskadon, 2011; Porkka-Heiskanen, 2013; Crowley et al., 2018). The circadian and sleep-homeostatic processes work together to create a balanced sleep-wake cycle. They also partially account for the natural preference of adolescents to go to sleep later and wake up later too (Carskadon, 2011; Crowley et al., 2018). These bioregulatory factors interact with other individual and external factors, all of which contribute to the change in sleep-wake behaviour in adolescents.

Changes in adolescent sleep with age

Adolescent sleep changes from early to late adolescence (Carskadon et al., 1993; Wolfson & Carskadon, 1998; Wolfson et al., 2003). There are fewer reports of sleep loss in younger adolescents; however, sleep loss has been noted to increase linearly with increases in age (Anders et al., 1978; Giannotti et al., 2002; Campbell et al., 2007). Drastic changes to the sleep patterns of adolescents have been noted from the age of 12 (Reid et al., 2002; Campbell et al., 2007; Wolfson et al., 2007), with adolescents obtaining shorter sleep durations, naturally wanting to go to bed later and wake up later, and having discrepancies between weekdays and weekends sleep (Wolfson and Carskadon, 1998; Reid et al., 2002; Wolfson et al., 2003). These may

not only be due to the changes in sleep timing, but to the societal pressures learners might have at school, which may result in less sleep (Henschel & Lack, 1987; Carskadon et al., 1993; Andrade et al., 1993; Laberge et al., 2001; Giannotti et al., 2002; Van den Bulck, 2004; Wolfson et al., 2003; Campbell et al., 2007; Ghanizadeh et al., 2008; Gradisar et al., 2011). These changes progress as adolescents get older (Wolfson & Carskadon, 1998; Liu & Zhou, 2002).

Gender-differences in adolescents' sleep patterns

The onset of puberty triggers changes in the sleep-wake behaviour of adolescents. However, the findings regarding gender differences in sleep patterns are inconsistent (Saarenpää-Heikkilä, 1995; Liu et al., 2008; Crowley et al., 2007; Paiva, Gaspar, & Matos, 2015). There is little evidence of the difference in sleep behaviour patterns between male and female adolescents as certain daytime behaviours may also influence adolescents' sleep habits regardless of gender (Reid et al., 2002; Knutson, 2005; Hysing et al., 2013). However, males and females experience differential growth rates and hormone secretion during puberty, and as such, some studies highlight that female adolescents experience more difficulties in falling asleep, have more frequent awakenings, shorter sleep duration and lower sleep quality than male adolescents (Laberge et al., 2001; Miller, Danner & Staten, 2008).

Female adolescents have also been shown to wake up earlier than their male counterparts on school days; however, they may sleep longer and wake up later on weekends (Wolfson & Carskadon, 1998; Yang et al., 2005; Vidal & Shochat, 2017). Female adolescents would wake up earlier on weekdays/schooldays because they take time to prepare themselves (Yang et al., 2005). This could be partially attributed to the phenomenon that females tend to mature earlier than males, and they have a late chronotype and a more delayed circadian phase (Roenneberg et al., 2007; Knutson, 2005; Vidal & Shochat, 2017). In contrast, other studies report that male adolescents may tend to go to bed later playing video games and would wake up earlier, possibly because they have athletic or sports obligations that require them to have early rise times (Wolfson et al., 2007) more especially on weekends (Gariepy et al., 2020). This, along with other factors, may account for why male teenagers tend to take more naps during the day (Reid et al., 2002).

2.2.3.2 Effects of psychosocial and environmental factors

In addition to certain biological changes, the sleep-wake behaviour of adolescents is also influenced by social factors, the home environment, cultural factors/practices and other behavioural and lifestyle factors (Van den Bulck, 2004; Kabrita et al., 2014; Calamaro, Mason, & Ratcliffe, 2009; Felden et al. 2015; Bartel et al., 2015; Sampasa-Kanyinga et al.,2018; Crowley et al., 2018; Schmeer, 2019; Gariepy, 2020).

Home-related challenges and enablers

Socioeconomic factors

Socioeconomic status (SES) is a factor that has been covered widely in literature to influence the sleep-wake behaviour of adolescents (O'Brien & Mindell., 2005; Wolfson et al., 2011;Marco et al., 2012; Felden et al., 2015; Schmeer et al., 2019). SES is a construct that aims to classify people into social classes and strata based on family income, level of schooling, and occupation (Marco et al., 2012; Felden et al., 2015). The economic, social, environmental, and behavioural components of communities that individuals find themselves in influence their development (Felden et al., 2015). Furthermore, the socioeconomic factors is linked to factors such as family income, education, occupation, neighbourhood factors (noise and lighting), home environment, and daily activities (routine) that may affect sleep (O'Brien & Mindell., 2005; Wolfson et al., 2011; Marco et al., 2012; Felden et al., 2015; Schmeer et al., 2019). These factors are influenced by socioeconomic status, and deeper explanations of these factors are expanded upon below.

The home environment and neighbourhood factors

The conditions adolescents experience in their home environments influence their ability to obtain adequate sleep (Spilsbury et al., 2005). Adolescents need a healthy sleeping environment which would include controlling the noise, light, and temperature so as to make it conducive to optimising the chance to sleep (Bagley et al., 2015). Excessive noise or light, uncomfortable sleeping surfaces, low or high bedroom temperatures, and limited space has been shown to affect sleep adversely (Kahn et al., 1989; Lee et al., 1999; & Sateia, 2002; Spilsbury et al., 2005). Additionally, family stress (Bates et al., 2002), maternal depression (Sadeh, Raviv & Gruber, 2000; Quine, 2001), specific bedtime practices such as sharing a bed may negatively affect the sleep of adolescents (Owens et al., 2000; Drake et al., 2003).

Adolescents from lower socioeconomic backgrounds often have lower sleep durations and may experience poor sleep quality than adolescents from higher socioeconomic backgrounds (Wolfson et al., 2011; Marco et al., 2012; Jarrin, McGath, & Quon, 2014). Families from a lower SES typically live in high-density settings, less organized and crowded homes (Billows et al., 2009; Marco et al., 2012; Bayat et al., 2014; Jarrin et al., 2014; Buxton et al., 2015; Daniel et al., 2020; Gaarde et al., 2018). In addition, families from lower SES may experience more noise from the household or violent neighbourhood (Billows et al., 2009; Marco et al., 2012; Bayat et al., 2014; Jarrin et al., 2014; Buxton et al., 2015; Daniel et al., 2020; Gaarde et al., 2018). Adolescents living in disadvantaged neighbourhoods characterised by high levels of violence have a particularly high risk for sleep difficulties (Kliewer & Leopore, 2015). An estimated one out of six youth living in neighbourhoods characterized by violence, poor housing, litter, and vandalism report sleep problems compared with one in ten youths living in more favourable social environments (Singh & Kenney 2013; Kliewer & Leopore, 2015). The home environment and neighbourhood factors that may affect sleep will be contextualised in South Africa later in the thesis.

Sleep hygiene practices & parental influence

Another factor that influences the sleep-wake behaviour of adolescents is sleep hygiene (Malone, 2011). Sleep hygiene refers to the conditions, routines, and practices that establish an effective and favourable sleeping environment (Stores, 2011; Godsell & White, 2019). Adolescents have been reported to have poor knowledge of good sleep hygiene practices and thus may face difficulties in achieving the recommended amount of sleep needed per night (Malone, 2011; Godsell & White, 2019). Nonetheless, studies highlighted the importance of having parents as "sleep influencers" in promoting healthy sleep hygiene practices amongst adolescents (Malone, 2011; Gaarde et al., 2018; Godsell & White, 2019).

Parental monitoring is encouraged in enforcing good quality and quantity of sleep in adolescents (Dahl & Lewin, 2002; Arredondo et al., 2006; Maume, 2013; Dittus et al., 2015). However, less-educated parents may not be equipped with knowledge of good sleep hygiene practices, which in turn may not practice and supervise the sleep habits of their children (O'Brien & Mindell, 2005; Billows et al., 2009; Wolfson et al., 2011; Bagley et al., 2015; Kanis et al., 2015). Less-educated parents were documented to model poor sleep hygiene practices in front of their adolescent children, such as

working late in the evening to complete households' tasks or choosing to relax in front of the computer before going to bed (Billows et al., 2009). Adolescents may then also choose or be forced to adopt these poor sleep hygiene behaviours (Billows et al., 2009), such as staying up late relaxing in front of the television or on their electronic devices, which may contribute to poor sleep-wake behaviour (Shochat et al., 2010; King et al., 2013; Mei et al., 2019; Godsell & White, 2019). Adolescents with less-educated parents may learn to rely on their resources to meet school and social commitments such as homework or organizing after schoolwork (Billows et al., 2009), and this could include going to bed late in the evening and waking up early to prepare for school, which results in poor and inadequate sleep(Billows et al., 2009; Gaarde et al., 2018).

The increasing autonomy throughout adolescence and little parental education make monitoring sleep difficult. As a result, fewer parents enforce bedtimes for their teenagers (Buxton et al., 2015), thus contributing to the decrease in adolescents' quantity and quality of sleep (Marco et al., 2012). The increased autonomy throughout adolescence may allow adolescents to set their bedtimes to practise poor sleep behaviours, which could include the increased use of electronic devices before bedtime to things done.

Technology use

Adolescents tend to rely on and value the connectivity that is offered by technology to interact with their friends and other people on a global scale from the intimacy of their bedroom (National Research Council, 2000; Dahl & Lewin, 2002; Johansson et al., 2016; Orben & Przybylski, 2020; Becker & Gregory, 2020). Adolescents engage in social activities, have self-determined bedtimes, and have easy access to a vast range of stimulating activities that may keep them up at night through the use of technology (Dahl & Lewin, 2002; Adams et al., 2017; Godsell & White, 2019). There has been a reported increase in the use of a diverse range of technology (smartphones, tablets, computers, video games, television, e-readers), especially in the evening times (Eggermont & Van den Bulck, 2006; King et al., 2013; Ofcom, 2018; Sleep Foundation, 2020). Adolescents often do this without parental monitoring and regulation of time spent on devices (National Research Council, 2000; Dinleyici et al., 2016; Toh et al., 2019) which may subsequently result in adolescents getting addicted to their electronic devices (Shochat et al., 2010; Mei et al., 2019; Godsell & White, 2019).

The use of electronic devices and the mere presence of electronic devices in bedrooms often results in adolescents becoming absorbed in this interaction, which may delay sleep onset (Brooks, 2018; Tustin, 2017). These electronic devices may result in adolescents staying awake longer because of their sensitivity to evening light (Bartel et al., 2015; Sampasa-Kanyinga et al., 2018). Specifically, exposure to the blue spectrum light emitted from electronic devices can delay melatonin secretion, which can interfere with sleep onset (Weaver et al., 2010; Bartel et al., 2015; Sampasa-Kanyinga et al., 2018). Another possible explanation for this is that there is cognitive and physiological arousal from the use of stimulating technologies such as television, video games, computers, or smartphones that may make it difficult for the body to wind down (preparing to go to sleep) (Weaver et al., 2010; Johansson et al., 2016).

In addition, the inclusion of screen time during the unwinding period may stimulate the minds of teenagers with information, knowledge, thoughts and elicit subjective emotional experiences like fear of missing out, which provide may delay sleep onset and push bedtimes to later (Scott, Biello & Cleland, 2018; Johansson et al., 2016; Brooks, 2018). These devices may also disturb adolescents while sleeping by waking them up a few times per week to every night (Van den Bulck, 2003; Johansson et al., 2016; Van den Bulck, 2007). Sleep is affected by the use of technology an hour before bed (Gradisar et al., 2013).

However, it is important to note that there is still some contention regarding the direction of the relationship and the degree to which stimulating technology affects sleep (Weaver et al., 2010; Gaarde, 2018). This may stem from the fact that additional factors, apart from the interaction with technology, may influence sleep. Another possible reason for this is that the extant literature that examines adolescents' use of technology often relies on retrospective self-report measures of screen time, requiring adolescents to report how much and how many times they utilise their electronic devices (Orben, Etchells & Przybylski, 2018).

Caffeine use

There is generally an increased prevalence of caffeine consumption during adolescence (Calamaro et al., 2009; Bartel et al., 2015). These caffeinated substances include coffee, soda, energy drinks, tea, or chocolate (Reid et al., 2002; Calamaro et al., 2009; Pennington et al., 2010; Owens, 2014). The acceptable range of caffeine intake in adolescents is less than 400mg per day (Mitchell et al., 2014), however adolescents are consuming more than that per day (Cho, 2018). A high total caffeine intake, primarily in the form of sweetened coffee and energy drinks was correlated with difficulty sleeping, increasing the risk of experiencing sleep disturbances, resulting in truncated poor quality of sleep and feeling tired in the morning (Ban & Lee, 2001; Ohayon 2004; Ergun et al., 2017; Cho, 2018).

However, it is important to note that there is a bi-directional effect of caffeine on sleep; teenagers have been found to mainly consume caffeinated beverages to counteract the effects of daytime sleepiness because of the effect of caffeine on alertness and concentration (Calamaro et al., 2009; Bryant-Ludden & Wolfson, 2010; Bartel et al., 2015; Treur et al., 2018). This is compounded by the fact that caffeine acts as an adenosine receptor antagonist (Pollak & Bright, 2003; Drapeau et al., 2006; Porkka-Heiskanen & Kalinchuk, 2011). Adenosine is a sleep-promoting chemical thus the level of adenosine in the brain increases in relation to previous wakefulness (Calamaro et al., 2009; National Institute of Neurological Disorders and Stroke, 2017). Elevated adenosine concentrations seem to profoundly regulate the depth and duration of sleep (Calamaro et al., 2009; National Institute of Neurological Disorders and Stroke, 2017). Thus it is fully clear if caffeine consumptions interrupts sleep negatively or helps adolescents compensate for the disturbances in sleep (Pollak & Bright, 2003).

The fact in literature however, is that caffeine consumption late in the afternoon or evening has been associated with prolonged sleep latency, decreased sleep efficiency, reduced sleep duration and poor sleep quality (Dahl & Carskadon, 1995; Pollak & Bright, 2003; Orbeta et al., 2006; Calamaro et al., 2009; Ludden & Wolfson, 2010; Bertal et al., 2015; Clark & Landolt, 2017; Treur et al., 2018).

School-related commitments

In addition to the impact of the home environment, adolescent sleep is also heavily influenced by school-related commitments. Learners are often required to wake up early to go to school using various modes of transport to tackle many school-related commitments such as academics and, for some, sporting and cultural commitments that form part of the school day (Calamaro et al., 2009; Bartel et al., 2015; Felden et al. 2015; Sampasa-Kanyinga et al.,2018; Crowley et al., 2018; Schmeer, 2019). Adolescents tackling school commitments and how that may affect sleep is explored below.

Commuting to school

The sleep-wake behaviour of the general population is affected by daily commuting distance (Pradhan & Sinha, 2017). Studies have documented that long-distance commutating may require adolescents to go to bed early and wake early to adhere to shool commitments specifically (Pereira, Moreno & Louzada, 2014; Voulgaris, Smart & Taylor, 2019). Adolescents with long commutes generally spend less time in bed (Pereira et al., 2014; Pradhan & Sinha, 2017). The reason for commuting may be due to the geographic locations of the adolescents (Voulgaris et al., 2019) and the early school start times (Crowley et al., 2007; Gradisar et al., 2011; Nahmod et al., 2019).

Early school start times

School start times in many countries range from 07:30 – 08:30 am, which often require adolescents to wake up between 06:00 and 07:30 am during school nights (Crowley et al., 2007; Gradisar et al., 2011; Nahmod et al., 2019). The effects of early school start times are early awakenings, combined with the need to commute (Pereira et al., 2014; Pradhan & Sinha, 2017). Adolescents in other countries including South Africa are faced with early school start times that usually range between 7:30 – 8:30 am (Reid et al., 2002; Wolfson et al., 2007). For adolescents to get the average recommended hours of sleep which is 8-10 hours, going to sleep before 10:30 pm on school nights is recommended (Gradisar et al., 2011). However, this is not the case as adolescents in different parts of the world were documented to get less than 8 hours of sleep on weekdays (Gau & Soong, 1995; Reid et al., 2002; Wahlstrom, 2002; Wolfson et al., 2003; Carskadon et al., 2004; Merikanto et al., 2013; Dewald et al., 2014; Bei et al., 2014). Adolescents obtaining insufficient sleep is attributed to the natural and social changes in adolescents' sleep-wake behaviour that favour a later

bedtime and therefore necessitates a later rising, both of which conflict with school start times which require early rise times (Wolfson & Carskadon, 1998; Wolfson et al., 2007; Yang et al., 2005; O'Brien & Mindell, 2005; Carskadon, 2011, Crowley et al., 2018). Therefore, this may result in adolescents obtaining significantly less sleep each night, displaying daytime sleepiness and having significant discrepancies between week and weekend sleep (Wolfson & Carskadon, 2003; Crowley et al., 2007; Wolfson et al., 2007; Owens et al., 2010; Gradisar et al., 2011; Kalsbeek et al., 2012; Touitou, 2013; Kelley et al., 2017; Winnebeck et al., 2019; Illingworth et al., 2019).

As it is well established that early school start times are incompatible with the biopsychosocial changes experienced by adolescents (Carskadon et al., 1998; Reid et al., 2002; Wahlstrom, 2002; Wolfson et al., 2007; Owens et al., 2010; Minges & Redeker, 2016; Crowley et al., 2018). In trying to combat this, there are calls to delay school start times (Epstein, 1995; Wahlstrom, 2002; Ziporyn et al., 2022). Delaying school start times has been shown to improve adolescents' sleep, improve mood and alertness, overall health and academic performance (Wahlstrom, 2010; Owens et al., 2010; Minges & Redecker, 2016).

Homework

Another factor that has been shown to compromise adolescents' sleep is the need to complete homework (Owens & Weiss, 2017; Becker et al., 2015). Homework often requires learners to work at night, resulting in delayed bed times and less time in bed (Zhou et al., 2012; Galloway et al., 2013; Sun et al., 2014). This is more common in older adolescents in the final year of school who may be trying to get into competitive tertiary institutions (Yang et al., 2005; Pope, 2008; Galloway et al., 2013; Sun et al., 2014). Time spent on homework may increase adolescents stress and depressive symptomatology (Kouzma & Kennedy, 2002), which may, in turn, further impact sleep (Becker et al., 2015).

Extracurricular commitments at school

Adolescent sleep is influenced by the activities that adolescents take part in daily. These activities may include part-time jobs and other school activities as part of adolescents' extracurricular programs, including musical groups, dance, religious activities and sport (Reid et al., 2002; Gamble et al., 2014). These activities may keep adolescents entertained and might, if not adequately balanced, lead to increased

stress and anxiety, which have been linked to compromised sleep quality and quantity (Meerlo et al., 2008). Sport, in particular, is one extracurricular activity that tends to compromise adolescents' sleep (Mellalieu et al., 2009).

Sport training

Participation in sports or physical activity is associated with positive outcomes such as improved mood, managing stress better and maintaining an optimal level of cognitive function (Anshel, 2010). Moreover, participation in sport has a positive effect on sleep patterns (Beck et al., 2009; Brand et al., 2010; Suppiah, Low & Chia, 2015). Adolescents need to find a favourable balance between sport and academics in that they must maintain self-care skills to cope with stress, sport, school, and all other facets of their lives (Jonker et al., 2010). However, not all adolescents find that balance, as learners participating in sport were shown to be at more risk of having additional stressors because of conflicting commitments, time restrictions, and anxiety surrounding training and competition (Mellalieu et al., 2009).

Sports participation may require a high volume of training which may include early morning training in an attempt to fit enough training into the week (Stennekamp et al., 2020). This early morning training has been shown to truncate sleep (Sargent et al., 2014; Lastella et al., 2015; Kolling et al., 2016; Gudmundsdottir, 2020; Stennekamp et al., 2020). Adolescents may also experience disturbed sleep due to excessive thinking, worrying, or planning before important matches or competition (Fullagar et al., 2015; Jullif et al., 2015; Halson, 2016). All of this may result in compromised sleep quality and quantity , which may negatively affect recovery, performance in sports, but also in other facet of life, such as academic performance (Van den Bulck, 2004; Halson et al., 2016; Skein et al., 2019).

Part-time jobs

There is evidence that many adolescents have to juggle the demands school and part-time jobs, associated with reduced sleep duration and more sleep problems (Maume, 2013; Becker et al., 2015). This may result from the stress that may arise from their part-time jobs (Burgard & Ailshire, 2009). Several authors have also shown adolescent employment to be a significant predictor of shorter sleep duration (due to earlier rise times), poorer sleep quality, greater daytime sleepiness, and extended sleep duration on weekends in adolescents (Fischer et al., 2005; Teixeira et al., 2007; Adam et al.,

2007; Fischer et al., 2008). Furthermore, adolescent employment may be associated with poor mental health (Hollmann et al., 2001) and poor performance academically (Fischer et al., 2005; Teixeira, Fischer & Lowden, 2006). Working may also enable adolescents to afford to access and use substances that may affect their health (Mortimer, 2003; Maume, 2013).

Overall, several bioregulatory and psychosocial factors interact and contribute to the reduced sleep amongst adolescents, captured in the Perfect Storm of insufficient and ill-timed sleep model, discussed below (Carskadon, 2011; Crowley et al., 2018).

2.2.1 The Perfect Storm: insufficient and ill-timed sleep

The Perfect Storm model of insufficient and ill-timed sleep was originally established by Carskadon (2011) and recently updated by Crowley and colleagues (2018). The model provides a summary of the the bioregulatory and psychosocial factors that conspire to produce a Perfect Storm of insufficient and inappropriately-timed sleep during adolescence (Carskadon, 2011; Crowley et al., 2018).

The bioregulatory pressures include the sleep homeostatic process wherein the sleep pressure rise slows down, and there is circadian phase delay in the circadian rhythm of adolescents. The bioregulatory pressures sustain alertness later into the night. At the same time, parental set bedtimes decrease, academic demands increase, social networking in adolescents expand (Carskadon, 2011; Crowley et al., 2018). Activities that produce additional light stimuli or are stimulating can reinforce evening alertness, pushing bed times later and later as adolescents mature. Opposing these factors that push sleep later, there are morning activities that would push for early rise times such as school start times, religious or early sport practices (Crowley et al., 2018). It is important to acknowledge that the factors affecting adolescents' sleep are complex and multifaceted.

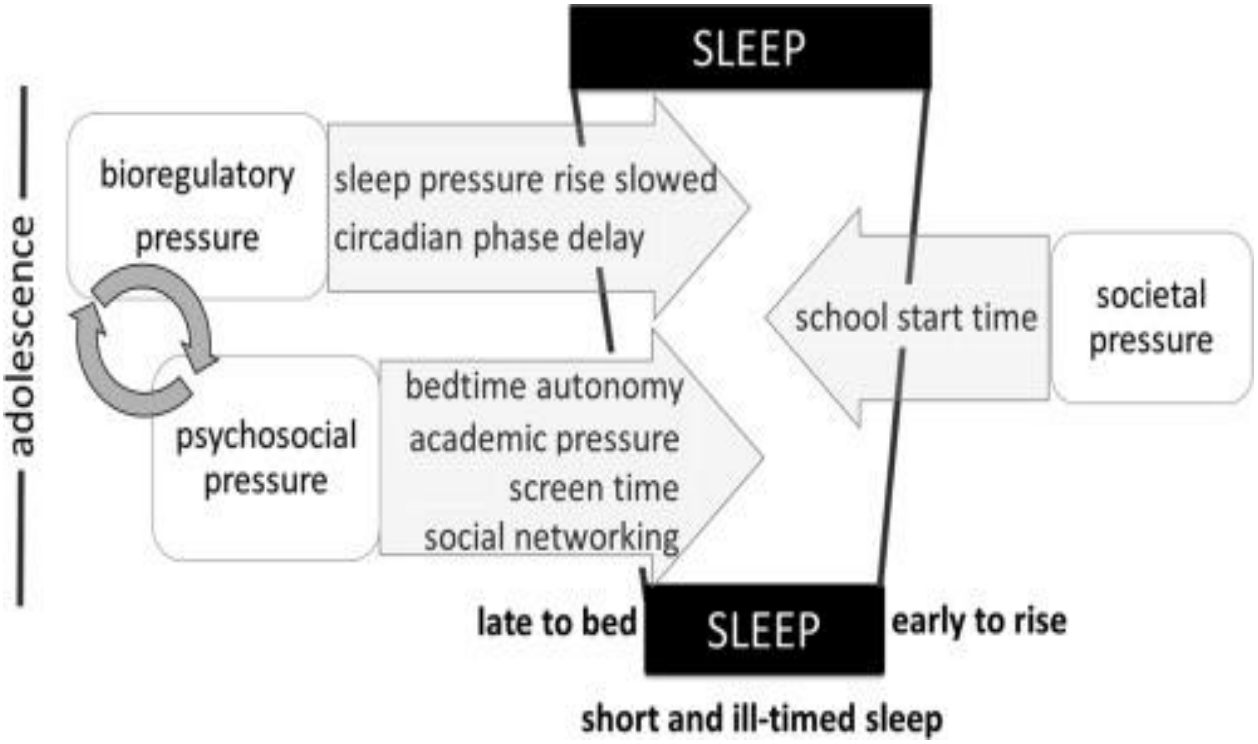


Figure 2. A summary of the several factors that conspire to produce a Perfect Storm of insufficient and inappropriately timed sleep (taken from Crowley et al., 2018).

While adolescents around the world experience the effects of these factors on their sleep, it is important to acknowledge the impact that different contexts may have on adolescents obtaining sufficient sleep. While there has been extensive research in other contexts in the Global North, there has been comparatively less in countries like South Africa. The research that has been conducted on adolescents' sleep in South Africa has been in urban settings (Reid et al., 2002; Mandondo, 2020). The overall finding in these studies were that adolescents were sleeping less than the recommended hours of sleep, that is they were getting insufficient sleep (Reid et al., 2002; Mandondo, 2020). However, to the best of the authors' knowledge there has been no research into adolescents' sleep-wake behaviour in rural and township settings of South Africa.

As South Africa has a diverse population with schooling and living conditions that differ, largely due to historic, political, and economic factors, it is important to acknowledge the impact that context and the associated factors to understand adolescents' unique challenges concerning their sleep, particularly those living in a rural and township setting. As expanded upon below, the living and schooling

conditions for adolescents in these areas may have an impact of their sleep wake behaviour, but this needs to be elucidated.

2.3 Understanding the South African context

South Africa is a country that differs from other contexts in several respects, including the extreme levels of inequality that exist and the recent Apartheid history that systematically disempowered the majority of South Africans (Bell & McKay, 2011; Graven, 2014). After Apartheid, in 1996, a South African settlement system was formed according to the characteristics of a residential population (Consensus, 2001; StatsSA, 2013; Atkinson, 2014). The settlement system is characterised into four main broad settlement types;

- ***Formal urban areas (city areas)*** – These areas are in metropolitan areas. They may also be secondary and tertiary towns that are joined in metropolitan areas.

- ***Informal urban areas (township areas)*** – These are informal settlements, which are often in between the rural and urban fringe, often referred to as peri-urban or township areas.

- ***Tribal areas and informal rural settlements (rural areas)*** - are usually former homelands. They may contain a rural-urban continuum, including formal dormitory dense rural settlements (without any economically functional core), small towns, agricultural villages, and small farms.

Given the focus of this thesis, it is important to characterise the living conditions of adolescents living in a rural and township setting to highlight contextual factors that may influence their sleep-wake behaviours.

2.3.1 The home environment of adolescents in rural and township areas

The majority of rural and township adolescents are usually from lower socioeconomic backgrounds (Bayat et al., 2014; Dass & Rinquest, 2017). A lower socioeconomic background in South Africa is often characterized by living in a home where parents/guardians are unemployed, have a low education level, and have poor housing conditions (Motha & Frempong, 2014). There is usually inadequate access to basic services and housing in these areas (Bayat et al., 2014). Most households from

lower socioeconomic backgrounds also rely on social grants from the government (Motha & Frempong, 2014; Bayat et al., 2014; Dass & Rinquest, 2017). These adolescents may come from households where food insecurity is a reality due to parents or caregivers being unemployed (Bayat et al., 2014; Dass & Rinquest, 2017). To expand further and hone in on the differences between rural and township settings, more detail is provided below.

2.3.1.1 Rural areas

Children from rural areas live in agricultural villages or small farms that may be geographically far from local towns (du Toit, 2017). The community size is usually small, and the residents' houses may be far from each other (du Toit, 2017). The children in rural areas are expected to carry out domestic tasks in the early morning and in the afternoon (Hendricks, 2008; Du Plessis & Mestry, 2019). The chores can involve collecting water from the river or local taps, washing their uniforms, collecting, and chopping wood, herding cattle and cooking (Hendricks, 2008; Ndlovu, 2014). Children are often also expected to work on farms to contribute at home (Hendricks, 2008; Ndlovu, 2014; Bayat et al., 2014; Du Plessis & Mestry, 2019).

Parents depend on their children to help with domestic labour (Hendricks, 2008). The duties adolescents are expected to do can create tensions between family responsibilities and social roles and clash with the school's routines and timetables, eventually decreasing their desire for education altogether (Hendricks, 2008; Mpofu, 2015; Du Plessis & Mestry, 2019). This, along with the actual living environment, may influence an adolescent’s sleep-wake behaviour, as some are expected to arise early to perform some of their chores and have to get ready for school.

2.3.1.2 Township areas

Learners from township areas tend to live under small apartments, which may include houses from Reconstruction and Development Programme (RDP houses) (https://omalley.nelsonmandela.org/omalley/index.php/site/q/03lv02039/04lv02103/05lv02120/06lv02126.htm) and with rows filled with informal dwellings such as shacks built of scrap metal, cardboard, iron or wood (Eloff & Sevenhuysen, 2011). Township areas often do not have proper sanitation systems such as running water, where people often have to queue with heavy buckets at communal taps for water. There may be areas that have poor sewage systems (Eloff & Sevenhuysen, 2011; Bayat et

al., 2014; Du Plessis & Mestry, 2019). Township areas in South Africa usually have a high population density, with houses that are often overcrowded (Bayat et al., 2014; Pillay, 2016; Hall & Mokomane, 2018). Township communities have also been associated with high crime rates (Bayat et al., 2014), which may in turn affect the perceived safety and wellbeing of occupants in these areas.

2.3.1.3 Realities of rural and township living

Education level of parents

Parental monitoring is encouraged in enforcing good quality and quantity of sleep in adolescents (Dahl & Lewin, 2002; Arredondo et al., 2006; Maume, 2013; Dittus et al., 2015). Most parents residing in rural areas have a low level of education (Mbajiorgu et al., 2014), and often do menial work with long hours of work being normal. This can result in parents or guardians getting home and being too tired or unmotivated to even check their children's schoolwork (Modioatsile, 2012). There is a lack of research in the rural and township area of South Africa to see whether parents monitor or supervise the sleep of their adolescent children.

Commuting for adolescents

Early school start times are an established barrier for adolescents' sleep. Adolescents from rural and township areas commute to school every day using various modes of transport, as the schools are geographically dispersed (General Household Survey, 2018; Department of Education, 2019; Amnesty, 2020). Some learners walk an approximate distance of more than 3km for between 30 minutes and an hour to get to school (Amnesty, 2020). The distance travelled to school by adolescents is defined as "far" if they take more than 30 minutes to reach it, irrespective of the mode of transport (Hall & de Lannoy, 2014).

In South Africa, children or adolescents live in more remote areas, where public transportation to schools is inadequate and in households that cannot afford private transport for children to get to school (Longueira, 2017; Hall & de Lannoy, 2014). Due to poor infrastructure and the limited number of easily accessible schools, they walk long to access schools (Mgushelo, 2018). This would mean adolescents would have to wake up extra early to make it to school in time, which may compromise their sleep. Their school attendance may be influenced by weather; attendance might be

low on days of heavy rains or lightning storms (Longueira, 2017; Hall & de Lannoy, 2014).

In previous years, adolescents in KwaZulu-Natal reportedly walked for two hours to get to school (Stuurman & Joseph, 2015). Students from this province would wake up at 4 am to prepare for school and help their siblings get ready for school (Equal Education, 2013). They would be required to leave home at 6 am for a two-hour walk to school (Stuurman & Joseph, 2015). Living far from school would not exempt them from being punished by teachers who would wait for them at the gate to punish them, as they would be late (Ndlovu, 2014). The walk to school would not give them a chance to perform optimally at school as they would be exhausted by the time for class (Ndlovu, 2014; Mgushelo, 2018). An emergent outcome of learners walking to school is teachers reportedly complaining about children being hungry and tired and being inattentive in class (Ndlovu, 2014; Mgushelo, 2018).

2.3.2 Impact of living conditions of rural and township areas on adolescent sleep

Adolescents from rural and township areas live under unique conditions, many which may be beyond the scope of this thesis. The impact of the living conditions of adolescents from this context especially in South Africa on sleep is unclear and has not yet been fully researched. However, the financial situation of adolescents from lower socioeconomic backgrounds may have an effect on daily routines that may potentially influence adolescents from obtaining adequate quality sleep (Longueira, 2017). The over crowdedness in learner's homes from this context may lead to adolescents in most cases having to share their sleeping space with their siblings as well as adult relatives (Bayat et al., 2014; Pillay, 2016; Hall & Mokomane, 2018). The section on home environment and neighbourhood above explained how a violent neighbourhood might cause a heightened vigilance that arises from fear or stress, or through noise and disruption from gunfire, shouting, and expanded police presence that is happening in their communities which may affect their sleep (Dahl, 1996; Hale et al., 2013; Lacoe & Sharkey, 2016). Studies have shown that adolescents had later bedtimes on the nights following a violent crime in either their households or in the neighbourhood, which decreased their sleep duration (Heissel et al., 2017). These adolescents will be required to go to school and be alert the following day after a night of poor quality and quantity of sleep (Heissel et al., 2017). Adolescents living far from

their schools and having to commute a long distance from their home to school may result to adolescents spending less time in bed, lead to sleep deprivation, poor sleep quality, and excessive daytime sleepiness (Pereira et al., 2014; Pradhan & Sinha, 2017). It is important to note that this has not been explored in this context. Overall, the interaction of several factors that influence adolescents' sleep is likely to have negative consequences (Reid et al., 2002; Crowley et al., 2018), which will be expanded below.

2.4 Effects of poor sleep on adolescents

The effects of sleep loss in adolescents have been associated with negative effects on adolescents' wellbeing and performance. There are some aspects of adolescents' wellbeing that are compromised by sleep loss such as cognitive and physical performance, mental health, academic performance, and others that are explored in subsequent paragraphs (Wahlstrom, 2002; Dewald et al., 2010; Katz & McHorney, 2002; Merikanto et al., 2013; Owens, 2014; Shochat et al., 2014; Hirshkowitz et al., 2015; Schmeer et al., 2019).

2.4.1 Effects on alertness

Poor and inadequate sleep in adolescents has been linked with an increase in daytimes sleepiness and reduced alertness (Wahlstrom, 2002; Katz & McHorney, 2002; Dewald et al., 2010; Merikanto et al., 2013; Owens, 2014; Shochat et al., 2014; Hirshkowitz et al., 2015; Schmeer et al., 2019). Daytime sleepiness impairs cognitive functioning by reducing levels of alertness and compromising the functioning of certain brain areas such as the prefrontal cortex (Dewald et al., 2010). Reduced alertness and daytime sleepiness affect interest in task performance, and make concentrating in class challenging and difficult, which in turn can affect learning and overall academic performance (Wahlstrom, 2002; Katz & McHorney, 2002; Dewald et al., 2010; Merikanto et al., 2013; Owens, 2014; Shochat et al., 2014; Hirshkowitz et al., 2015; Schmeer et al., 2019).

2.4.2 Effects on cognitive and academic performance

While likely the result of many different factors, sleep loss in adolescents has repeatedly been shown to negatively affect academic performance (Wolfson & Carskadon, 1998; Wahlstrom, 2002; Fredriksen et al., 2004; Wolfson & Carskadon, 2003; Dewald et al., 2010; Merikanto et al., 2013; Owens, 2014; Shochat et al., 2014;

Hirshkowitz et al., 2015; Schmeer et al., 2019). Sleep-related problems make achieving complex tasks, which require abstract thinking, reasoning, creative processing, integration, and planning challenging for sleep-deprived adolescents (Dewald et al., 2010). The prefrontal cortex, a part of the brain that is responsible for solving complex tasks, is impaired by inadequate sleep and, therefore, the ability to learn and, consequently, academic performance (Beebe, 2011; Giedd, 2015).

Moreover, the effects of low quality and quantity of sleep in adolescents can manifest during class and influence student-teacher interaction (Dahl, 1999). Learners may fall asleep while a teacher is conducting a lesson (Dahl; 1999; Saminsky, 2010) and some may even skip school (Katz & McHorney, 2002). Absenteeism has also been shown to increase as a result of sleep loss (Crowley et al., 2018).

2.4.3 Health-related effects

2.4.3.1 Effects on mental health

It has long been recognised that mental health disorders in adolescents exhibit a bidirectional relationship with sleep disturbances (Dahl & Lewin, 2002; Owens, 2014; Lovato et al., 2017). In studies where adolescent report trouble with sleeping, tiredness, nightmares, and being a long sleeper, there are significant associations with psychological symptoms such as mood disturbances, anxiety/depression withdrawal, and suicide ideation (Krakow et al., 2000; Fawcett et al., 1990; Liu, 2004; O'Brien & Mindell, 2005; Bernert & Joiner, 2007; Liu & Buysee, 2006; Coulombe et al., 2010; Lee et al., 2013; Owens, 2014; Owens, 2014; Shochat et al., 2014; Hirshkowitz et al., 2015; Schmeer et al., 2019). Circadian factors such as increased self-reported “eveningness”, a marker of circadian phase delay in some adolescents, has also been associated with increased risk of depression (Hasler et al., 2004; Owens, 2014).

2.4.4 Effects on physical health

Increased food intake following insufficient sleep is a physiological adaptation to provide the energy needed to sustain additional wakefulness. Insufficient sleep increases food intake, and this association is due to decrease production of the appetite supressing hormone leptin and an increased production of the appetitive hormone ghrelin (Markwald et al., 2013; Chaput & St-Onge, 2014). As a consequence, insufficient sleep is associated with weight gain, which places individuals at a high risk of obesity (Owens, 2014; Grandner, 2018; Chattu et al., 2019) and other associated

health challenges (Gupta et al., 2002; Knutson & Van Cauter, 2008) such as a reduced immune response (Mileski et al., 2014), developing Type 2 diabetes mellitus (Martinez-Gomez et al., 2011; Beebe et al., 2007), cardiovascular morbidity and hypertension (Schlafer et al., 2014; Chattu et al., 2019).

Insufficient sleep is also associated with an increased likelihood of injury in adolescents who play sport (Milewski et al., 2014; Gao et al., 2019; Fox et al., 2020; Sawczuk et al., 2018). Current evidence shows that adolescent athletes who have frequent night-time awakenings or sleep less than 8 hours per night are more likely to experience sports or musculoskeletal injuries (Gao et al., 2019; Fox et al., 2020).

2.4.5 Risk-taking behaviour

Risk-taking in adolescence may serve to fulfil developmental needs related to autonomy (Irwin & Millstein, 1986; O'Brien & Mindell, 2005). Sleep loss has been associated with a tendency of heightened risk-taking behaviour through the detrimental effects on brain regions responsible for risk-taking and decision making such as the prefrontal cortex (Thomas et al., 2000; Short & Weber, 2018). The risk-taking behaviours include alcohol use, tobacco use, violent behaviour, using automobile vehicles irresponsibly, and partaking in unsafe sexual activities (Wolfson & Carskadon, 1998; Reid et al., 2002; O'Brien & Mindell, 2005; Owens, 2014; Chaput et al., 2018; Crowley et al., 2018; Short & Weber, 2018). It is important to note that the causes and consequences of acute and chronic sleep loss in adolescents are often closely intertwined in more complex ways (Owens, 2014; Becker et al., 2015; Owens & Weiss, 2017). These are the few examples of how the causes and consequences are intertwined; studies show that alcohol consumption may lead to insufficient and poor-quality sleep and subsequent daytime sleepiness (Berkey, Rockett & Colditz, 2008; Singleton & Wolfson, 2009; Lund et al., 2010; Owens, 2014), while chronic sleep loss has been associated with an increased risk of alcohol and drug use (Loessl et al., 2008; Mednick et al., 2010; Roberts et al., 2011; Owens, 2014).

2.5 Methods used in assessing sleep of adolescents

Researchers use different methodological approaches to understand the sleep patterns and the factors affecting the sleep of adolescents. The sleep patterns of adolescents can be evaluated through various objective and subjective methods (Short et al., 2012). Polysomnography (PSG), actigraphy, sleep diaries,

questionnaires, interviews, and time use methods can be used to assess the sleep of adolescents (Kushida et al., 2001; Gupta et al., 2002; Sadeh & Acebo, 2002; Toth & Javheri, 2003; Taheri et al., 2004; Williams et al., 2009; Sitnick et al., 2008; Gregory et al., 2011; Reis, Gable & Maniaci, 2013; Mazza et al., 2020; Orben & Przykbylski, 2020). These are discussed below.

2.5.1 Objective measures

2.5.1.1 Polysomnography

Polysomnography (PSG) is a systemic process used to collect physiologic parameter during sleep (Rundo & Downey, 2019) and has long been considered the gold standard for objectively measuring sleep (Toth & Jhaveri, 2003; Verhulst et al., 2006; McCall & McCall, 2012). PSG is often performed in a clinic or laboratory setting to record various physiological characteristics over a limited period (McCall & McCall, 2012). However, PSG is an expensive procedure that provides information about sleep for usually one or two nights, often in an unfamiliar environment and this limits its applicability to field studies. It also makes PSG challenging and even frightening for participants (Lockley et al., 1999; Ancoli-Israel et al., 2003; Sadeh, 2011; Short et al., 2012; Arora et al., 2013). However, there has been reported use of ambulatory PSG in South African rural homes for older persons (Roche et al., 2021).

2.5.1.2 Actigraphy

Actigraphy is a non-invasive method of capturing body movements that can be used over long periods in the natural sleep setting of the participant (McCall & McCall, 2012). An actigraph is a wristwatch-like device containing an accelerometer that continuously monitors motor activity (Acebo et al., 1999; Mazza et al., 2020). It is a cost-effective method to assess sleep-wake rhythms of adolescents in the comfort of their environment for extended periods, (Lockley et al., 1999; Sadeh, 2011; Short et al., 2012; Arora et al., 2013; Quante et al., 2018). Actigraphy is often used with subjective measures (Short et al., 2012; Mazza et al., 2020) such as sleep diaries provide more detailed information that can be utilized to understand better the sleep of adolescents (Wolfson et al., 2003; Arora et al., 2013; Tomita et al., 2013; Biddle et al., 2015).

2.5.2 Subjective measures

Subjective measures such as sleep diaries and questionnaires or surveys are tools that most studies rely upon to document adolescent sleep patterns and the factors affecting them (Kim et al., 2011; Short et al., 2012; Arora et al., 2013; Owens, 2014).

2.5.2.1 Sleep diaries

Sleep diaries are a useful methodology to record sleep on a night-by-night basis (e.g., bedtime, sleep duration, sleep onset latency, night awakenings) and reflect a subjective global appraisal of each night's sleep (Mazza et al., 2020; Arora et al., 2013). Sleep diaries, however, are a more effective method for documenting average sleep duration relating to the previous month, provided they are completed daily and close to the point of waking (Blake & Kerr, 2010; Arora et al., 2013; Mazza et al., 2020; Mallinson et al., 2019).

2.5.2.2 Questionnaires and surveys

Questionnaires can provide a detailed description of sleep schedules, night awakenings, and sleep-related behaviours (Mazza et al., 2020). Commonly used survey methods for school going children and adolescents include: the School Sleep Habits Survey (SSHS) (Carskadon et al., 1991; Wolfson & Carskadon, 1998; Wolfson et al., 2003) which is a 63-item questionnaire designed to assess the sleep/wake habits and typical daytime functioning of high school students; the Pediatric Daytime Sleepiness Scale (PDSS) (Drake et al., 2003) which is a simple, 8-item instrument where each item assesses the frequency of a sleep related behaviour using a 5-point Likert type scale (0= never, 4= always) and is designed for use with children of middle-school age (11–15 years) (Spilsbury et al., 2007); the Cleveland adolescent sleepiness questionnaire (CASQ) in which there are 16 items to measure extreme sleepiness during the day in adolescents aged 11–17 years old (Spilsbury et al., 2007; Aghajani et al., 2020); the Pittsburgh sleep quality index (PSQI) consists of 18 individual items that assess sleep habits, sleep disturbances, and daytime impairments experienced during the previous month in adolescents (Buysee et al., 1989; Mollayeva et al., 2016; Raniti et al., 2018; Aghajani et al., 2020). There is also the Insomnia Severity Index (ISI) which has seven items that assess the severity of problems that include falling asleep, staying asleep, waking up early, and satisfaction with sleep (Morin, 1993; Chehri et al., 2021). It also evaluates the interference of insomnia in daytime functions and intensity of the interference caused by sleep problems (Chehri et al., 2021).

Overall, these methods do not come without limitations, participants when using questionnaires or surveys have been found either to under report their sleep duration and over report their sleep onset (Wolfson et al., 2003). Self-reported data therefore do not always yield accurate responses in adolescent sleep wake behavior (Wolfson et al., 2003).

2.6 Summary and rationale for this study

The consensus across different studies worldwide that have employed different methodological approaches to track sleep in adolescents is that this group has and continues to be at risk of experiencing chronic sleep loss due to the complex interaction of various biological, social, environmental, and contextual factors. While there has been some research into understanding this in South Africa, most research has occurred in urban/city settings and no research to date has focussed on the sleep-wake behaviour of adolescents in the rural and township context in South Africa. Therefore, the focus of this study is to characterise the sleep-wake behaviour of adolescents in rural and township areas and explore the factors that may be influencing this behaviour.

CHAPTER III

3 METHODOLOGY

3.1 Experimental design

The study adopted a descriptive, cross-sectional design to characterise the sleep-wake behaviour of a sample of Grade 12 learners from rural and township areas through the use of the School Sleep Habits Survey (SSHS) (Wolfson et al., 1998).

3.2 Research study setting

The study setting was in Alice, a small rural town in the Amathole District of the Eastern Cape in South Africa (figure 3). Alice has 56 surrounding villages with a small town with businesses that service the area (Xuza, 2005). Alice functions as a link between the rural hinterland and the larger cities (Xuza, 2005), and is widely known for the tertiary institutions in the town, such as the University of Fort Hare and Lovedale Further Education and Training College (Alice LED Strategy Report, 2000; Xuza, 2005). The small business area with shops and the University of Fort Hare is referred to as Alice town (CBD). The whole settlement system in Alice is referred to as rural peri-urbanization, which means it has both rural and township areas. The surrounding areas that are closest to town are peri-urban or township areas (Cross et al., 2000; Powell, 2011; Atkinson, 2014) (figure 4). The rural area encompasses all the surrounding villages that are furthest away from town (Alice LED Strategy Report, 2000) (Please refer to figure 4).

Figure 3. Map of South Africa and Alice (Norval & Wright, 2017)

Figure 4. Detailed map of Alice town and its surrounding villages. The location of the participating rural schools is marked in blue circles and township schools in red circle.

The location of the Alice, Town in the Eastern Cape is in an orange circle in figure 3. A more clearly detailed map of Alice can be accessed on this website https://www.bing.com/maps?osid=dd798e98-46d9-42b8-b38a-05149d50a78d&cp=-32.784984~26.82511&lvl=13&style=h&imgid=5a13faaa-47f3-4c1f-b5bc-977cd62e076f&v=2&sV=2&form=S00027 (Figure 4).

3.3 Data collection method

3.3.1 School Sleep Habits Survey (SSHS)

The School Sleep Habits Survey (SSHS), the instrument used in this study, was developed by Carskadon et al. (1991), Wolfson and Carskadon (1998) and Wolfson et al. (2003) and has been used in different study populations (Anders et al., 1978; Acebo & Carskadon, 2002; Wolfson et al., 2003; Giannotti et al., 2002; Yang et al., 2005; Russo et al., 2007; Shochat et al., 2010; Owens et al., 2010; Arora et al., 2013; Short et al., 2013). The SSHS was designed to assess the sleep-wake habits and typical daytime functioning of high school learners (Wolfson et al., 1998; Shahid et al., 2011). The survey allowed researchers to collect information concerning the sleep-wake behaviour of adolescents over two weeks (Wolfson & Carskadon, 1998; Yang et al., 2005; Wolfson et al., 2007).

In summary, the survey comprised of four sections (Wolfson & Carskadon, 1995; Yang et al., 2005; Wolfson et al., 2007; Shahid et al., 2011). Please see appendix A for the original School Sleep Habits Survey. The different sections of the survey are detailed below.

3.3.1.1 Different sections of the SSHS

Demographic characteristics

The first section of the survey enquired about the demographic and health related information of participants. The questions in this section included their age, gender (male or female), height, weight, ethnicity, the school performance of participants based on self-reported grades and the level of education the learners' perceived reaching such as whether they thought they would finish high school, college or go beyond college. Furthermore, this section enquired on who participants lived with at home, and the employment of their parents/guardians. The health-related information were questions around whether participants had any disabilities or chronic illnesses and were taking medication for them.

Sleep patterns

The second section of the survey was about the sleep-wake behaviour of participants over the last two weeks on weekdays and weekends such as their bedtimes and reasons for bedtimes, rise times and reasons for rise times, sleep duration, perceived sleep need and sleep onset. The survey also assessed nocturnal awakenings, frequency of daytime naps, perceived sleep quantity and quality, and daytime sleepiness problems. There were also questions on what time the participants left for school and the mode of transport they used.

Individual information and scales

The third section asked students about their growth in height and maturation status, caffeine consumption, and included different scales to assess daytime sleepiness, sleep-wake behaviour, chronotype and depressive mood. The different scales and how they are calculated are described below:

- Daytime sleepiness was assessed using the sleepiness scale by asking whether the respondent had struggled to stay awake (fought sleep) or fallen asleep in 10 different situations in the last two weeks (Wolfson and Carskadon, 1998; Giannotti et al., 2002; Wolfson et al., 2007; Yang et al., 2005). The possible answers on the sleepiness scale are scored on a Likert scale, 1 being no and 4 being yes to both struggling to stay awake and fall asleep in specific situations. Scores range from 10 to 40 and scores less than 10 indicate decreased levels of sleepiness and higher indicate more increased levels of sleepiness (Wolfson et al., 2007; Owens et al., 2010).

- Sleep-wake behaviour was assessed using the sleep-wake behaviour problems scale through ten items that asked about the frequency of indicators of irregular sleep-wake behaviours. The possible answers were never or every day/night, and they were on a 5-point scale, with 1 being never and 5 being every day/night (Wolfson & Carskadon, 1998; Wolfson et al., 2007; Owens et al., 2010). The sleep-wake-problems behaviours scale range from 10-40 and score less than 10 indicate fewer sleep-related problems, and 40 and higher indicate more sleep-related

problems (Wolfson &Carskadon, 1998; Giannotti et al., 2002; Wolfson et al., 2007).

- Depressive mood symptoms were assessed using the depressive mood scale that consists of six items that explore the mood state of participants. Response to question is Likert scale type, with 1 being not bothered at all by current situations and 3 being somewhat too much bothered (Wolfson and Carskadon, 1998). The depressive mood scale is scored from 6-18, and higher scores indicate a more depressed mood (Wolfson et al., 2007; Yang et al., 2005).

The depressive mood scale was included as sleep impairments have been associated with high levels of depression (Dahl and Lewin, 2002; Danner, 2000; Fichter et al., 2009; Ong et al., 2006; Wolfson and Carskadon, 1998). A bidirectional causal pathway may exist between depression and sleep loss (Dahl and Lewin, 2002).

- The chronotype was assessed using the morning/evening-ness (M/E) scale which is indicative of the time of day that an individual prefers to engage in daily activities or that they feel to function at their optimum levels (Wolfson and Carskadon, 1998; Crowley et al., 2007). This gives us an idea of the adolescents' chronotype. Chronotype lies on a continuum between two extremes: morning types (larks) and evening types (owls) (Russo et al., 2007). The M/E scale is scored from 10-42, and higher scores indicate a greater preference for morning (Yang et al., 2005).

General lifestyle characteristics

The fourth and last section of the survey enquired about the extracurricular activities and history of injury of participants. The questions focused on sports participation, employment, and homework (please see Appendix A for the original survey).

3.3.2 Amendments to SSHS to suit the South African context.

There was a need to amend some of the questions in the SSHS to suit the South African context. These alterations were initially done by Mandondo (2020) for a previous study which explored the sleep wake behaviour of adolescents in a private and public high school setting in an urban area near to Alice in the Eastern Cape

(Please see appendix B for the Mandondo Modified School Sleep Habits Survey). The amendments aimed to ensure that the learners could understand the questions better and so that the questions reflected the language and metrics used in South African schooling systems. Given that the current study was in a different context to that of the Mandondo (2020) study, there was a need for further modifications (refer to Table 2). The only questions that were further amended to suit the context it was now applied to were around home environment-related questions (such as reasons adolescents went to bed/wake-up, who they lived with, who woke them up) and how they got to school (please refer to Appendix C for the modified version of the survey). The questions Mandondo (2020) modified along with the newly amended questions relevant for this study are all outlined in the table 2. The final version that was used was the original SSHS with Mandondo (2020) modifications as well the final local modifications (Table 2).

Table 2. An overview of original and modified questions from the school sleep habits survey

Question from the Original Sleep Habits Survey (refer to Appendix A for the original versions of the survey)	**Amended Questions (Refer to Appendix B for the modified version of the survey) (Mandondo, 2020)**	**Further modifications and incorporations for current study (Refer to Appendix C for the modified version of the survey)**	**Reason for modification**
5. What is your height? (inches)	Height (cm/m)	The Mandondo version of this question was incorporated	Centimetres and meters (cm/m) are the most used and understood measurements for height in South Africa.
6. What is your weight? Pounds.	Weight (kg)	The Mandondo version of this question was incorporated	Kilograms (kg) are the most used and understood units of measurements for height in South Africa
9. What best describes your racial/ethnic background? • White/Caucasian • Black/African American • Hispanic/Latino • Asian/ Asian American • Native American/ Amerindian • Multiracial • Other:	Racial/Ethnic background: • White • Black/African • Coloured • Indian • Other	The Mandondo version of this question was incorporated	This is per the Department of Home Affairs Classification for race in South Africa
11. Who lives in your home other than you: • Mother/ Stepmother • Father/ Stepfather • Older brother(s)/sister(s) • Younger brother(s)/sister(s) • Other family members(s)	Who lives in your home other than you: • Mother/ Stepmother • Father/ Stepfather • Sibling(s) • Other family members(s) • Hostel/Boarding school	The original version of this question was used	
12. Does your mother work outside of the home?	Does your mother/guardian work outside of the home?	The Mandondo version of this question was incorporated	Approximately 20% of the children in South Africa do not live with their biological parents (Statistics South Africa, 2018), and some children are head of their homes, with parents or guardians who have died (Lutya, 2007; Lutya, 2012; Motha & Frempong, 2014; Pillay, 2016).

14. Are your Grades in school mostly: • As • As and Bs • Bs • Bs and Cs • Cs • Cs and Ds • Ds • Ds and Fs	Are your Grades in school mostly: • 80-100% • 70-79.9% • 60-69.9% • 50-59.9% • 40-49.9% • 30-39.9% • 0-29.9%	The Mandondo version of this question was incorporated	As per the academic grading system utilized in high schools in High Africa (Department of Basic Education Republic of South Africa., 2012)
19. Do you take Ritalin or some other medication to help with concentration or a learning problem?	Do you take Ritalin/Concerta or some other medication to help with concentration or a learning problem?	The Mandondo version of this question was incorporated	Much like Ritalin, Concerta is also commonly used in South Africa (Truter & Kotze, 2005; Snyman and Truter, 2012).
23. There are many reasons for doing things at one time or another. What is the **main reason** you usually go to bed at this time on school days? (mark one) 31. There are many reasons for doing things at one time or another. What is the **main reason** you usually go to bed at this time on weekends? (choose one) • My parents have set my bedtime • I feel sleepy • I finish my homework • My TV shows are over • My brother(s) or sister(s) go to bed • I finish socializing • I get home from my job • Other:	There are many reasons for doing things at one time or another. What is the **main reason** you usually go to bed at this time on school days? (mark one) There are many reasons for doing things at one time or another. What is the **main reason** you usually go to bed at this time on weekends? (mark one) • My parents have set my bedtime • I feel sleepy • I finish my homework • My TV shows are over • My brother(s) or sister(s) go to bed • I finish socializing • I get home from my job • Lights out at hostel/boarding school • Other:	The original version of this question was used	

25. What is the **main reason** you usually wake up at this time on school days? (choose one) 33. What is the **main reason** you usually wake up at this time on weekends? (choose one) • Noises or my pet wakes me up • My alarm clock wakes me up • My parents or other family members wake me up • I need to go to the bathroom • I don't know, I just wake up • Other	What is the **main reason** you usually wake up at this time on school days? (choose one) What is the **main reason** you usually wake up at this time on weekends? (choose one) • Noises or my pet wakes me up • My alarm clock wakes me up • My parents or other family members wake me up • I need to go to the bathroom • I don't know, I just wake up • The bell in hostel/boarding school • Other	The original version of this question was used	
27. How do you usually get to school? • Walk • Take the bus • Get a ride with a parent • Get a ride with a friend(s) • Drive my car	How do you usually get to school? • Walk • Get a ride with friend(s) • Take the school bus • Ride my bicycle • Take a taxi • Get a ride with a parent/family member	How do you usually get to school? • Walk • Take the bus • Ride my bicycle • Take a taxi • Take the scholar transport taxi • Get a ride with a parent/family member	Public taxis are a common means of transport among South African learners (Statistics South Africa, 2018). Some learners utilize the government's transport in public high schools (GHS, 2018).

3.4 Participant characteristics

3.4.1 Inclusion criteria

All Grade 12 female and male learners from the four public high schools in rural and township areas were invited to participate in the study. Grade 12 is the final year of learner's high school career. The reason for the focus on this group was Grade 12 learners are older adolescents and older adolescents are at a later phase of the circadian rhythm and may experience more changes in their sleep-wake behaviour than younger adolescents (Giannotti et al., 2002; Jenni & Carskadon, 2004; Kelley et al., 2017; Chaput et al., 2018). Furthermore, many schools tend to start earlier for adolescents in Grade 12 due to increased academic obligations and pressures (Crowley et al., 2007; Wolfson et al., 2007). The academic obligations and pressures may include Grade 12 learners striving to get into competitive tertiary institutions, influencing their sleep-wake behaviour (Pope, 2008; Galloway et al., 2013; Sun et al., 2014).

3.4.1.1 Sampling procedure

A combination of convenience and purposive sampling was used to recruit participants. Purposive sampling was used in selecting the participating schools such that there were two townships and two rural high schools that were chosen to participate in the study. Purposive sampling was the conscious choice of participants due to the participants' characteristics relevant to the study (Sarantakos, 2013). These four public high schools were chosen to adhere to one of the study's objectives, which was to compare the differences between the sleep patterns of the Grade 12 learners from rural and township schools. The four schools were only chosen because of time constraints and limited access to the schools due to COVID-19. Furthermore, convenience sampling was used in recruiting the participants such that the survey was distributed to all Grade 12 learners that were present on the day of survey distribution.

3.4.1.2 Characteristics of the participating schools

Four schools participated in this study – two from township areas and two from rural areas. The schools in the rural areas were in the surrounding villages and farms around Alice, and the schools in the township areas were located closer to the small business town in Alice. The two rural public high schools that were a part of the study

were 13 kilometres and 16 kilometres away, respectively, from Alice's small town. In addition, the other two township public high schools were 4.3 and 6.3 kilometres away, respectively, from Alice. These schools were co-educational schools, with 200 to 300 learners in township areas and 150 or less learners in rural areas attending their schools. The schools in rural areas had learners coming from the villages where the schools were located. However, the schools in township areas had learners from other neighbouring villages and townships in Alice.

3.4.2 Ethical considerations

Before commencing with recruitment in the schools, ethical approval for the study was granted by the Rhodes University Human Ethics Committee (RU-HEC) - Approval number: 2021-2800-6017 (Appendix D: Rhodes University Final Ethical Clearance). Following this, ethical clearance was granted by the Eastern Cape Department of Education (Appendix E: Department of Education Ethical Clearance). Subsequently, the heads of school of the four public schools in Alice were approached (Appendix F: Letter to principals). For the learners under the age of 18 years, parents and guardians were sent letters, through their children, informing them of the study and requesting their consent for their children to participate in the study (Appendix G: Letter of invitation to parents). Once parents and guardians consented to their children participating, each learner was asked to provide written assent before participation in the study (Appendix H: Letter of invitation to learners). Those learners over 18 provided their own consent.

3.5 Data collection procedure

The letters given to the learners under and over the age of 18 years encompassed information that highlighted that participation was voluntary and that learners had the right to withdraw from the study at any should they wish to. Once learners had either consented or assented to participating. It was also emphasized to the learners verbally that participation in the study was voluntary and that they could freely choose to withdraw from the study at any point if they wanted to, even after they had consented (Appendix H: Letter of invitation to learners). The survey was in English, and it did not require any personal information to ensure the participants their rights to privacy and anonymity.

The surveys were distributed to the learners that were present at school on the day that had assented to participating in the study in hard paper copy. Due to the restrictions outlined in the clearance letter from the Department of Basic Education, the surveys had to be completed at home by participants. To assist in the completion of the survey, the researchers left a contact number for the learners if they had any questions or concerns because the researchers could not physically be present when the participants were filling out the survey. There was no reimbursement for the study. The researchers were instructed to return the following day to fetch the completed surveys from the principal's office.

3.6 Data analyses

Data from the completed survey was captured manually into spreadsheets on Microsoft Excel, where categorical data was cleaned and coded into numerical values to allow for statistical analysis. There were questions on the survey that were excluded from the analysis, including the following: In the demographic sections, participants left the question about their height blank; therefore, BMI of the participants could not be computed. Sleep latency data were also omitted as many of the values given by the learners reflected that they did not necessarily understand this question.

Time spent in bed was calculated using the time learners reported for bedtime and time reported for rise times on weekdays and weekends. There were instances where the reported sleep duration was more than the calculated time spent in bed and the sleep duration was changed to match time spent in bed. There were 27 participant responses on weekday and 34 participant responses on weekend reported sleep duration that were changed to match time spent in bed. Five participant responses for the question of perceived sleep need were omitted from analysis because they reported needing 20 or more hours of sleep.

3.6.1 Descriptive statistics for the different components of the survey

All statistical testing was conducted using the TIBCO Statistica® (Version 14.0.0.15) statistical software. Basic descriptive statistics (mean, standard deviation, median and inter quartile range) were performed for the different components of the survey. Before conducting any statistical statistics, a Shapiro-Wilk test was applied to check for normality for the data. The results from the Shapiro-Wilk test showed that the data were not normally distributed, which meant that the researchers needed to employ

non-parametric statistical tests. All descriptive and inferential data for the different variables in the survey were reported in medians with interquartile ranges (IQR) of 25% and 75%. The number of learners that answered each question varied; therefore, the number of responses per question is included in every table and figure for clarity.

3.6.2 Statistical analysis tests

Given that the data were not normally distributed, non-parametric tests were applied. An alpha level of 0.05 was set to define statistically significant results. All statistical findings can be found in Appendix I. All descriptive data is reported in median and IQR. The Wilcoxon matched-pairs signed-ranks test was used to test the difference between weekday and weekend bedtimes, wake times, sleep duration, time spent in bed for the whole group's data (Table 3). The Mann-Whitney U test was used for the comparison of independent groups such as type of learner (rural schools compared to township schools), gender (male compared to female) and age group (non-adolescents compared to adolescents) for all sleep variables on weekdays and weekends (table 3). The Pearson's Chi-Square Test was used to test the relationships between categorical sleep variables such as main reasons for bed and wake times, perceived sleep quantity and quality, nocturnal awakening, frequency of daytime naps and perceived sleepiness problems with type of learner, gender, and age group (table 3). The Kendall Tau-b correlation coefficient was used to measure the association between ordinal variables such as reported grades, frequency of consumption of soda with caffeine, frequency of consumption of coffee or tea with caffeine with sleep variables (table 3). Kendall Tau-b correlation has a threshold rank that can be used for interpretation; a threshold ≤ 0.07 represents a weak association; 0.21 represents a medium association; and ≥0.35 represents a strong association (Kuenstner et al., 2002; Brossart, Laird & Armstrong, 2018; Crawford et al., 2021)

Table 3. Non-parametric tests used for statistical analysis.

Test	The first list of grouping variables	Second list of grouping variables
Wilcoxon Matched Pairs Test	Weekday sleep variables	Weekend sleep variables
Mann Whitney U Test	Type of learner	-Sleep variables for weekdays -Sleep variables for weekends -Scores from the sleepiness, sleep-wake problems, depressive mood scale and morning evening-ness scales -Median reported time for leaving home on school days
	Gender	
	Age group	
	Engagement in physical activity	
Kendall Tau b Correlation Test	Reported grades	-Sleep variables for weekdays -Sleep variables for weekends -Scores from the sleepiness, sleep wake problems, depressive mood scale and morning evening-ness scales
	Frequency of consumption of soda with caffeine	
	Frequency of consumption of tea or coffee with caffeine	
Pearsons Chi-Square Test	Main reasons for bed and rise times for weekdays and weekends	Type of learner Gender Age group
	Perceived sleep quantity	
	Perceived sleep quality	
	Daytime sleepiness	
	Nocturnal awakenings	
	Frequency of daytime naps	

CHAPTER IV

4 RESULTS

This section will begin by presenting the entire sample's demographic, general health, home and school-related information, followed by the sample's weekday and weekend sleep-wake behaviour. Thereafter, the results of the within groups, including type of learner (rural or township), gender (male or female), and age group (adolescent or non-adolescent/older learner) in relation to sleep variables, are compared. Following this, other sleep variables, including perceived sleep quantity, perceived sleep quality, perceived daytime sleepiness problems, nocturnal awakenings and frequency of daytime naps are reported and compared. Then, the results from the different scales such as sleepiness, sleep-wake behaviour problems, depressive mood, and morning evening-ness are presented and compared between the within groups. Lastly, the relationship between sleep variables and sport or physical activity, caffeine consumption, and reported grades are presented. All statistical effect tables are included in Appendix I.

4.1 Descriptive characteristics of the sample

One hundred and twenty-three Grade 12 (final year) learners from two rural and two township high schools completed the School Sleep Habits Survey (SSHS). The sample was mostly composed of participants from township high schools (n=95; 77%), with only 28 (23%) from rural high schools. The participants were between the ages of 16-26 years (18, 18-19). The sample comprised 74 (60%) females and 49 (40%) males.

Out of the 123 participants, 101 (82%) were adolescents, defined as participants between 10-19 years. In the adolescent group, 63 (51%) were females and 38 (31%) were males. The remaining 22 (18%) participants were classified as "non-adolescents" as they were older than 19 years but still in Grade 12 (Table 4). The non-adolescent group consisted of 11 females and 11 males. This group had an age range of 20-26 years (20.5, 20– 26). The majority (n=122; 99%) of the participants self-identified as Black African, and only one learner identified themselves as Coloured.

Table 4. Summary of the demographic information of the learners using median with interquartile ranges (IQR) where appropriate.

	Variables	Number of learners (%)	Median (IQR)
	Age	123 (100)	18 (18-19)
Gender	Male	49 (40)	
	Female	74 (60)	
Learner location	Township	95 (77)	
	Rural	28 (23)	
Age group	Adolescents	101 (82)	
	Non-adolescents	22 (18)	

4.2 Health-related characteristics of the sample

Majority of the learners (n=55; 45%) perceived their health status as fair, good (n=33; 27%), excellent (n=30; 24%), poor (n=2; 2%) and the remainder (n=3; 2.4%) did not answer this question. One hundred and seven (87%) participants reported not having a disability or chronic illness, while ten (8%) participants reported having some disability or chronic illness. Only one learner reported their chronic illness, which was asthma.

Only twelve (10%) participants reported having Attention-deficit Hyperactive Disorder (ADHD) or a learning disability, while 103 (84%) did not. There were participants seven (6%) that did not state whether they had a disability or a chronic illness. Regarding the use of medication to help with concentration or a learning problem, eight (7%) participants reported taking medication, while 110 (89%) of the learners reported not taking medication. The remainder (n=6; 5%) did not respond to this question.

Regarding self-assessed growth in height, most learners 68 (55%) selected *"I don't know"* followed by 25 (20%) who thought their growth was complete, while sixteen (13%) selected that their growth has not begun to spurt (increase rapidly). There were 6 (5%) learners that did not answer this question. As for self-assessed signs of maturation, most learners selected *"I don't know"* (n= 45; 37%), followed by 26 (21%) learners who perceived theirs as complete. Nineteen (15%) reported that their maturation had barely started (Figure 5). There were eight (7%) participants that did not answer this question.

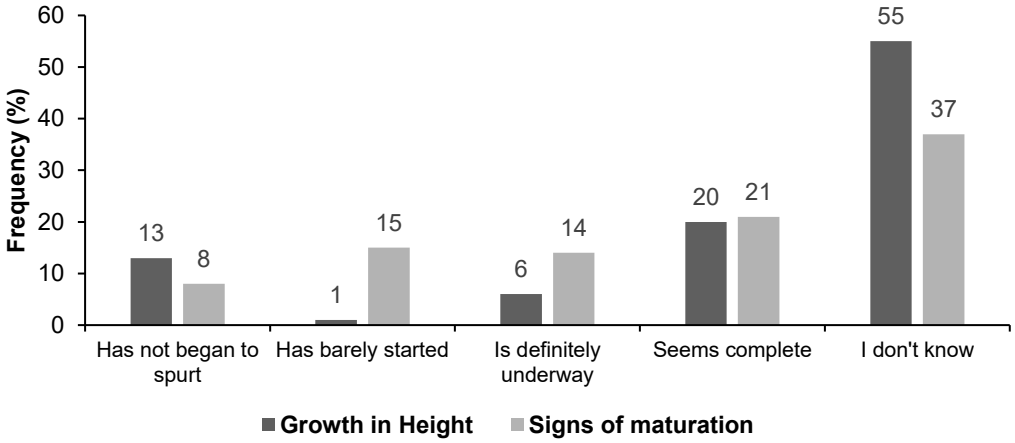


Figure 5. Reported growth in height and signs of maturation**.**

4.3 Home-related characteristics of the sample

4.3.1 Reported members in learners' household and parental demographics

In terms of who the respondents lived with, 47 (38%) participants reported living with their mother only, 34 (28%) lived with their relatives, 20 (16%) with siblings, four (3%) learners said they lived with their father/guardian and 16 (13%) learners said with their parents/guardians (*mother/guardian and father/guardian*) and siblings. There were only two (2%) participants that did not answer this question.

4.3.2 Categories of parents'/guardians' employment

In terms of parental/guardian employment, most learners (n=60; 49%) reported that their mothers/guardians did not work, and 58 (47%) reported that their mother/guardian worked in the homes. There were only five (4%) participants that did not answer this question. For fathers/guardians, most learners (n=54; 44%) reported having fathers/guardians that worked out of their home and 53 (43%) reported having fathers/guardians that did not work. Most learners who reported working parents, 26 (21%) reported their mothers/guardians' and 21 (17%) reported their fathers/guardians' job as day shifts. The different types of jobs for parents/guardians are outlined in the figure below (Figure 6).

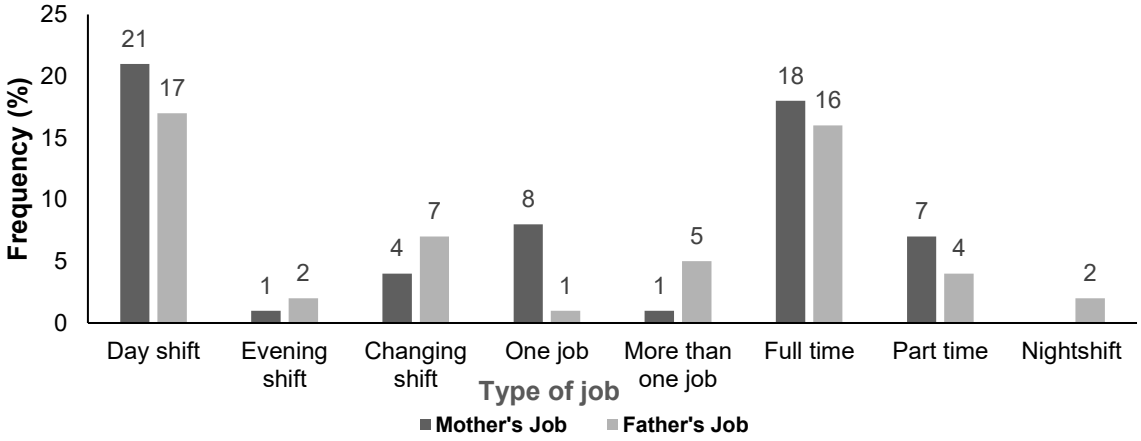


Figure 6. Categories of parents'/guardians employment

4.4 School-related characteristics of the sample

4.4.1 Academic performance, extra lessons and days absent from school

One hundred and nine (89%) of the Grade 12 learners responded to this question when asked about their academic performance. Fourteen (11%) learners reported the highest range of between 80-100%; 28 (23%) reported getting mostly between 70-79%; 24 (20%) reported a range of between 60-69%; 28 (23%) reported 50-59%. The rest of the learners reported mostly scoring between 40-49% (n=12; 8%) and 30-39% (n=2; 1.6%) in their grades.

4.4.2 Reported extra classes or lessons and homework

More than half of Grade 12 learners (n=69; 56%) reported taking extra lessons, and the majority (n=100; 81%) reported to have done their homework during the last week.

4.4.3 Days absent from school and reasons

In total, there were 42 (34%) participants that reported being absent from school in the last two weeks, with more female participants (n=27; 22%) being absent than male participants (n=15; 12%). The number of days' learners reported being absent from school ranged from one to ten days with reasons such as being sick (n=20; 16%), having flu (n=8; 7%), attending a funeral (n=2; 1,6%) and waking up late (n=1; 1%) being cited as to why learners missed school. Four (3%) learners selected "other" without stating their main reason.

4.4.4 Highest grade expected to complete

Out of the 114 learners who responded to this question, 42 (34%) learners said they would finish high school when asked to select the highest grade they expected to complete. Thirty-six (29%) selected that they would get a university/college degree, while 35 (28%) said they would go beyond university or college. Only one learner reported that they might not finish high school.

4.4.5 Reported time for leaving home and modes of transport on school days

One hundred and fourteen participants (93%) reported leaving home at 07:00 (6:40 - 7:55) for school. Rural learners (n=26) reported leaving for school significantly later than township learners (p=0.04; z=-2.03; U=847.5). There was no significant difference between the time male and female learners left home for school (Table 5).

Table 5. School start times and descriptive statistics in median (IQR) for time reported for leaving for school. The parenthesis is IQR. Significant differences (p<0.05) are shown by asterisks*

School start times		P-value
Rural	08:00	
Township	07:30	
Median time reported for leaving to school		
Learner location		
Rural (n=26)	07:10 (07:00 - 07:30)	***0.04**
Township (n=88)	07:00 (6:32 - 07:19)	
Sex		
Females (n=69)	07:00 (06:40 - 07:20)	0.62
Males (n=45)	07:00 (06:40 - 07:30)	

In terms of commuting to school, most learners (n=47; 38%) reported walking to get to school, while 41 (33%) took scholar “government” provided transport to school. The remaining learners reported other modes of transport (Figure 7).

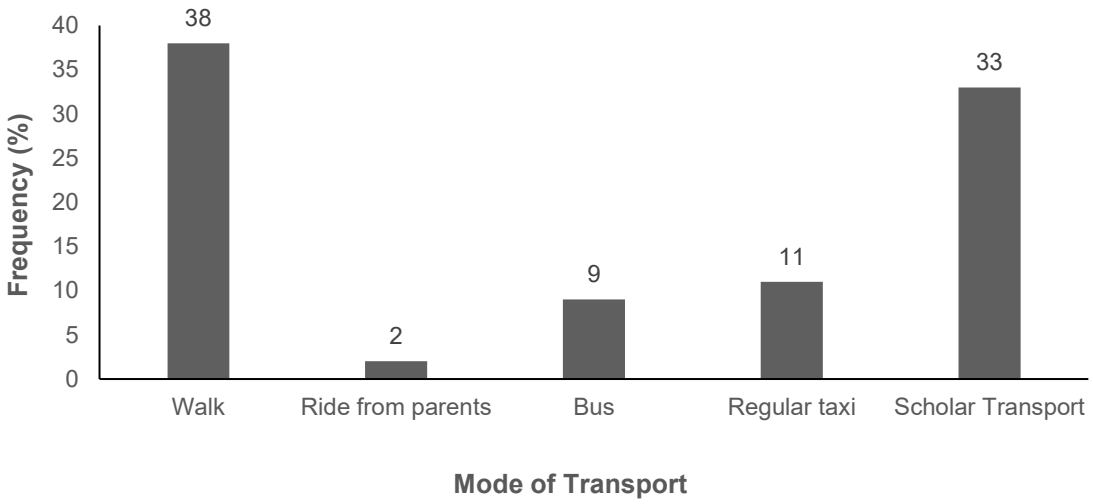


Figure 7. Reported modes of transport to get to school

There was no significant difference between the mode of transport to school and the type of learner (p=0.53; z=-0.92; U=48), gender (p=0.26; z=1.45; U=37.5) and age group (p=0.71; z=0.66; U=54) (Table 6).

Table 6. Means of getting to school for the type of learner, gender, and age group. The number of responses is indicated **(n).**

Different means of transport	Rural (n=28) **n** (%)	Township (n=95) **n** (%)	P	Females (n=74) **n** (%)	Males (n=49) **n** (%)	P	Adolescents (n=101) **n** (n%)	Non-adolescents (n=22) **n** (%)	P
Walk	**13** (46%)	**33** (35%)		**21** (28%)	**25** (51%)		**36** (36%)	**9** (41%)	
Take the bus	**2** (7%)	**9** (9%)		**9** (12%)	**2** (4%)		**10** (10%)	**7** (32%)	
Ride my bicycle	**0**	**0**		**0**	**0**		**0**	**2** (9%)	
Take the taxi	**1** (4%)	**12** (13%)	0.53	**8** (11%)	**5** (10%)	0.26	**10** (10%)	**1** (5%)	0.71
Scholar transport taxi	**10** (36%)	**31** (33%)		**30** (41%)	11 (22%)		**35** (35%)	**1** (5%)	
Ride from parents	**0**	**3** (3%)		**1** (1%)	**2** (4%)		**3** (3%)	**0**	
Other	**1** (4%)	**1** (1%)		**2** (3%)	**0**		**1** (1%)	**0**	

4.5 Sleep-wake behaviour of the whole group

4.5.1 Reported sleep-wake behaviours for the sample

Table 7 provides an overview of the reported sleep-wake behaviour of the sample for both weekdays and weekend days. Reported bedtimes during weekdays were significantly earlier than weekend bedtimes (p<.001; z=3.8). This meant that bedtime weekend delay (WBD) was 45 minutes, with learners going to bed later on weekends than on weekdays (Table 7). There was no significant difference between weekdays and weekends rise times (p=0.09; z=1.72). As a result, the median weekend rise time delay (WRD) was 0.

There were no significant differences found between the reported sleep duration (p=0.57; z=0.57) or reported time in bed (p=0.40; z=0.84) for learners on weekdays and weekends (Table 7). Learners perceived needing an overall median sleep duration of 8 hours and 14 minutes (8:00- 10:00) to feel their best every day (Table 7). The perceived ideal duration was significantly longer than their reported sleep duration on weekdays (p<0.001; z= 5.64) and on weekends (p<0.001; z= 4.52).

Table 7: Descriptive and inferential summary of the reported times for weekdays and weekends with median (IQR). Significant differences (p<0.05) are shown by asterisks*

Variables	Weekdays Median (IQR) **(n)**	Weekends Median (IQR) **(n)**	P- value
Bedtimes	21:30 (21:00- 22:30) **(115)**	22:15 (21:00- 23:30) **(112)**	***<.001**
Rise-times	05:30 (5:00- 6:00) **(115)**	05:30 (5:00-6:30) **(112)**	0.09
Reported sleep duration	7:00 (6:30- 8:00) **(91)**	7:00 (05:30 -08:30) **(70)**	0.57
Time spent in bed	8:00 (7:00- 9:00) **(111)**	7:30 (6:12- 8:30) **(108)**	0.4
Overall perceived sleep duration needed	8:14 (8:00- 10:00) **(80)**		
Weekend bedtime delay (WBD)	1 (0- 2,0) **(106)**		
Weekend rise time delay (WRD)	0 (-0.5-1.33) **(107)**		

4.5.2 Reported reasons for bed and rise times

4.5.2.1 Reported reasons for bed and rise times on weekdays

One hundred and ten (89%) learners reported their reasons for bedtimes on weeknights. Most learners (n=57; 46%) selected "*I finish my homework*" followed by "*I feel sleepy*" (35%; n=43) as the main reasons for going to bed (Figure 8). Only four (3%) learners did not select any reasons for bedtimes on weeknights.

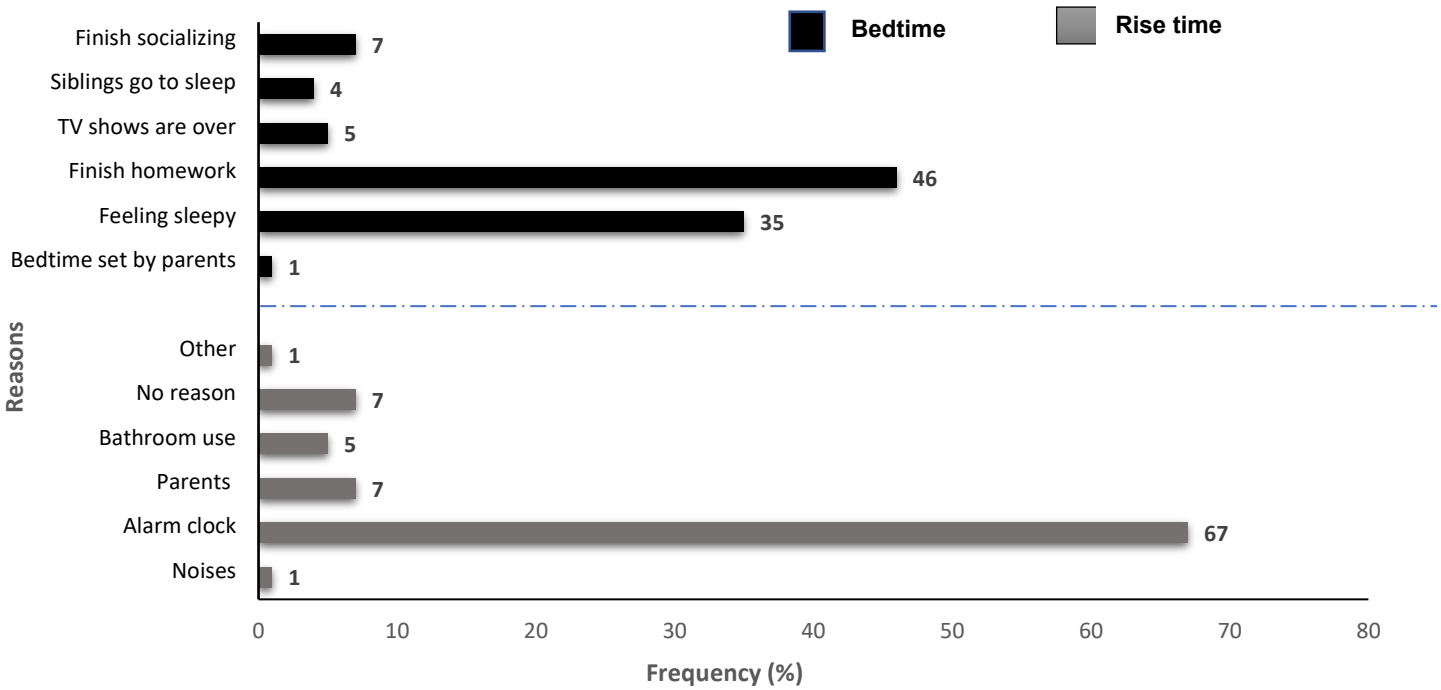


Figure 8. Main reasons for bed and rise times on weekdays.

Regarding the reasons for waking during weekdays, 109 (89%) learners responded to this question. An "alarm clock' was cited as the most common reason for waking (n=93; 76%), followed by nine (7%) learners being woken up by *"parents*" (Figure 8).

4.5.2.2 Reported reasons for weekend bed and rise times

A total of 119 (97%) learners reported their reasons for bedtimes on weekends. Forty-six (37%) learners reported the main reason for going to bed as *"I feel sleepy"*, while 41 (33%) selected "*TV shows are over*" and 14 (11%) *reported "I finish socializing"* as their main reason for weekend bedtime (Figure 8). A total of 112 (91%) reported their reasons for waking up on weekends, with 40 (33%) learners reporting that their "*alarm clock"* as the main reason, while 32 (26%) selected "*I don't know. I just wake up*".

Twenty-six (21%) selected that their parents woke them up as the reason for their rise times (Figure 9).

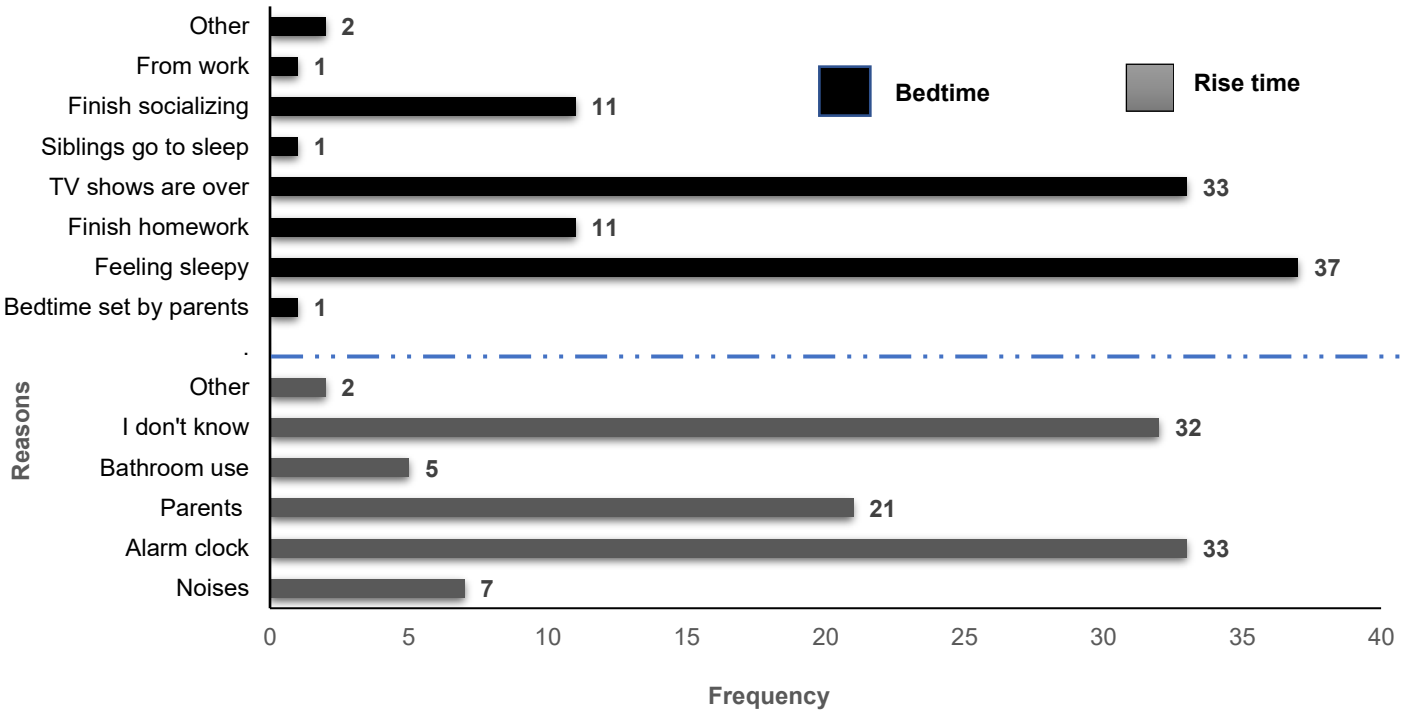


Figure 9. Main reasons for bed and wake time on weekends.

Most learners (77%; n=95) reported sleeping in the same bed almost every night (Table 8).

Table 8. Summary of learners sleeping in the same bed.

Options	**Number of learners (%)**
Every night	95 (77%)
Almost every night	12 (10%)
A few nights	11 (9%)
Not at all	3 (2%)

4.6 Comparison between rural and township scholars and sleep variables

4.6.1 Sleep patterns

There were no significant differences in the bedtimes (p=0.99; z= 0.01; U= 1186), rise times (p=0.47; z=-0.75; U=954), reported sleep duration (p=0.22; z=-1.24; U=581), and time spent in bed (p=0.37; z=-0.91; U= 887.5) when comparing rural and township learners during the week (Table 9). Similarly, on weekends, there were no significant differences between the sleep variables such bedtimes (p=0.73; z=0,35; U=975), rise times, (p=0.52; z=0.66; U= 995), reported sleep duration (p=0.37; z=0.91; U=289.5) and time spent in bed (p=1; z=0; U=977) (Table 9).

Table 9. Descriptive and inferential summary of the reported times for weekdays and weekends with median (IQR).

Variables	Rural (n=28) Median (IQR) **(n)**	Township (n=95) Median (IQR) **(n)**	**P**
Weekdays			
Bedtimes	21:30 (21:00- 23:00) **(27)**	21:30 (21:00- 22:00) **(88)**	0.99
Risetimes	05:30 (5:00 - 6:00) **(23)**	5:30 (5:00- 6:00) **(92)**	0.47
Reported sleep duration	7:00 (5:30- 8:00) **(23)**	7:30 (6:00- 8:00) **(73)**	0.22
Time spent in bed	8:00 (7:00- 8:30) **(22)**	8:00 (7:00-8:30) **(85)**	0.37
Weekends			
Bedtimes	22:00 (21:00- 23:50) **(23)**	22:30 (21:30- 23:30) **(89)**	0.73
Rise times	06:00 (5:30- 6:00) **(25)**	5:30 (5:00- 6:30) **(87)**	0.52
Reported sleep duration	6:17 (4:39- 8:00) **(16)**	7:00 (5:30- 8:30) **(70)**	0.37
Time spent in bed	8:00 (6:04- 8:30) **(23)**	7:00 (6:00- 8:30) **(83)**	1

4.6.2 Bed and rise times reported reasons on weekdays

Regarding the reasons for going to bed, both rural and township scholars mainly reported *"I finish my homework"* and *"I feel sleepy"* as their main reasons. Thus, there was no association between the type of learner (rural and township scholars) and their main reported reasons for bedtimes on weekdays ($X^2(5, N= 123) = 2.2$, p=0.82).

Rural scholars reported being woken up by an *"alarm clock*" and being woken up by wanting to go the *"bathroom"* as the main reasons for rise times during the week. Township scholars mainly reported being woken up by an *"alarm clock*" and "*parents*".

However, there was no association between type of learner and the main reported reasons for rise times on weekdays (X^2(5, *N=123*) = 3.7, p=0.59).

4.6.3 Bed and rise times reported reasons on weekends

Regarding the reasons for going to bed on weekends, rural and township scholars mainly reported *"TV shows are over"* and *"I feel sleepy"* as their main reasons. Thus, there was no association between the type of learner (rural and township scholars) and their main reported reasons for bedtimes on weekends (X^2(7, *N= 123)* = 5.5, p=0.60).

Rural scholars stated that being woken up by an "*alarm clock"* followed by being woken up by their "parents" were the main drivers for waking. In contrast, township scholars indicated that they "*just woke up for no reason*", followed by being woken up by an "*alarm clock*". There was no association between type of learner and main reported reasons for rise times on weekends (X^2(7, *N= 123)* = 5.5, p=0.60).

In summary, there were no associations between reported reasons for bed and rise times on weekdays and weekends and the type of learner. However, all the reported reasons of rural and township learners for bed and rise times for week and weekends are attached in the appendices (please refer to Appendix I).

4.7 Comparison between age group of participants and sleep variables

4.7.1 Sleep patterns

The age group of participants was categorised into adolescents and non-adolescents. There were no significant differences between the age groups for bedtimes (p=0.48; z=0.72; U=888.5), rise times (p=0.93; z=0.08; U= 917.5) and time spent in bed (p=0.99; z=-0.008; U=758.5) during the week. There was a significant difference found for the reported sleep duration (p=0.03; z=-2,15; U=419,5) where non-adolescents reported sleeping significantly longer than adolescents (Table 10).

For the weekends, adolescents reported going to bed significantly later (p=0.03; z=-2.15; UU=419.5) than non-adolescents There were no significant differences with the rise times (p= 0.93; z=0.08; U=781.5), reported sleep duration (p= 0.75; z=0.32; U=327) and time spent in bed (p=0.71; z=-0.37; U=799.5) (Table 10)

Table 10. Comparison of sleep variables during the weekend and weekdays for adolescents and non-adolescents. Data is displayed in median (IQR). Significant differences (p<0.05) are shown by asterisks*

Variables	Non-adolescents (n=22) Median (IQR) **(n)**	Adolescents (n=101) Median (IQR**) (n)**	**P**
Weekdays			
Bedtimes	21:30 (20:30- 22:00) **(21)**	21:30 (21:00- 22:30) **(94)**	0.48
Rise-times	05:30 (05:00- 06:00) **(16)**	05:30 (05:00- 06:00) **(99)**	0.93
Reported sleep duration	7:30 (6:00- 9:00) **(19)**	7:00 (6:00- 8:00**) (79)**	***0.03***
Time spent in bed	8:00 (7:30- 9:00) **(15)**	8:00 (7:00- 8:30) (**92)**	0.99
Weekends			
Bedtimes	22:00 (20:30- 22:30) **(20)**	22:45 (22:00- 23:47) **(92)**	***0.02***
Rise-times	05:30 (05:00- 06:00) **(20)**	05:30 (05:00- 06:30) **(92)**	0,28
Reported sleep duration	6:15 (3:48-8:00) **(16)**	7:00 (5:30- 8:30) **(68)**	0.75
Time spent in bed	7:00 (7:00- 9:30) **(19)**	7:15 (6:00- 8:30) **(86)**	0.71

4.7.2 Bed and rise times reasons on weekdays

Adolescents and non-adolescents stated, *"I finish homework"* and *"I feel sleepy"* as their main drivers for sleep. As a result, there was no association between the age group and the main reported reasons for bedtimes on weekdays (X^2 (5, *N= 123)* = 3.9, p= 0.57).

Adolescents on weekdays main reported reasons for rise times were mostly being woken up by an alarm clock followed by being woken up by parents. Non-adolescents' reasons for rise times were mainly being woken up by an alarm clock followed by waking up to the bathroom. There was no association between the age group and the reported reasons for wake time on weekdays (X^2 (5, N=123) = 3.7, p=0.59).

4.7.3 Bed and rise times reasons on weekends

On the weekend, adolescents and non-adolescents reported bedtime reasons were "*I feel sleepy"* and *"TV shows are over"*. There was no association between the age group and their main reported reasons for bedtimes on weekends X^2(7, *N=123*) = 11.8, p=0.11). The main reasons for both groups' rise time were being woken up by an alarm clock followed by selecting *Ï just woke up"* spontaneously. There were no associations

between the age group and their main reported reasons for rise times on weekends (X^2(5, N=123) = 4.5, p=0.48).

In summary, there were no associations between reported reasons for bed and rise times on weekdays and weekends and age group of participants. However, all the reported reasons of adolescents and non-adolescents for bed and rise times for week and weekends are attached in the appendices (please refer to Appendix I).

4.8 The comparison between gender and sleep variables

4.8.1 Bed and rise times reasons on weekdays

Females on weekdays mainly reported bedtime reasons were "*I finish homework"* and *"I feel sleepy"*. Their male counterparts' main reason for reporting to bed mostly selected *"I feel sleepy"* and *"TV show is over"*. There was no association between the main reasons reported for bedtimes and gender during the week X^2(*5, N=123)* = 7.93, p=0.16. Females selected "*Alarm clock"* and *"Parents"* as their reasons for waking up on weekends. Males' reasons for rise times were mostly ''*alarm clock"* and "*going to the bathroom"*. There was no association between the main reasons reported for rise times and gender during the week (X^2(*5, N=123)* = 7.97, p=0.16).

4.8.2 Sleep patterns

There were no significant differences between the male and females for weekday bedtimes (p=0.97; z= -0.04; U= 1580), the rise times (p=0.28; z=1.11; U=1374), reported sleep duration (p=0.99; z=-0.004; U= 1006) and the time spent in bed (p=0.44; z=-0.77; U= 1335). For the weekends, there were no significant differences as well for bedtimes (p=0.34; z=-0.97; U=1334), rise times (p= 0.25; z=1.16; U=1316), reported sleep duration, (p= 0.32; z= 0.99; U= 525,5) and time spent in bed (p=0.25; z=1.16; U= 1212.5) (Table 11).

Table 11. Comparison of sleep variables during the weekend and weekdays for male and female learners with median (IQR).

Variables	Males (n=49) Median (IQR) **(n)**	Females (n=74) Median (IQR) **(n)**	**P**
Weekdays			
Bedtimes	21:30 (21:00- 23:00) **(46)**	21:30 (21:00- 22:00) **(69)**	0.97
Rise-times	05:30 (05:00- 05:48) **(44)**	05:30 (05:00- 06:00) **(71)**	0.28
Reported sleep duration	7:30 (6:00- 8:00) **(39)**	7:00 (6:00- 08:00) **(56)**	0.99
Time spent in bed	8:00 (7:00- 8:30) **(41)**	08:00 (07:30- 09:00) **(68)**	0.44
Weekends			
Bedtimes	22:37 (21:45- 00:00) **(44)**	22:00 (21:00; 23:00) **(68)**	0.34
Rise-times	05:30 (05:00; 06:30) **(45)**	05:30 (05:00; 06:30) **(67)**	0.26
Reported sleep duration	6:30 (5:00; 08:00) **(35)**	7:00 (5:30; 8:45) **(48)**	0.22
Time spent in bed	7:00 (6:10, 8:00) **(41)**	7:00 (6:30, 8:30) **(61)**	0.32

4.8.3 Bed and rise times reasons on weekends

Females and males reported the same reasons for reporting to bed on weekends as they did during the week. Females' reported bedtime reasons: "*I finish homework"* and "*I feel sleepy"*. Males selected *"I feel sleepy"* and "*TV shows are over*" as their main reasons for going to bed. There was no association between the main reasons for reported bedtimes during the weekend with gender (X^2(*7, N=123*) = 5.4, p=0.61).

For rise times, females mostly selected "*parents"* and "*alarm clock"* as their main drivers for waking up. Males also reported being woken up by an "*alarm"* clock followed by saying "*they just woke up"* spontaneously. There were no associations between gender and reported reasons for rise time during the weekend (X^2(*5, N=123)* = 13.2, p=0.22).

In summary, there were no associations between reported reasons for bed and rise times on weekdays and weekends and gender. However, all the reported reasons of males and females for bed and rise times for week and weekends are attached in the appendices (please refer to Appendix I).

4.9 Other sleep variables and comparisons

This section contains the descriptive results for perceived sleep quantity, perceived sleep quality, perceived daytime sleepiness problem, nocturnal awakenings, and frequency of daytime naps with each variable compared with the type of learner, gender differences and age group. As there were no significant effects of the different learner groups, these results are attached in the appendices (please refer to Appendix I).

4.9.1 Perceived sleep quantity

Out of the 110 (89%) learners who responded to this question, 44 (36%) students indicated not getting enough sleep, 43 (35%) reported getting enough sleep and 22 (18%) reported getting too much sleep (Figure 10).

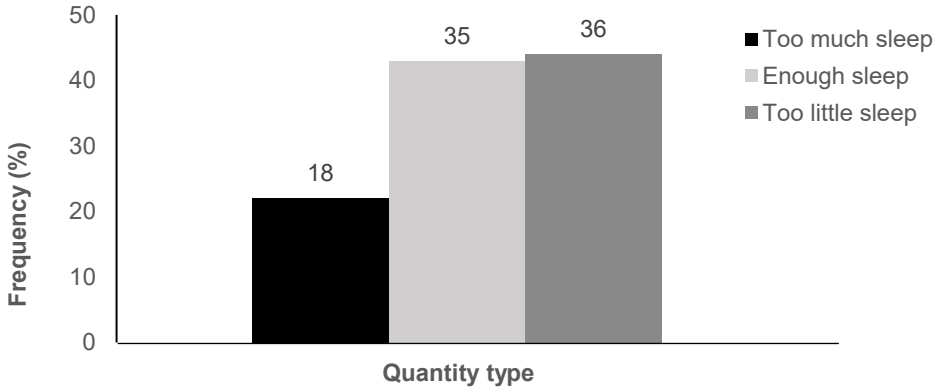


Figure 10. Perceived sleep quantity of the whole group

For group comparisons, there were no significant associations between type of learner (X^2(2, *N=110)* = 5, p=0.08); gender (X^2(2, *N= 110)* = 0.69, p=0.71); age group (X^2(2, *N= 110*) = 5.7, p=0.06) on the perceived sleep quantity.

4.9.2 Perceived sleep quality

Concerning perceived sleep quality, 119 (97%) learners responded, with 78 (63%) participants identifying as "*good quality sleepers*" compared to 40 (33%) participants who perceived themselves as "*poor sleepers*" (Figure 11).

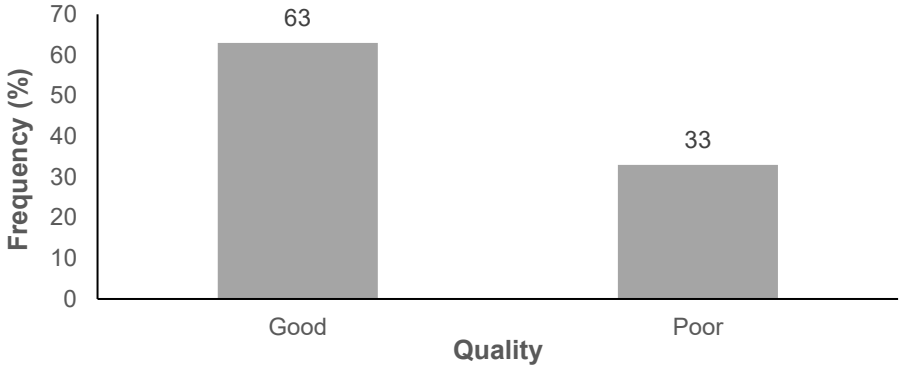


Figure 11. Perceived sleep quality for the whole group

With regards to the group comparisons, there were also no significant associations found between; type of learner (X^2(*1, N=119*) = 0.09, p=0.77); gender (X^2(*1, N=119*) = 2.32, p=0.13); age group (X^2(*1, N=119*) = 1.64, p=0.19) on the perceived sleep quality.

4.9.3 Perceived daytime sleepiness problem

Out of the 118 (96%) that responded, 41 (33%) learners reported having a little problem, 50 (41%) students reported not having a problem with daytime sleepiness at all, and only three; (2%) reported having a very big problem with daytime sleepiness (Figure 12).

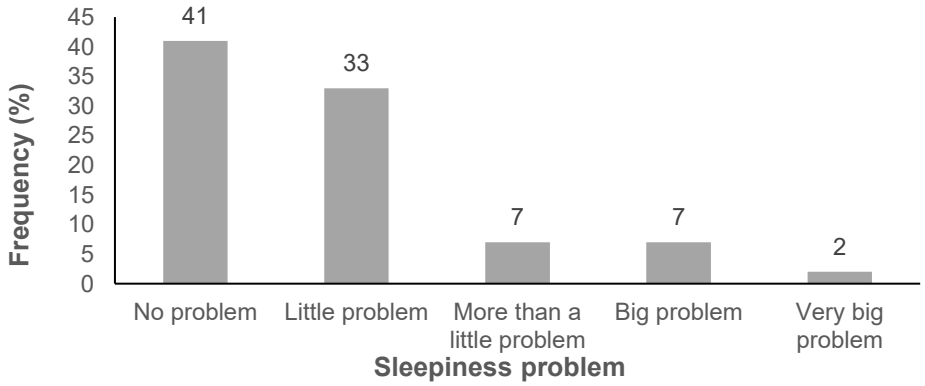


Figure 12. Perceived daytime sleepiness for the whole group

There were no significant associations between type of learner (X^2(4, *N=118)* = 1.5, p=0.84); gender (X^2(4, *N=118*) = 1.3, p=0.86); age group (X^2(4, *N=118*) =1.2, p=0.87) on the perceived daytime sleepiness problems.

4.9.4 Nocturnal awakenings

Out of 115 (93%) learners that responded to this question with nocturnal awakenings (night awakenings), 39 (32%) reported waking up at least once, 36 (29%) reported waking up two or three times a night, and five learners (4%) reported waking up more than three times (figure 13)

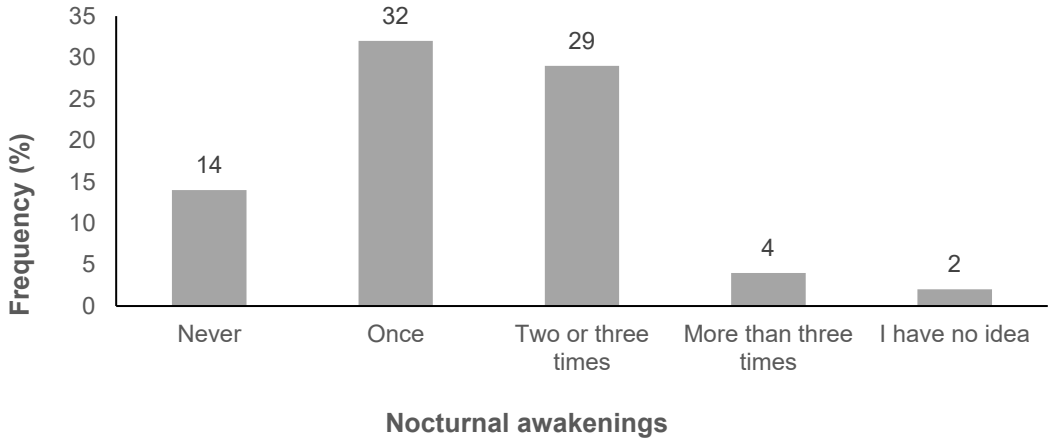


Figure 13. Frequency of nocturnal awakenings

There were no significant associations between type of learner ($X^2(4, N=115) = 5.6$, p=0.23); gender ($X^2(4, N= 115) = 6.2$, p=0.18); and age group ($X^2(4, N=115) = 5.7$, p=0.22) on nocturnal awakenings.

4.9.5 Frequency of daytime naps

Out of 116 (94%) learners that responded to this question concerning daytime naps, 53 (43%) reported napping occasionally only on school days, and 36 (29%) reported napping only on weekends (Figure 14).

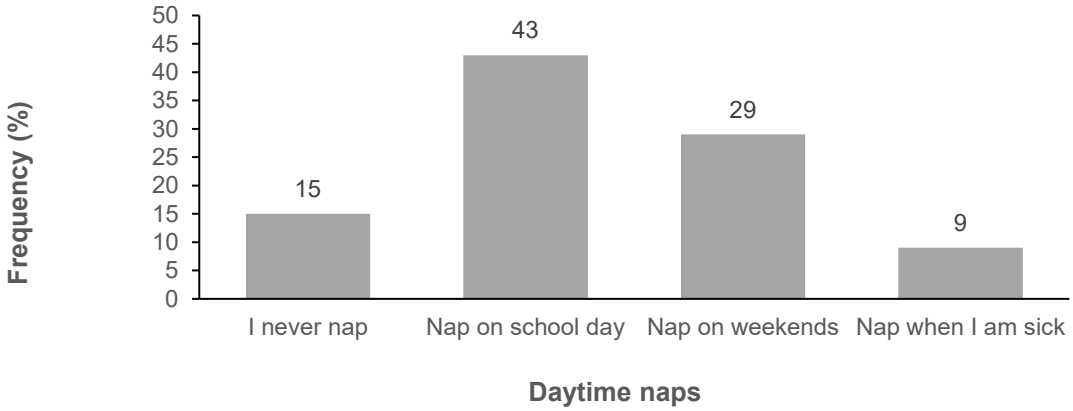


Figure 14. Daytime naps for the whole group

There were also no significant associations between the type of learners (X^2 (3, *N=116*) =5.2, p=0.16); gender (X^2(*3, N=116*) =3.9, p=0.27); and age group (X^2(3, *N=116*) =5.5, p=0.14) on the frequency of daytime naps.

4.10 Scales: Sleepiness, Sleep-wake behaviour problems, Depressive mood, and Morning Evening-ness

This section describes the results from the scores taken from the different scales such as the sleepiness, sleep-wake behaviour, depressive mood, and morning evening-ness scales. The overall summative scores obtained from the scales are shown in Table 12. Following that, comparisons are made between the type of learner, gender, and age group. The scores for each group are also illustrated in Table 13 below.

4.10.1 Sleepiness Scale

There were 76 (62%) responses received for the sleepiness scale, with the median score being 18 (14- 20). This indicates that the overall group demonstrated a tendency towards low daytime sleepiness (Table 12). There was no significant difference between the type of learner (p=1; z=-0.09; U=18), between genders (p=0.7; z=-0,47; U=15) and age groups (p=0.4; z=1.34; U=12) (Table 13).

Table 12. Descriptive statistics reported in median (IQR) of the results and interpretation obtained from the scales for the whole sample

Scales (Number of learners)	Scale range	Median (IQR)	Results of the scale
Sleepiness scale (58)	10-40	18 (14-20)	Low daytime sleepiness
Sleep-wake behaviour problems (80)	10-40	36 (33-38)	More related sleep-related issues
Depressed Mood (70)	6-18	12 (9-14)	Mild depressive symptoms)
Morning evening-ness (116)	10-42	32 (28-33)	Greater preference for morning

4.10.2 Sleep-wake behaviours problem scale

A total of 80 (65%) responses were received for the sleep-wake behaviour problems scale. Grade 12 learners obtained a median score of 36 (Table 12), which denotes that the group may be experiencing sleep-wake behaviour problems. There were no significant differences the type of learner scale (p=0.83; z=-0.2; U=5); gender (p= 0.4;

z= 0.82; U=3.5); and age group (scale (p=0.63; z=-0.87; U=4) in relation to the scores obtained on the sleep-wake behaviours problem scale (Table 13).

4.10.3 Depressive mood scale

Regarding the depressed moods scale, the scores were summed up for 70 (57%) of the learners from the whole sample. Grade 12 learners scored a median sum of 12 on the depressive mood scale (Table 12). The score indicates that this group might be experiencing depressive mood symptoms. There was no significant difference between type of learner (p=0.6; z=-0.71; U=11); gender (p= 0.6; z= -0.53; U=11); and age group (p=1; z=0.11; U=14) in relation to sums obtained from the depressed mood scale (Table 13).

4.10.4 Morning Evening-ness Scale

M/E was calculated for 116 (94%) Grade 12 learners in the sample. Learners scored a median sum of 33 on the ME scale, indicating that the learners had a greater morning preference (Table 12). There were no significant differences between type of learner (p=0.82; z=-0.38; U=129); gender (p= 0.68; z= 0.47; U=124.5); and age group (p=0,13; z=-2.16; U=93) in relation to sums obtained from the M/E scale (Table 13).

Table 13. Descriptive statistics reported in median (IQR) of the results from the scales for the different groups.

Scales	**Rural** Median (IQR) **(n)**	**Township** Median (IQR) **(n)**	**P**	**Females** Median (IQR) **(n)**	**Males** Median (IQR) **(n)**	**P**	**Adolescents** Median (IQR) **(n)**	**Non-adolescents** Median (IQR) **(n)**	**P**
Sleepiness scale	18 (17- 23) **(15)**	17 (14 -20) **(37)**	1	18 (16- 20) **(26)**	18 (14- 20) **(26)**	0.7	18 (15-20) **(44)**	20 (15- 21) **(8)**	0.4
Sleep-wake behaviour problems	36 (33- 38) **(8)**	28 (0,5 - 37) **(32)**	0.86	32 (0- 36) **(23)**	35 (28- 38) **(16)**	0.4	33 (13-36) **(37)**	36 (22- 39) **(4)**	0.63
Depressed Mood	9 (0 -13) **(21)**	12 (8-14) **(43)**	0.6	11 (8-13) **(33)**	13 (10-15) **(23)**	0.6	12 (9- 14) **(43)**	8 (11- 15) **(8)**	1
Morning evening-ness	31 (28- 34) **(27)**	32 (28- 33) **(94)**	0.82	31 (28- 33) **(44)**	32 (14-20) **(32)**	0.68	32 (28- 33) **(61)**	31 (30- 34) **(20)**	0.13

4.11 Lifestyle and behavioural related information

4.11.1 Prevalence of sports or physical activity

Seventy-five (61%) learners reported not engaging in organized sport or physical activity. In comparison, 46 (37%) reported that they had engaged in some organized sport or a regularly scheduled physical activity, including competitions, in the last week. Table 14 provides an overview of the different types of sports and the number of students who played sports participated.

Table 14. Summary of the different types of sports played and the number of participants

Sport	Number of learners (%)
Soccer	17 (14%)
Rugby	6 (5%)
Cricket	7 (6%)
Netball	12 (10%)
Jogging	2 (2%)
Cycling	1 (1%)
Yoga	1 (1%)

There were no significant differences between type of learner ($p=0.45$; $z= 1.04$; U;1582.5) and age group ($p=0.66$; $z=0.51$; $U=1642.5$) on the prevalence of sports or physical activity. There was a significant difference between gender and the prevalence of sport ($p<.001$; $z= 3.11$; $U=1233$). Most males reported participating in sport or physical activity compared to the females who reported not playing sport or engaging in any physical activity.

4.11.2 Frequency of caffeine consumption

Out of the 94 (76%) that responded to the question of caffeine consumption with soda and 95 (77%) learners that responded to the question of caffeine consumption with coffee or tea. There were only 23 (28%) learners that reported having consumed soda with caffeine once or twice, and only 12 (10%) reported the consumption of coffee or tea with caffeine daily. 36 (29%) and 28 (23%) reported never consuming caffeinated substances such as soda, coffee, or tea, respectively (Figure 15).

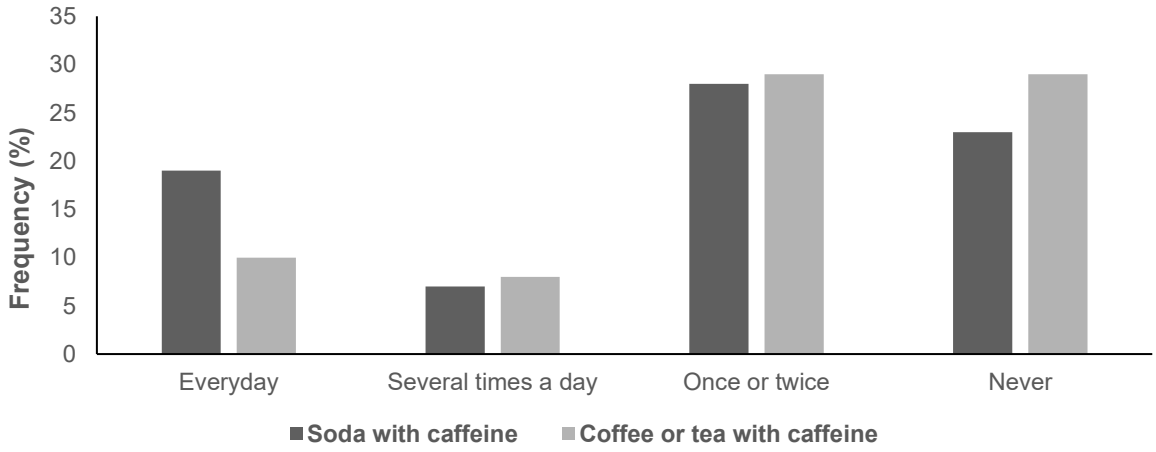


Figure 15. Frequency of caffeine consumption

There were no significant differences between the type of learner consuming soda with caffeine (p=0.15; z=-1.96; U=125) and tea or coffee with caffeine (p=0.89; z=-0.22; U=207,5). Regarding gender comparisons, there were no significant differences between males and females with consuming soda with caffeine (p=0.12; z=-1.81; U=121) and tea or coffee with caffeine (p=0.12; z=-1.86; U=103). There were no significant differences noted between age group with consuming soda with caffeine (p=0,78; z=-0.45; U=169) and tea or coffee with caffeine (p=0.93; z=-0.12; U=154).

4.11.3 Correlation between caffeine consumption and sleep variables

The correlation coefficients with sleep parameters and scales are shown below, ranging from weak to moderate association (Table 15). There was no association between caffeine consumption of soda with caffeine and sleep parameters on weekdays. However, there was a positive but weak significant association between the consumption of soda with caffeine and weekend rise times (Table 15). This meant

that the learners that consumed caffeinated substances were more likely to have later rise times.

There was no association between the morning evening-ness scale, sleepiness scale, sleep-wake behaviour problems scale, and caffeine consumption. However, there was an association with depressive mood scale and caffeine consumption (Table 15). There was a weak positive correlation between depressive mood scale and the consumption of soda with caffeine, meaning the learners who consumed caffeine more were likely to have more prevalent depressive symptoms (Table 15).

Table 15. An overview of the correlation coefficients for the relationship between caffeine consumption in relation to sleep variables (τb, $p<0.05$). Weak to moderate associations are indicated by the asterisk*

Sleep and other variables	Frequency of consumption soda with caffeine	Frequency of consumption coffee or tea with caffeine
Sleepiness Scale	-0.13	-0.11
Sleep-wake Behaviour Problems Scale	-0.07	-0.09
Depressive Mood Scale	***0.14**	0.03
Morning Evening-ness Scale	-0.01	-0.05
Weekdays		
Bedtimes	0.06	-0.09
Rise times	-0.02	-0.01
Time spent in bed	0.06	-0.07
Weekends		
Bedtimes	0.15	0.13
Rise times	***0.15**	0.06
Time spent in bed	0.1	-0.02

4.11.4 Correlation between reported grades and sleep variables

This section will look at whether there is an association between the academic performance of all learners and some sleep variables such as bedtime, rise time and time spent in bed during the week and the weekend. This section also describes the association of academic performance with the different scales; sleepiness, sleep-wake behaviour problems and depressive mood scales.

There were no associations between the reported grades and some sleep parameters such as bedtimes on weekdays and weekends, rise times on weekends, time spent in bed on weekdays and weekends. However, there was an association between the reported grades and weekdays wake times (Table 16). There was a positive and moderately strong association between weekdays rise times and reported grades, meaning that learners who reported the highest performance were also more likely to have later rise times.

There were no associations between the sleepiness scale, sleep-wake behaviour problems scale, depressive mood scale and morning evening-ness scale.

Table 16. An overview of the correlation coefficients for the relationship between reported grades and sleep variables (τb, $p<0.05$). Weak to moderately medium associations are indicated by the asterisk*

Sleep and other variables	Reported grades
Sleepiness Scale	0.05
Sleep-wake Behaviour Problems Scale	0.02
Depressive Mood Scale	-0.12
Morning Evening-ness Scale	0.03
Weekdays	
Bedtimes	0.08
Rise times	***0.22**
Time spent in bed	-0.01
Weekends	
Bedtimes	0.09
Rise times	0.02
Time spent in bed	0.04

CHAPTER V

5 DISCUSSION

5.1 Summary of findings

This current study aimed to characterize the sleep-wake behaviour of a sample of late adolescents from a rural and township area surrounding Alice in the Eastern Cape of South Africa. The most important findings were that the reported sleep duration for weekdays and weekends for the learners in Grade 12 was below the recommended 8-10 hours of sleep duration with learners reporting sleep durations of 7 hours on weekdays and weekends. The bedtimes of the learners during the week were earlier than weekend bedtimes, while the rise times remained the same on weekdays and weekends. Bedtimes during the week were influenced predominantly by the need to complete homework in the evenings, while rise times were driven by the need to commute in order to make the early school start times. On the weekends, learners feeling sleepy or finishing their television shows drove bedtimes, while rise times resulted from the use of an alarm clock or learners just waking up naturally.

Comparisons between the different groups with the sample (township vs rural; male vs female and adolescent vs non-adolescents) were also made. The findings highlighted that there were no learner location effects on sleep variables, except that rural scholars left home earlier for school compared to township scholars. There were no differences for gender in any of the sleep variables, but more males participated in sport compared to females in this study. In terms of the effects of age group, non-adolescents slept significantly longer than adolescents did on weekdays and adolescents had later bedtimes on weekends.

The findings showed that learners in this sample reported getting too little sleep, had nocturnal awakenings, and took daytime naps especially on weekdays. The group also tended towards a morning preference, experienced sleep wake disturbances, and experienced depressive symptoms. However, this group did not report a prevalence of daytime sleepiness. The prevalence of caffeine consumption in this sample was low and only a few learners reported participating in sport or physical activity. These observations will now be discussed in more detail.

5.2 Sleep-wake behaviour of the whole group

The reported sleep duration of learners in this sample was shorter than the sleep duration adolescents reported from other studies in Europe (Loess et al., 2008; Gariepy et al., 2020; Leger et al., 2012), North America (Patte et al., 2017), South America (Lyall et al., 2020), Oceania (Short et al., 2013), Asia (John et al., 2019; Huang et al., 2010; Ghanizadeh et al., 2008) and Africa (Maduabuchi et al., 2014; Reid et al., 2002). Learners reported obtaining 7 hours of sleep during the weekday, which was less than both their self-reported preferred sleep need (of 8hrs 14 minutes) and the recommendation of between 8 to 10 hours. Learner sleep in this sample, was therefore insufficient on average, a finding that is consistent with previous research (Short et al., 2013; Wolfson et al., 1998; Calamaro, Mason & Ratcliffe, 2009; Shochat et al., 2014; Meijer et al., 2010; Crowley et al., 2018). However, the learners' self-reported sleep of 7 hours was found to be longer than previous studies that have explored adolescent sleep in parts of Asia such as Japan, Korea and China (Ohida et al., 2004; Kim et al., 2011; Kang et al., 2012), and Norway, in Europe (Hysing et al., 2013). This difference may be explained by the observation that the learners' bedtimes during the week were earlier than many studies in other contexts have reported (Gau & Soong, 1995; Reid et al., 2002; Wolfson et al., 2003; Merikanto et al., 2013; Dewald et al., 2014; Bei et al., 2014), including more recent research in the same province by Mandondo (2020), who explored sleep wake behaviour in adolescents from public and private schools in an urban setting. These earlier bedtimes may be due to contextual realities for many of the participants, many of whom reported living with their parents, guardians, or other family members. Living with parents may have meant that there may have been some degree of parental influence on bedtime (Laberge et al., 2001; Dahl & Lewin, 2002; Arredondo et al., 2006; Maume, 2013; Dittus et al., 2015) compared to learners from previous studies who have some degree of independence at boarding school, as reported by Mandondo (2020).

Learners' main reasons for going to bed on weekdays were that they finished doing their homework and that they felt sleepy. Having to do homework at night has previously been shown to influence adolescent sleep (Gau & Soong, 1995; Yang et al., 2005; Suldo et al., 2009; Noronha, 2016). All the learners in this sample were in their final year of high school, which likely meant that their workload was higher than other years, given that they would be aiming to gain admission into tertiary institutions

such as a university or college the following year (Gau & Soong, 1995; Yang et al., 2005). However, despite the fact that homework was being performed at night, the results of this study indicate that this behaviour did not push bedtimes too late, a finding which contrasts with other studies (Wolfson & Carskadon, 1998; Giannotti et al., 2002; Taylor et al., 2005; Yang et al., 2005; Campbell et al., 2007; Gradisar et al., 2011). The early bedtimes could also be driven by the learners having to wake up early to commute and get to school. These early starts, discussed in more detail below, may mean that learners experience extended wakefulness by the end of the day, the result of which is high sleep pressure and an earlier bedtime.

Despite the early bed times, the truncated sleep across the group was more likely driven by the early rise times during the week, which were earlier than reported rise times in other studies outside of South Africa (Gau and Soong, 1995; Lee et al., 1999; Van den Bulck, 2004; Crowley et al., 2007; Ghanizadeh et al., 2008; Crowley et al., 2014; Gamble et al., 2014) and in South Africa (Reid et al., 2002; Mandondo, 2020). Learners reported being woken up by an alarm and being woken up by their parents, which indicates that they did not wake up naturally and that waking up was premature (Radosevic-Vidacek & Koscec, 2004; Carskadon, 2011). While likely multifactorial, the early rise times could be driven by the need to commute in order to get to school on time and make the early school start times, which differed between township (7:30 am) and rural (08:00 am) schools. The impact of early school start times on truncating sleep is in line with previous research, which has found that early school times contribute to insufficient sleep (Wolfson & Carskadon, 2005; Crowley et al., 2007; Basch et al., 2014; Gradisar et al., 2011; Zuckerman, 2015; Nahmod et al., 2019). In the current study, this was likely exacerbated by the need for learners to commute to school, either by walking or by catching various forms of transport. The early rise times and the need to commute to get to school on time may explain why learners tended more towards a morning-ness for the chronotype scale, a finding which contradicts previous research that reported that adolescents tend to have a preference for evening-ness, especially late adolescents such as those in this study (Giannotti et al., 2002; Yang et al., 2005; Russo et al., 2007; Gradisar et al., 2011).

The reported duration of sleep during the weekends was similar to the weekdays, a finding that is not consistent with previous studies. Sleep duration of adolescents on

weekends tends to be longer than weekdays, likely in response to the need to catch up on lost sleep from the week (Reid et al., 2002; Ohida et al., 2004; Loessl et al., 2008; Ghanizadeh et al., 2008; Shochat et al., 2010; Huang et al., 2010; Kim et al., 2011; Kang et al., 2012; Leger et al., 2012; Hysing et al., 2013; Short et al., 2013; Maduabuchi et al., 2014; Hirshkowitz et al., 2015; Patte et al., 2017; John et al., 2019; Mandondo et al., 2020; Gariepy et al., 2020; Lima et al., 2020; Lyall et al., 2020; Lima et al., 2020; Sleep Foundation, 2020).

The reason sleep could not be longer on weekends in this sample could be that the learners generally went to bed later on weekends, a finding that aligns with previous research that adolescents have later bedtimes on weekends (Yang et al., 2005; Crowley et al., 2007; Gradisar et al., 2011; Gamble et al., 2014). However, learners woke up at the same time they did during the week on weekends, an observation that also contradicts previous research (Yang et al., 2005; Crowley et al., 2007; Gradisar et al., 2011; Gamble et al., 2014). The main reasons cited for the reported weekend rise times were ‘being woken up by an alarm’, ‘waking up spontaneously’ and ‘being woken up by parents’. Although not explored explicitly in this study, the early rise times on the weekend may be influenced by the habits of early waking during the week. However, it may also reflect the reality of some learners in this context, where their parents might be waking them up for duties or chores that they would need to perform in or around the household (Hendricks, 2008; Ndlovu, 2014; Bayat et al., 2014; Du Plessis & Mestry, 2019). In Black African culture, parents delegate specific tasks and responsibilities to their children and this may be a reality in rural and township areas where learners might have certain chores or duties that they may be expected to perform in the early morning on weekends when these commitments do not clash with school commitments (Hendricks, 2008; Du Plessis & Mestry, 2019).

Another reason for these early rise times on weekends could be that some learners might have extra lessons, as over half of the learners in this sample reported having extra lessons. While not explored explicitly in this study, the high prevalence of reported extra lessons may be the results of the COVID-19 pandemic and the limitations it had on learners attending school. Extra lessons are also provided in attempt to help learners improve performance for final examinations (South African Government, 2010; Human Science Research Council, 2014). There could be

implications to learners not utilising the weekend to rest. One such implication could be that learners may experience cumulative sleep loss and suffer sleep debt (Yang et al., 2005; Russo et al., 2007; Wolfson et al., 2007) which will affect learners' wellbeing and performance (Gau & Soong, 1995; Giannotti et al., 1997; Carskadon, 2011). However, more research is needed to understand this finding in more detail and its implications for learners.

The findings in this study indicated that the learners in this sample experienced sleep disturbances, which is consistent with other studies that found an increased prevalence of sleep disturbances in adolescents as they get older (Laberge et al., 2001; Van den Bulck, 2004; Crowley et al., 2007). It is well established that inadequate sleep (in terms of duration and quality) leads to daytime sleepiness (Pereira, Moreno & Louzada, 2014; Voulgaris, Smart & Taylor, 2019), however, in the current sample, there was a low prevalence of daytime sleepiness following the completion of the sleepiness scale and the question on experiences of sleepiness. The low prevalence of daytime sleepiness in this sample is a finding that contradicts previous research that has reported a high prevalence of sleepiness in late adolescents (Wolfson & Carskadon, 1998; Reid et al., 2002; Giannotti et al., 2002; Yang et al., 2005; Huang et al., 2010; Owens et al., 2010; Jarrin et al., 2014). While there may be many reasons for this, the low sleepiness prevalence may be due to the fact that nearly half the learners reported napping during the week. While the relationship between sleep and napping was not explored in detail, inadequate and or poor-quality sleep may increase learners' need for or preference to nap (Reid et al., 2002). Learners in this study may have napped during the week due to the school commitments such as early rise times, early school start times, having to commute, and academic work. They also could have had more time to nap given that the group reported having relatively few extracurricular activities such as sport or jobs. Previous research has shown that daytime napping reduces daytime sleepiness (Reid et al., 2002; Malone et al., 2011) and this could account for the lower sleepiness prevalence in this study. A few learners also reported napping on weekends, and this may be because they could not extend their sleep during the weekend as they slept later and woke up earlier. Napping has been reported to be an efficient strategy to alleviate sleep problems (Santos, Peirera & Louzada, 2021) such as excessive daytime sleepiness and cognitive deficits experienced after sleep restriction (Lo et al., 2017). However, studies emphasized that napping needs

to be adopted with caution due to the reported detrimental effects of frequent and prolong naps have on nocturnal sleep (Jakubowski et al., 2016; Häusler et al., 2019; Santos, Peirera & Louzada, 2021; Santos & Louzada, 2022). It is important to note, that more research is needed to explore the characteristics of this napping behaviour, including the length, timing, and depth in order to understand the role they may play in this context.

The score the learners' obtained from the depressive mood scale indicates that learners may be experiencing depressive mood symptoms. While fairly limited in terms of its diagnostic power, this finding is similar to previous research which has highlight a strong link between inadequate sleep and poor mental health (Gau et al., 2007; Lee et al., 2012; Zang et al., 2017; Mandondo et al., 2020). The presence of depressive symptoms in this sample may also have been exacerbated by the heightened stress, anxiety and depression associated with the COVID-19 pandemic (Innocenti et al., 2020; Meyer et al., 2020; Stanton et al., 2020). Depressive mood symptoms could have also been as a result of examination stress, but this was not explored in detail. However, it is worth noting that there are complex factors that contribute to depression and other mental health challenges in adolescence that need to be considered and more research in this area is necessary.

5.3 The effects of learner location on sleep

There were no differences in the sleep variables such as the bed and rise times, the reported sleep duration and time spent in bed for rural and township scholars on weekdays and weekends. Both township and rural scholars reported a sleep duration of less than 8 hours. However, rural scholars left later than township scholars did to school, which was likely the result of having to commute further to get to school. This was however compensated for by the school starting later in rural schools. In this case, the differences in school start times for rural and township scholars recognises the commuting requirements of rural learners but does not translate into more time to sleep, learners do not get enough rest.

There were no differences for sleep variables on weekends when comparing rural and township learners. Furthermore, they reported the same reasons for bedtimes and for their rise times. Both rural and township learners went to bed later but woke up at much the same time. This was in contrast with what other studies found that

adolescents living in rural environments had earlier bedtimes on school days and weekends than urban adolescents (Louzada & Menna-Barreto, 2004; Peixoto et al., 2009). The sleep duration of the rural sample, specifically, was shorter on the weekends than weekdays and this is a concern given that this may mean that rural learners do not enough rest on weekends and go into the following week carrying more sleep debt. This may have to do with the context in which these learners live, where they may be required to carry out certain domestic tasks such as fetching water from the river or local taps, washing their uniforms, collecting, and chopping wood, herding cattle, cooking, working on farms to contribute at home as reported in other studies (Hendricks, 2008; Ndlovu, 2014; Bayat et al., 2014; Du Plessis & Mestry, 2019). However, the link between having to fulfil these duties and their impact on sleep was not explored in the study and research that is more empirical in nature is necessary to understand this observation more fully.

5.4 The effects of gender on sleep

There were no significant differences between the sleep variables on weekdays between male and female learners. This finding was in line with other studies that have shown that there is little evidence to the effects of gender on sleep (Lee et al., 1999; Yang et al., 2005; Knutson, 2005; Ghanizadeh et al., 2008; Hysing et al., 2013). However, these findings contradict other studies that did report gender differences in some sleep variables such as bedtimes (Wolfson et al., 2007; Gariepy et al., 2020) and rise times (Gau & Soong, 1995; Wolfson & Carskadon, 1998; Van den Bulck, 2004; Yang et al., 2005; Loessl et al., 2008; Vidal & Shochat, 2017). In relation to rise times, previous research has reported that female adolescents are more likely to wake earlier than their male counterparts are, especially on weekdays (Gau & Soong, 1995; Wolfson & Carskadon, 1998; Van den Bulck, 2004; Yang et al., 2005; Loessl et al., 2008; Vidal & Shochat, 2017). However, in this study, both males and females had the same rise times on weekdays in this study. On weekends, males also tended to go to bed later compared to weekdays, which resulted in less sleep on weekends compared to the weekdays. The bedtimes were also more variable than females. The lack of differences between the genders, as with the rural and township learners, may be attributed to the fact that these learners may have had similar commitments at school and were therefore faced with the same constraints such as having to perform household chores.

5.5 The effects of age group of participants on sleep

An interesting observation, not originally part of this study, was the emergence of a group of learners who were still at school but who, according to the definition of what constitutes adolescents, were not adolescents. This is attributable to the reality of learners from some township and rural schools, where learners sometimes fail years and have to repeat, while some also dropout before reaching the 12th grade and return to complete their schooling at a later stage. The various reasons why that may be includes, but not limited to; engaging in risky behaviours such as the use of alcohol and other drugs (Townsend, Flisher & King, 2007), having to deal with teenage pregnancy (Reddy, Sewpaul & Jonnas, 2016; Bardaji et al., 2011 & Willan, 2013), family breakdown (Ananga, 2011), poverty (Strassburg, Meny-Gilbert & Russell, 2010), the ineffective and often overcrowded schooling system, dysfunctional schools and sometimes, even a lack of access to schools (Masitsa, 2006). This is evident because previous research from the DBE has shown that there is only 52% of the age-appropriate population (learners aged 17-18 years) that remain enrolled in Grade 12 (Department of Basic Education, 2015; Weybright et al., 2017). This presented an opportunity to compare the learners who were adolescents with the learners who were non-adolescents or effectively young adults.

When comparing the sleep wake behaviour of these two groups, on weekdays, adolescents reported shorter sleep when compared to older learners. This finding is consistent with the evidence that adolescents obtain insufficient sleep because of an interaction of several biopsychosocial factors explored above (Kalsbeek et al., 2012; Touitou, 2013; Kelley et al., 2017). On weekends, adolescents reported going to bed 45 minutes later than non-adolescents, while the rise time remained the same as the weekdays. This finding was also in line with evidence in other studies that show that adolescents will have later bedtimes and early rise times (Hirshkowitz et al., 2015; National Sleep Foundation, 2015; Sleep Foundation, 2020). Non-adolescents had less sleep on weekends compared to adolescents. While there could be many reasons for non-adolescents sleeping less than adolescents, some of these older learners may have additional responsibilities such as taking care of their children as teenage pregnancy rates in this context are usually high (Bardaji et al., 2011; Willan, 2013; Reddy, Sewpaul & Jonnas, 2016) or their siblings as child-headed households are prevalent in South Africa (Lutya, 2007; Lutya, 2012; Motha & Frempong, 2014; Pillay,

2016). Some of these non-adolescents may be married and could be working status as there were a few (n=4; 3.3%) non-adolescents in this sample that reported working which may have contributed in part to the observed differences. However, this was not explored in the study, and there is a need to understand the impact of other lifestyle factors such work and school on sleep in more detail through additional research.

5.6 General behavioural and lifestyle factors of the whole group

5.6.1 Frequency of caffeine consumption

Just over half of the learners in this sample reported not consuming caffeinated substances. This contradicts previous studies that have reported that there is a high prevalence of consumption of caffeinated substances in adolescents (Orbeta et al., 2006; Bryant-Ludden & Wolfson, 2010; Bartel et al., 2015). The reason learners might not consume as much caffeine as the learners from other contexts could be linked to students in the current study having a lack of access to tuckshops that sell caffeinated products, or it could be that there is a lack of knowledge regarding “caffeinated” products.

There may have also not been a need for students to consume caffeine products, given the low prevalence of reported sleepiness reports in this study. Although not explored explicitly, the low consumption of caffeine-containing products may account for why sleep was somewhat longer in this sample compared to previous research, given that caffeine affects sleep quality and quantity, especially if consumed in the afternoon and evening by adolescents (Dahl & Carskadon, 1995; Pollak & Bright, 2003; Orbeta et al., 2006; Calamaro et al., 2009; Ludden & Wolfson, 2010; Bertal et al., 2015; Clark & Landolt, 2017; Treur et al., 2018). However, this study did not explore the times at which learners consumed caffeinated substances. It would be interesting to explore this in more detail in future research.

5.6.2 Prevalence of sports or physical activity

Majority of the learners (n=75; 61%) in this sample reported not engaging in any sports or physical activity. The lack of sport participation may be due to their schools complying with the COVID-19 rules and regulations, which at the time led to the suspension of physical contact sporting codes such as water polo, basketball, baseball, football, hockey, netball, rugby, and softball to decrease the risk of spreading the virus. Additionally, the need for extended commute and extra lessons the learners

reported attending in this sample might have affected the time available for physical activity or sports participation. This also meant that learners could go home earlier, so they did not need to push their days and homework late into the night, which may partially explain their early bedtimes. There is evidence that highlights the importance engaging in sports, such as having an improved mood, better stress management stress, maintaining an optimal level of cognitive function (Anshel, 2010) and improved sleep (Bartel et al., 2015).

The remaining learners (n=46; 37%) reported participating in different sporting codes; however, no significant differences between the type of learner/learner location and age group were found. There was a significant difference between gender and the prevalence of sport. Most males reported participating in sport or physical activity compared to the females who reported not playing sport or engaging in any physical activity. This finding was in line with previous research that has highlighted that males are likely to have sport or athletic obligations, especially on weekends (Wolfson et al., 2007; Gariepy et al., 2020). This may also indicate an inequity of opportunity for female learners to participate in sport in this context, a finding that likely needs to be addressed at a school level, but one that is beyond the scope of this thesis.

5.7 Integration of findings into the Perfect Storm Model

Although not explored explicitly in this study, the results of this study indicate how the interaction between the different biopsychosocial factors affect learner sleep in rural and township settings, an observation that supports the utility of the Perfect Storm of insufficient and ill-timed sleep (Carskadon, 2011; Crowley et al., 2018) (Figure 2).

The weekday bedtimes in this sample were influenced by bioregulatory factors such as feeling sleepy and by psychosocial factors of school-related commitments such as having to do homework during the weekdays, while the impact of technology (through watching television and being exposed to stimulating content and light) may have influenced weekend bedtimes. While bedtimes were earlier than many previous studies had reported, sleep duration was truncated on both weekdays and weekends. This was largely explained by early rise times, which learners cited as the results of having to be woken up by an alarm clock and their parents mostly on weekdays in order to commute to get to school on time (as shown in the Perfect storm model). These learners reported an early morning start of 5:30 am on weekdays and

weekends. These early morning starts on weekdays were influenced by commuting and early school start times. The weekend rise times may have been influenced by academic pressures (extra lessons), chores and responsibilities that the learners from this context have to perform.

In summary, there are common and unique constraints that learners in this context face that impacted their sleep. However, the lack of recovery sleep opportunities on the weekend, the factors that influence this and its effects need to be elucidated further.

5.8 Policy change recommendations

The results of this study align with previous research, and point to the fact that adolescents in this setting obtain insufficient sleep. Thus, there is a need for context specific interventions that can be developed and instituted at different levels of the system in focus. It is important to acknowledge that insufficient sleep has negative consequences for not only the learners, but also the teachers, the heads of the schools and even parents. However, there needs to be more research to understand the long-term effects of poor quality and quantity of sleep in samples like this across South Africa as this was beyond the scope of the study. Below are some recommendations emanating from this research, which highlight some possible practical recommendations for schools and learners, and the Department of Basic Education (DBE), as well as some areas for further research.

5.8.1 Recommendations for schools for learners

In addressing the challenges of sleep in this group, there is a need to increase awareness of the importance of sleep through the introduction of sleep education programs/interventions. Such programs have effectively promoted healthy sleep and sleep habits amongst adolescents in previous research (Cain, Gradisar & Moseley, 2011; Irish et al., 2015; Wolfson et al., 2015) like the use of posters in the different classrooms that would provide important information on sleep in an easily accessible way (Sleep Education, 2015). The posters may incorporate information around the recommendations on how much sleep is required for different age groups, the different healthy sleep practices to improve sleep and the different ways to meet the sleep duration recommendations (Gupta et al., 2021). The learners should be encouraged to adopt healthy sleep habits that improve their sleep as previous studies have

highlighted that self-regulatory and motivational skills are required to promote behavioural changes (Bandura, 2004) and not knowledge acquisition alone (Moseley & Gradisar, 2009). However, the introduction of these sleep education programs in rural and township areas may be challenging as many of the schools in this context are resource scarce, which may influence the development and promotion of such a program.

The learners in this sample reported low levels of sports participation, and that was understandable considering the COVID-19 pandemic regulations of no contact sports. However, since South Africa is currently under level 1 lockdown (at the time of writing this thesis) and that means the easing of some restrictions including sport. Administrators could consider bringing to participation in sport or physical activity back as participation in sport has been linked with better sleep (Bartel et al., 2015).

5.8.2 Recommendations for Department of Basic Education (DBE)

Most learners from this context reported going to bed at a reasonable time but had to wake up early to commute in order to make school start times. It is evident that the school start times in these schools are likely too early and contribute to the insufficient sleep learners observed in the current sample, particularly given the need to commute. The Department of Basic Education as the governor of public schools could consider delaying school start times to start no earlier than 8:30 am. Delaying school start times especially for high school has been associated with improved sleep, numerous health and academic benefits and safety (Ziporyn et al., 2022). It is important to note, however, that delaying school start times may be not as simple as it seems, it must be supported by high-quality research on the impact of these changes (Eliasson et al. 2002). Therefore, it may require extensive consultation and planning to ensure that all community stakeholders (teachers, parents, businesses, transportation providers, and other stakeholders) that may be affected by the change in start times are not negatively affected (Wahlstrom, 1999; Wolfson et al., 2007). However, these are not insurmountable as schools in other countries that have delayed school start times show that community life adjusts and that these schools have found affordable ways to delay high school start times (Ziporyn et al., 2022). There is a need to liaise with stakeholders in various disciplines especially those knowledgeable about the schooling system that exists in the country to determine what the most appropriate course of action should be in trying to initiate this debate.

In spite of the evidence presented in this study that suggests that learners from rural and township areas obtain insufficient sleep, most perceived themselves as good quality sleepers. This may point to the lack of understanding around the importance of sleep in this context. As such, the Department of Basic Education could consider including sleep in the current curriculum (National Curriculum and Assessment Policy Statement) in subjects like Life Orientation. In this subject, health, and wellness issues around the importance of physical activity and diet are discussed, but currently, there is nothing about the importance of sleep. Including sleep in this subject would require the government to involve the sleep experts to ensure an evidence-based integration of this information. There could be the inclusion of the program in Life Orientation called a Sleep Smart Program that emphasizes the importance of sleep through sleep hygiene training which allows adolescents to manage their academic work and other activities better prior to sleep, as has been done in other contexts (LeBourgeois et al., 2005; Wolfson et al., 2015). This program could also extend to raising awareness to parents about the importance of sleep, especially in letting their children sleep in on weekends as the results of this study have shown that learners have early rise times on weekends with no opportunity to catch up on sleep. Previously studies have shown how the sleep of adolescents who had parentally set bedtimes improved in that they had earlier bedtimes on school nights and less sleepiness (Beinjamini & Louzada, 2012).

5.8.3 Recommendations for future research

Given that there is a lack of existing knowledge on adolescent sleep problems, especially in the South African context, more widespread research is needed across different parts of South Africa to get a more representative picture of the sleep-wake behaviour of adolescents from all different areas, including different urban, township and rural settings. The use of objective methods such as actigraphy to support self-reported data in assessing sleep-wake behaviour in this context over time is also needed. These objective methods would help in understanding specifics about the sleep patterns of adolescents such as the daytime naps that were reported in this sample. It would also be important for future research to understand the length, timing, and depth of daytime naps in order to understand the role they may play in this context.

Future research should further evaluate the sleep habits of South African adolescents from a rural and township setting, explore especially why learners from this context

did not sleep in on the weekends There is also a need for research to explore the impact of the living conditions and the day-to-day activities of learners in this context and how these influence their sleep wake behaviour. These factors could also include why the learners had the same rise times on weekends and how this could look in other age groups. Furthermore, there is need to explore the schooling conditions of learners from this context, specifically focusing on what their schooling day looks like and the demands that the schools place on the learners, particularly given the impact of the COVID-19 pandemic. It would also be important to get an idea of the schooling conditions of South African learners who have to commute long distances, walk, and heavily rely on public transport to school and how this impacts sleep wake behaviour and general wellbeing.

Future research could also explore the impact of introduction education programs or other interventions of sleep in this context over a longer period. In addition, more research is necessary to determine whether the reported sleep loss observed in this study objectively affects learner, alertness, performance, and well-being. Additionally, there was a low prevalence of caffeine consumption in this sample whereas previous research highlighted that adolescents consume caffeinated beverages more. This therefore highlighted a need for future research to explore if and why learners in this context consume less caffeine. Lastly, future research should explore more in depth, the mental health of learners with more appropriate diagnostic methods to characterise and effectively manage the mental health challenges that may be linked to the inadequate sleep in this sample.

5.9 Limitations of the study

This study did present some limitations. The data collection occurred in one area, and not all the schools in the town could participate given the restriction on time to collect the data due to the third wave of the pandemic and the associated constraints put in place by the Department of Basic Education. There were also smaller numbers of participants from rural schools than township schools, which affected the sample size and the overall power of the study. The participants sampled were also in their final year of high school. Therefore, results cannot be generalised to other settings, schools and other year groups and need to be interpreted with caution.

In addition, the Department of Basic Education (DBE) had strict protocols and regulations prompted by the COVID-19 pandemic. Due to having to adhere to these regulations, physical interaction with learners was limited. The researcher was only allowed to give out information on what the study was about, explain the contents of the SSHS, distribute the survey and return to collect the surveys the following day in all the schools. The researcher was not permitted to be present when learners filled out the survey, most of which were completed at home and not during the school day, in line with the stipulations by the DBE and the principals. The absence of the researcher when learners completed the surveys likely impacted the accuracy around how they were completed, which was evidenced by the need to exclude some responses like sleep latency. However, the researcher left a contact number for the learners for calls or texts if they had any questions and concerns, but only a few learners reached out.

The electronic devices section of the survey was taken out before data collection due to time constraints and limitations put in place by the schools and the Department of Basic Education in attempt to limit participant fatigue and improve completion rates. Future research should look at the prevalence of technology and its impact on sleep in this sample, given the impact that technology use (and light exposure) may have on sleep. The exclusion of the responses like sleep latency may have also been influenced by the lack of understanding of the English language that the survey was in, which is a second language to the learners in this context, most of whom speak IsiXhosa.

The cross-sectional design of the study limited the researchers from exploring causal inferences on the factors that may influence sleep over time. A cross-sectional design that relies on self-reported data is limiting because it depends on the ability of participants to recall information, which may have been affected by recall bias (Gupta et al., 2020). The findings of this study should be read in light of these limitations.

CHAPTER VI

6 CONCLUSION

This study aimed to explore and characterise the sleep-wake behaviour of adolescents in selected rural and township schools in Alice, a small town in the Eastern Cape of South Africa. This is one of the first studies to have explored adolescents' sleep-wake behaviour in this context. The results of the study support previous research, where the duration of sleep reported in the current sample was insufficient. While likely the result of complex interactions of different factors, early rise times, the need to commute to school combined with the early school start times were some of the main reasons why learners in this study may have reported inadequate sleep. Contrary to much of the literature on adolescent sleep, the findings of this study showed that learners reported similar sleep durations on the weekdays and weekends, with rural learners reporting less sleep during the weekends than the weeks. This has implications for learners who may be at risk of experiencing the effects of cumulative sleep loss. In spite of this, there was a low reported prevalence of sleepiness. The evidence of sleep disturbances, a tendency towards depressive moods, the relatively high reported prevalence of napping on school days do provide some evidence of poor and inadequate sleep in this group.

Sleep-wake behaviour did not differ between rural or township learners, between genders or between older and younger learners in the sample. As mentioned in the limitations above that there is a possibility that a small sample may affect the power of the study, and this could explain why there was a lack of differences between some of the sociodemographic characteristics such as learner location and gender. The lack of differences could also be attributed to being exposed to the same constraints and challenges and living with their families, which could mean that there may be parental influence on learners’ sleep-wake behaviour. This, however, points to the conclusion that further research is needed to explore the contributing factors on the sleep-wake behaviour of adolescents on weekends.

This study provides some limited, but important insights into the status of sleep wake behaviour of adolescents in the rural and township areas of Alice in the Eastern Cape of South Africa. In line with previous research, in South Africa and more broadly, there is a continued need for awareness raising and interventions that help to improve the opportunities for adolescents to get the quality and quantity of sleep that they need. More research aimed at exploring context-specific interventions to the challenges adolescents face in all parts of South Africa is therefore warranted. In order to achieve this, understanding the barriers to the sleep of adolescents across the different socioeconomic strata is important. At a local level, learners, parents, teachers, heads of the schools, and policy makers need to redesign the school days differently with what is in the best interest of the learners, to accommodate for the natural biological and psychosocial changes that influence sleep during adolescence. In the wake of the effects of the COVID-19 pandemic, fundamental behaviours like sleep need to be protected to ensure the health and well-being of learners in this context.

7 REFERENCE LIST

Acebo, C., Sadeh, A., Seifer, R., Tzischinsky, O., Wolfson, A. R., Hafer, A., & Carskadon, M. A. (1999). Estimating sleep patterns with activity monitoring in children and adolescents: how many nights are necessary for reliable measures?. *Sleep*, *22*(1), 95-103. https://doi.org/10.1093/sleep/22.1.95

Adam, E. K., Snell, E. K., & Pendry, P. (2007). Sleep timing and quantity in ecological and family context: A nationally representative time-diary study. *Journal of Family Psychology, 21*, 4–19. https://doi:10.1037/0893-3200.21.1.4.

Adams, S. K., Williford, D. N., Vaccaro, A., Kisler, T. S., Francis, A., & Newman, B. (2017). The young and the restless: Socializing trumps sleep, fear of missing out, and technological distractions in first-year college students. *International Journal of Adolescence and Youth*, *22*(3), 337-348. https://doi.org/10.1080/02673843.2016.1181557

Aghajani, M., Hajijafari, M., Akbari, H., & Asgarian, F. S. (2020). Cleveland Adolescent Sleepiness Questionnaire (CASQ): a translation and validation study of the Persian version. Sleep and Biological Rhythms, 1-7. https://doi.org/10.1007/s41105-020-00257-x

Alice LED Strategy Report. (2000). Economic Development, Research: ECSECC. Accessed from http://ecsecc.org/information-centre/item/alice-led-strategy on 20/09/2020.

Allada, R., & Siegel, J. M. (2008). Unearthing the phylogenetic roots of sleep. *Current Biology, 18*(15), R670-R679. https://doi:10.1016/j.cub.2008.06.033

Amnesty International. (2020). ROKEN AND UNEQUAL: THE STATE OF EDUCATION IN SOUTH AFRICA. Accessed on 01/06/2020 on https://amnesty.org.za/research/broken-and-unequal-the-state-of-education-in-south-africa/

An, H., Ahn, J. H., & Bhang, S. Y. (2010). The association of psychosocial and familial factors with adolescent suicidal ideation: A population-based study. Psychiatry research, 177(3), 318-322. https://doi.org/10.1016/j.psychres.2010.03.007

Ancoli-Israel, S., Cole, R., Alessi, C., Chambers, M., Moorcroft, W., & Pollak, C. P. (2003). The role of actigraphy in the study of sleep and circadian rhythms. Sleep, 26(3), 342-392. https://doi.org/10.1093/sleep/26.3.342

Anders, T. F., Carskadon, M. A., Dement, W. C., & Harvey, K. (1978). Sleep habits of children and the identification of pathologically sleepy children. Child psychiatry and human development, 9(1), 56-63. https://doi.org/10.1007/BF01463220

Andrade, M. M., Benedito-Silva, A. A., Domenice, S., Arnhold, I. J., & Menna-Barreto, L. (1993). Sleep characteristics of adolescents: a longitudinal study. Journal of Adolescent Health, 14(5), 401-406. https://doi.org/10.1016/S1054-139X(08)80016-X

Anshel, M. H. (2010). Cultural differences in coping with stress in sport. In A. R. Nicholls (Ed.), Coping in sport: Theory, methods, and related constructs (pp. 119-138). Hauppauge, NY: Nova Science. https://doi.org/10.1037/t36535-000

Arora, T., Broglia, E., Pushpakumar, D., Lodhi, T., & Taheri, S. (2013). An investigation into the strength of the association and agreement levels between subjective and objective sleep duration in adolescents. PloS one, 8(8), e72406. https://doi.org/10.1371/journal.pone.0072406

Arredondo, E.M., Elder, J.P., Ayala, G.X., Campbell, N., Baquero, B., & Duerksen, S. (2006). Is parenting style related to children's healthy eating and physical activity in Latino families?. Health Educ Res, 21(6):862-871. https://doi.org/10.1093/her/cyl110

Atkinson, D. (2014). Rural-urban linkages: South Africa case study. Territorial Cohesion for Development Program, Rimisp, Santiago.

Bagley, E. J., Kelly, R. J., Buckhalt, J. A., & El-Sheikh, M. (2015). What keeps low-SES children from sleeping well: the role of presleep worries and sleep environment. Sleep Medicine, 16(4), 496-502. https://doi.org/10.1016/j.sleep.2014.10.008

Baiden, P., Tadeo, S. K., & Peters, K. E. (2019). The association between excessive screen-time behaviors and insufficient sleep among adolescents: Findings from the 2017 youth risk behavior surveillance system. Psychiatry Research, 281, 112586. https://doi.org/10.1016/j.psychres.2019.112586

Ban, D. J., & Lee, T. J. (2001). Sleep duration, subjective sleep disturbances and associated factors among university students in Korea. *Journal of Korean Medical Science, 16*(4), 475-480.

Bandura, A. (2004). Health promotion by social cognitive means. Health Educ Behav. 31(2):143–164.

Bardaji, A., Sigauque, B., Sanz, S., Maixenchs, M., Ordi, J., Aponte, J. J., ... & Menéndez, C. (2011). Impact of malaria at the end of pregnancy on infant mortality and morbidity. Journal of Infectious Diseases, 203(5), 691-699. https://doi.org/10.1093/infdis/jiq049

Bartel, K. A., Gradisar, M., & Williamson, P. (2015). Protective and risk factors for adolescent sleep: a meta-analytic review. Sleep medicine reviews, 21, 72-85. https://doi.org/10.1016/j.smrv.2014.08.002

Basch, C. E., Basch, C. H., Ruggles, K. V., & Rajan, S. (2014). Prevalence of sleep duration on an average school night among 4 nationally representative successive samples of American high school students, 2007–2013.

Bates, J. E., Viken, R. J., Alexander, D. B., Beyers, J., & Stockton, L. (2002). Sleep and adjustment in preschool children: Sleep diary reports by mothers relate to behavior reports by teachers. Child development, 73(1), 62-75 https://doi.org/10.1111/1467-8624.00392

Bayat, A., Louw, W., & Rena, R. (2014). The impact of socio-economic factors on the performance of selected high school learners in the Western Cape Province, South Africa. Journal of Human Ecology, 45(3), 183-196. https://doi.org/10.1080/09709274.2014.11906692

Becker, S. P., Langberg, J. M., & Byars, K. C. (2015). Advancing a biopsychosocial and contextual model of sleep in adolescence: A review and introduction to the special issue. https://doi.org/10.1007/s10964-014-0248-y

Becker, S. P., & Gregory, A. M. (2020). Editorial Perspective: Perils and promise for child and adolescent sleep and associated psychopathology during the COVID-19 pandemic. Journal of Child Psychology and Psychiatry, 757–759. https://doi.org:10.1111/jcpp.13278

Beebe, D. W., Lewin, D., Zeller, M., McCabe, M., MacLeod, K., Daniels, S. R., & Amin, R. (2007). Sleep in overweight adolescents: shorter sleep, poorer sleep quality, sleepiness, and sleep-disordered breathing. Journal of Pediatric Psychology, 32(1), 69-79. https://doi.org/10.1093/jpepsy/jsj104

Beebe, D. W. (2011). Cognitive, behavioral, and functional consequences of inadequate sleep in children and adolescents. *Pediatric Clinics*, *58*(3), 649-665.

Bei, B., Allen, N. B., Nicholas, C. L., Dudgeon, P., Murray, G., & Trinder, J. (2014). Actigraphy- assessed sleep during school and vacation periods: a naturalistic study of restricted and extended sleep opportunities in adolescents. Journal of Sleep Research, 23(1), 107-117. https://0- doi.org.wam.seals.ac.za/10.1111/jsr.12080

Bell, J., & Mckay, T.M. (2011). The rise of "class Apartheid" in accessing secondary schools in Sandton, Gauteng. Southern African Review of Education, 17, 27-48

Beijamini, F., & Louzada, F.M. (2012): Are educational interventions able to prevent excessive daytime sleepiness in adolescents?, Biological Rhythm Research, 43:6, 603-613. http://dx.doi.org/10.1080/09291016.2011.630183

Berkey, C. S., Rockett, H. R., & Colditz, G. A. (2008). Weight gain in older adolescent females: the internet, sleep, coffee, and alcohol. The Journal of pediatrics, 153(5), 635-639. https://doi.org/10.1016/j.jpeds.2008.04.072

Bernard, S., Gonze, D., Čajavec, B., Herzel, H., & Kramer, A. (2007). Synchronization-induced rhythmicity of circadian oscillators in the suprachiasmatic nucleus. PLoS Comput Biol, 3(4), e68. https://doi.org/10.1371/journal.pcbi.0030068

Bernert, R. A., & Joiner, T. E. (2007). Sleep disturbances and suicide risk: a review of the literature. Neuropsychiatric disease and treatment, 3(6), 735. https://doi.org/10.2147/NDT.S1248

Biddle, D. J., Robillard, R., Hermens, D. F., Hickie, I. B., & Glozier, N. (2015). Accuracy of self-reported sleep parameters compared with actigraphy in young people with mental ill-health. Sleep health, 1(3), 214-220. https://doi.org/10.1016/j.sleh.2015.07.006

Billows, M., Gradisar, M., Dohnt, H., Johnston, A., McCappin, S., & Hudson, J. (2009). Family disorganization, sleep hygiene, and adolescent sleep disturbance. Journal of Clinical Child & Adolescent Psychology, 38(5), 745-752. https://doi.org/10.1080/15374410903103635

Blake, J., & Kerr, D. (2010). Development of an Online Sleep Diary. Biomedical Knowledge Management: Infrastructures and Processes for E-Health Systems / Pease, W, Cooper, M, Gururagan, R (eds): pp.289-302. https://doi.org/10.4018/978-1-60566-266-4.ch021

Borbély, A. A. (1982). A two process model of sleep regulation. Hum neurobiol, 1(3), 195-204.

Borbély, A. A., Daan, S., Wirz-Justice, A., & Deboer, T. (2016). The two-process model of sleep regulation: a reappraisal. Journal of sleep research, 25(2), 131-143. https://doi.org/10.1111/jsr.12371

Borbély, A., & Achermann, P. (1999). Sleep Homeostasis and Models of Sleep Regulation Journal of Biological Rhythms, 14 (6), 559-570 https://doi.org/10.1177/074873099129000894

Brand, S., Beck, J., Gerber, M., Hatzinger, M., & Holsboer-Trachsler, E. (2010). Evidence of favorable sleep-EEG patterns in adolescent male vigorous football players compared

to controls. The World Journal of Biological Psychiatry, 11(2-2), 465-475. https://doi.org/10.3109/15622970903079820

Brand, S., & Kirov, R. (2011). Sleep and its importance in adolescence and in common adolescent somatic and psychiatric conditions. *International Journal of General Medicine*, *4*, 425.

Brooks, R. (2018). How Technology Impacts Sleep Quality. AAST:The community for sleep-care professionals. Accessed on https://www.aastweb.org/blog/how-technology-impacts-sleep-quality on 20/07/2020.

Brossart, D. F., Laird, V. C., & Armstrong, T. W. (2018). Interpreting Kendall's Tau and Tau-U for single-case experimental designs. Cogent Psychology, 5(1), 1-26. https://doi.org/10.1080/23311908.2018.1518687

Bruce, E. S., Lunt, L., & McDonagh, J. E. (2017). Sleep in adolescents and young adults. Clinical medicine, 17(5), 424. https://doi.org/10.7861/clinmedicine.17-5-424

Bryant-Ludden, A., & Wolfson, A. R. (2010). Understanding adolescent caffeine use: connecting use patterns with expectancies, reasons, and sleep. Health Education & Behavior, 37(3), 330-342. https://doi.org/10.1177/1090198109341783

Burgard, S. A., & Ailshire, J. A. (2009). Putting work to bed: stressful experiences on the job and sleep quality. Journal of Health and Social Behavior, 50(4), 476-492. https://doi.org/10.1177/002214650905000407

Buxton, O. M., Chang, A. M., Spilsbury, J. C., Bos, T., Emsellem, H., & Knutson, K. L. (2015). Sleep in the modern family: protective family routines for child and adolescent sleep. Sleep health, 1(1), 15-27. https://doi.org/10.1016/j.sleh.2014.12.002

Buysse, D. J., Reynolds III, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry research, 28(2), 193-213. https://doi.org/10.1016/0165-1781(89)90047-4

Cain, N., Gradisar, M., & Moseley, L. (2011). A motivational school-based intervention for adolescent sleep problems. Sleep Medicine, 12(3), 246-251

Calamaro, C. J., Mason, T. B., & Ratcliffe, S. J. (2009). Adolescents living the 24/7 lifestyle: effects of caffeine and technology on sleep duration and daytime functioning. Pediatrics, 123(6), e1005-e1010. https://doi.org/10.1542/peds.2008-3641

Campbell, I. G., Higgins, L. M., Trinidad, J. M., Richardson, P., & Feinberg, I. (2007). The increase in longitudinally measured sleepiness across adolescence is related to the maturational decline in low-frequency EEG power. Sleep, 30(12), 1677-1687. https://doi.org/10.1093/sleep/30.12.1677

Carskadon, M. A., Seifer, R., & Acebo, C. (1991). Reliability of six scales in a sleep questionnaire for adolescents. *Sleep Research*, *20*, 421.

Carskadon, M.A, Vieira, C., & Acebo, C. (1993). Association between puberty and delayed phase preference. Sleep, 16, 258-262. https://doi.org/10.1093/sleep/16.3.258

Carskadon, M. A. (1993). Evaluation of excessive daytime sleepiness. Neurophysiologie clinique, 23(1), 91-100. https://doi.org/10.1016/S0987-7053(05)80287-4

Carskadon, M. A. (2011). Sleep in adolescents: The perfect storm. Pediatric Clinics of North America, 58(3), 637-647. Retrieved from http://itupl-ura1.ml.unisa.edu.au:80/R/?func=dbin-jump-full&object_id=121525. https://doi.org/10.1016/j.pcl.2011.03.003

Carskadon, M. A., & Acebo, C. (2002). Regulation of sleepiness in adolescents: update, insights, and speculation. Sleep, 25(6), 606-614. https://doi.org/10.1093/sleep/25.6.606

Carskadon, M. A., & Dement, W. C. (2011). Normal human sleep: an overview. In M.H. Kryger, T. Roth, & W.C. Dement (Eds.), Principles and practice of sleep medicine, 5th edition, (pp 16- 26). Elsevier Saunders.

Chaput, J. P., & St-Onge, M. P. (2014). Increased food intake by insufficient sleep in humans: are we jumping the gun on the hormonal explanation?. Frontiers in endocrinology, 5, 116. https://doi.org/10.3389/fendo.2014.00116

Chaput, J.P., Dutil, C., & Sampasa-Kanyinga, H. (2018). Sleeping hours: what is the ideal number and how does age impact this?. Nature and Science of Sleep, 10, 421-430. https://doi.org/10.2147/NSS.S163071

Chattu, V. K., Manzar, M. D., Kumary, S., Burman, D., Spence, D. W., & Pandi-Perumal, S. R. (2019, March). The global problem of insufficient sleep and its serious public health implications. In Healthcare (Vol. 7, No. 1, p. 1). Multidisciplinary Digital Publishing Institute. https://doi.org/10.3390/healthcare7010001

Chen, M. Y., Wang, E. K., & Jeng, Y. J. (2006). Adequate sleep among adolescents is positively associated with health status and health-related behaviors. *BMC public health*, *6*(1), 1-8. https://0-doi.org.wam.seals.ac.za/10.1186/1471-2458-6-59

Chervin, R. D., Hedger, K., Dillon, J. E., & Pituch, K. J. (2000). Pediatric sleep questionnaire (PSQ): validity and reliability of scales for sleep-disordered breathing, snoring, sleepiness, and behavioral problems. Sleep medicine, 1(1), 21-32. https://doi.org/10.1016/S1389-9457(99)00009-X.

Chehri, A., Goldaste, N., Ahmadi, S., Khazaie, H., & Jalali, A. (2021). Psychometric properties of insomnia severity index in Iranian adolescents. *Sleep Science*, *14*(2), 101. https://dx.doi.org/10.5935%2F1984-0063.20200045

Cho, Y. W., Lee, J. H., Son, H. K., Lee, S. H., Shin, C., & Johns, M. W. (2011). The reliability and validity of the Korean version of the Epworth sleepiness scale. Sleep and Breathing, 15(3), 377-384. https://doi.org/10.1007/s11325-010-0343-6

Cho H. W. (2018). How Much Caffeine is Too Much for Young Adolescents?. *Osong public health and research perspectives*, *9*(6), 287–288. https://doi.org/10.24171/j.phrp.2018.9.6.01

Clark, I., & Landolt, H. P. (2017). Coffee, caffeine, and sleep: A systematic review of epidemiological studies and randomized controlled trials. Sleep Medicine Reviews, 31, 70-78. https://doi.org/10.1016/j.smrv.2016.01.006

Colten, H. R., & Altevogt, B. M. (2006). Sleep physiology. In Sleep disorders and sleep deprivation: An unmet public health problem. National Academies Press (US).

Coulombe, J. A., Reid, G. J., Boyle, M. H., & Racine, Y. (2010). Concurrent associations among sleep problems, indicators of inadequate sleep, psychopathology, and shared risk factors in a population-based sample of healthy Ontario children. Journal of Pediatric Psychology, 35(7), 790-799. https://doi.org/10.1093/jpepsy/jsp097

Crawford, H., North, K., Wilson, M. J., Berman, Y., McKelvey-Martin, V., Morrison, P. J., ... & Barton, B. (2021). Development and preliminary evaluation of the Neurofibromatosis Type 1 Adult Quality of Life (NF1-AdQoL) questionnaire. *Clinical and Experimental Dermatology*.

Cross, C., Harwin, S.J., Schwabe, C., Morris, N., & Kekana, A. (2000). Rural and Urban Densification in South Africa: A preliminary review of policy implications for migration and infrastructure. University of Natal, Durban.

Crowley, S. J., Acebo, C., & Carskadon, M. A. (2007). Sleep, circadian rhythms, and delayed phase in adolescence. *Sleep Medicine*, *8*(6), 602-612.

Crowley, S. J., Van Reen, E., LeBourgeois, M. K., Acebo, C., Tarokh, L., Seifer, R., Barker, D. H., & Carskadon, M. A. (2014). A longitudinal assessment of sleep timing, circadian phase, and phase angle of entrainment across human adolescence. *PloS one*, *9*(11), e112199. https://doi.org/10.1371/journal.pone.0112199

Crowley, S. J., Wolfson, A. R., Tarokh, L., & Carskadon, M. A. (2018). An update on adolescent sleep: New evidence informing the perfect storm model. Journal of adolescence, 67, 55-65. https://doi.org/10.1016/j.adolescence.2018.06.001

Daan, S., Beersma, D. G., & Borbély, A. A. (1984). Timing of human sleep: recovery process gated by a circadian pacemaker. American Journal of Physiology-Regulatory, Integrative and Comparative Physiology, 246(2), R161-R183. https://doi.org/10.1152/ajpregu.1984.246.2.R161

Dahl, R. E. (1996). The regulation of sleep and arousal: Development and psychopathology. Development and Psychopathology, 8, 3-27. https://doi.org/10.1017/S0954579400006945

Dahl, R. E., Allen, N. B., Wilbrecht, L., & Suleiman, A. B. (2018). Importance of investing in adolescence from a developmental science perspective. Nature, 554(7693), 441-450. https://doi.org/10.1038/nature25770

Dahl, R.E. (1999). The consequences of insufficient sleep for adolescent's links between sleep and emotional regulation. Phi Delta Kappan, 80, 354-359.

Dahl, R.E., & Lewin, D.S. (2002). Pathways to adolescent health sleep regulation and behavior. J Adolesc Health, 31(6), 175-184. https://doi.org/10.1016/S1054-139X(02)00506-2

Daniel, L. C., Childress, J. L., Flannery, J. L., Weaver-Rogers, S., Garcia, W. I., Bonilla-Santiago, G., & Williamson, A. A. (2020). Identifying Modifiable Factors Linking Parenting and Sleep in Racial/Ethnic Minority Children. Journal of Pediatric Psychology. https://doi.org/10.1093/jpepsy/jsaa034

Dass, S., & Rinquest, A. (2017). School fees. Basic education rights handbook: Education rights in South Africa. Johannesburg, South Africa: SECTION27. Available at http://section27. org. za/wpcontent/uploads/2017/02.

Deboer, T. (2018). Sleep homeostasis and the circadian clock: do the circadian pacemaker and the sleep homeostat influence each other's functioning?. Neurobiology of sleep and circadian rhythms, 5, 68-77. https://0-doi.org.wam.seals.ac.za/10.1016/j.nbscr.2018.02.003

Dewald, J. F., Meijer, A. M., Oort, F. J., Kerkhof, G. A., & Bögels, S. M. (2010). The influence of sleep quality, sleep duration and sleepiness on school performance in children and adolescents: A meta-analytic review. Sleep medicine reviews, 14(3), 179-189. https://0-doi.org.wam.seals.ac.za/10.1016/j.smrv.2009.10.004

Dijk, D. J., & Lockley, S. W. (2002). Invited Review: Integration of human sleep-wake regulation and circadian rhythmicity. *Journal of applied physiology*, *92*(2), 852-862. https://doi.org/10.1152/japplphysiol.00924.2001

Dijk, D-K., & von Schantz, M., (2005). Timing and Consolidation of Human Sleep Wakefulness, and Performance by a Symphony of Oscillators. Journal of Biological Rhythms, 20(4), 279-290. https://doi.org/10.1177/0748730405278292

Dinleyici, M., Carman, K. B., Ozturk, E., & Sahin-Dagli, F. (2016). Media Use by Children, and Parents' Views on Children's Media Usage. *Interactive journal of medical research*, *5*(2), e5668. https://dx.doi.org/10.2196%2Fijmr.5668

Dittus, P.J., Michael, S.L., Becasen, J.S., Gloppen, K.M., McCarthy, K., & Guilamo-Ramos, V. (2015). Parental monitoring and its associations with adolescent sexual risk behavior: a meta-analysis. Pediatrics, 136(6), e1587-e1599. https://doi.org/10.1542/peds.2015-0305

Drake, C., Nickel, C., Burduvali, E., Roth, T., Jefferson, C., & Badia, P. (2003). The pediatric daytime sleepiness scale (PDSS): sleep habits and school outcomes in middle-school children. Sleep, 26(4), 455-458. https://doi.org/10.1037/t02761-000

Drapeau, C., Hamel-hébert, I., Robillard, R., Selmaoui, B., Filipini, D., & Carrier, J. (2006). Challenging sleep in aging: the effects of 200 mg of caffeine during the evening in young and middle-aged moderate caffeine consumers. Journal of sleep research, 15(2), 133-141.https://doi.org/10.1111/j.1365-2869.2006.00518.x

Du Plessis, P., & Mestry, R. (2019). Teachers for rural schools–a challenge for South Africa. South African Journal of Education, 39. https://0-doi.org.wam.seals.ac.za/10.15700/saje.v39ns1a1774

Du Toit, A. (2017). Explaining the persistence of rural poverty in South Africa. In *Report presented to the Expert Group Meeting on Eradicating Rural Poverty to Implement the* (Vol. 2030).

Eggermont, S., & Van den Bulck, J. (2006). Nodding off or switching off? The use of popular media as a sleep aid in secondary-school children. Journal of paediatrics and child health, 42(7-8), 428-433. https://doi.org/10.1111/j.1440-1754.2006.00892.x

Eliasson, A., Eliasson, A., King, J., Gould, B., & Eliasson, A. (2002). Association of sleep and academic performance. Sleep Breath. 6(1):45–48

Eloff, S., & Sevenhuysen, K. (2011). Urban black living and working conditions in Johannesburg, depicted by township art (1940s to 1970s). *South African Journal of Cultural History*, *25*(1), 1-25.

Epstein, R., Chillag, N., & Lavie, P. (1995). Sleep habits of children and adolescents in Israel: the influence of starting time of schools. Sleep Research. 24a, 432.

Essner, B., Noel, M., Myrvik, M., & Palermo, T. (2015). Examination of the factor structure of the Adolescent Sleep-Wake Scale (ASWS). Behavioral sleep medicine, 13(4), 296-307.https://doi.org/10.1080/15402002.2014.896253

Fawcett, J., Scheftner, W. A., Fogg, L., Clark, D. C., Young, M. A., Hedeker, D., & Gibbons, R. (1990). Time-related predictors of suicide in major affective disorder. The American journal of psychiatry.

Felden, É. P. G., Leite, C. R., Rebelatto, C.F., Andrade, R. D., & Beltrame, T. S. (2015). Sleep in adolescents of different socioeconomic status: A systematic review. Revista Paulista de Pediatria (English Edition), 33(4), 467-473. https://doi.org/10.1016/j.rppede. 2015.08.009.

Fichter, M. M., Kohlboeck, G., Quadflieg, N., Wyschkon, A., & Esser, G. (2009). From childhood to adult age: 18-year longitudinal results and prediction of the course of mental disorders in the community. Social Psychiatry and Psychiatric Epidemiology, 44(9), 792-803. https://doi.org/10.1007/s00127-009-0501-y

Fischer, F. M., Oliveira, D. C., Nagai, R., Teixeira, L. R., Lombardi Júnior, M., Latorre, M. D. R., & Cooper, S. P. (2005). Job control, job demands, social support at work and health among adolescent workers. Revista de saúde pública, 39, 245-253. https://doi.org/10.1590/S0034-89102005000200016.

Fischer, F. M., Nagai, R., & Teixeira, L. R. (2008). Explaining sleep duration in adolescents: the impact of socio-demographic and lifestyle factors and working status. Chronobiology International, 25, 359-372. https://doi.org/10.1080/07420520802110639.

Fox, J. L., Scanlan, A. T., Stanton, R., & Sargent, C. (2020). Insufficient sleep in young athletes? Causes, consequences, and potential treatments. Sports Medicine, 50(3), 461-470. https://doi.org/10.1007/s40279-019-01220-8

Fredriksen, K., Rhodes, J., Reddy, R., & Way, N. (2004). Sleepless in Chicago: tracking the effects of adolescent sleep loss during the middle school years. Child Development, 75(1), 84-95.

Fuligni, A. J., Bai, S., Krull, J. L., & Gonzales, N. A. (2019). Individual differences in optimum sleep for daily mood during adolescence. *Journal of Clinical Child & Adolescent Psychology*, *48*(3), 469-479. https://0-doi.org.wam.seals.ac.za/10.1080/15374416.2017.1357126

Fullagar, H. H., Duffield, R., Skorski, S., Coutts, A. J., Julian, R., & Meyer, T. (2015). Sleep and recovery in team sport: current sleep-related issues facing professional team-

sport athletes. International journal of sports physiology and performance, 10(8), 950-957. https://doi.org/10.1123/ijspp.2014-0565

Gaarde, J., Hoyt, L.T., Ozer, E.J., Maslowsky, J., Deardorff, J., & Kyauk, C.K. (2018). So Much to Do Before I Sleep: Investigating Adolescent-Perceived Barriers and Facilitators to Sleep. Youth & Society, 00(0), 1-26. https://doi.org/10.1177/0044118X18756468

Galloway, M., Conner, J., & Pope, D. (2013). Nonacademic effects of homework in privileged, high-performing high schools. The journal of experimental education, 81(4), 490-510.

Gamble, A. L., D'Rozario, A. L., Bartlett, D. J., Williams, S., Bin, Y. S., Grunstein, R. R., & Marshall, N. S. (2014). Adolescent sleep patterns and night-time technology use: results of the Australian Broadcasting Corporation's Big Sleep Survey. *PloS One*, *9*(11), e111700

Gao, B., Dwivedi, S., Milewski, M. D., & Cruz, A. I. (2019). Lack of sleep and sports injuries in adolescents: a systematic review and meta-analysis. Journal of Pediatric Orthopaedics, 39(5), e324-e333. https://doi.org/10.1097/BPO.0000000000001306

Gariepy, G., Danna, S., Gobiņa, I., Rasmussen, M., de Matos, M. G., Tynjälä, J., & Brooks, F. (2020). How are adolescents sleeping? Adolescent sleep patterns and sociodemographic differences in 24 European and North American countries. Journal of Adolescent Health, 66(6), S81-S88. https://doi.org/10.1016/j.jadohealth.2020.03.013

Gau, S. F., & Soong, W. T. (1995). Sleep problems of junior high school students in Taipei. Sleep, 18(8), 667-673. https://0-doi.org.wam.seals.ac.za/10.1093/sleep/18.8.667

Gau, S. S., Kessler, R. C., Tseng, W. L., Wu, Y. Y., Chiu, Y. N., Yeh, C. B., & Hwu, H. G. (2007). Association between sleep problems and symptoms of attention-deficit/hyperactivity disorder in young adults. *Sleep*, *30*(2), 195-201.

Ghanizadeh, A., Kianpoor, M., Rezaei, M., Rezaei, H., Moini, R., Ahmadi, J., & Moeini, S. R. (2008). Sleep patterns and habits in high school students in Iran. Annals of General Psychiatry, 7(1), 5. https://doi.org/10.1186/1744-859X-7-5

Giannotti, F., Cortesi, F., & Ottaviano, S. (1997). Sleep pattern daytime functioning and school performance in adolescence: preliminary data on an Italian representative sample. Sleep Research, 26, 196

Giannotti, F., & Cortesi, F. (2002). Sleep patterns and daytime function in adolescence: An epidemiological survey of an Italian high school student sample. https://doi.org/10.1017/CBO9780511499999.011

Gillette, M., & Abbott, S. (2005). Sleep research society. *SRS Basics of Sleep Guide. Westchester, IL: Sleep Research Society*, 131-138.

Giedd, J. N. (2015). The amazing teen brain. Scientific American, 312(6), 32-37.

Godsell, S., & White, J. (2019). Adolescent perceptions of sleep and influences on sleep behaviour: A qualitative study. Journal of Adolescence, 73, 18-25. https://doi.org/10.1016/j.adolescence.2019.03.010

Gradisar, M., Gardner, G., & Dohnt, H. (2011). Recent worldwide sleep patterns and problems during adolescence: a review and meta-analysis of age, region, and sleep. Sleep medicine, 12(2), 110-118. https://doi.org/10.1016/j.sleep.2010.11.008

Gradisar, M., Lack, L., Richards, H., Harris, J., Gallasch, J., Boundy, M., & Johnston, A. (2007). The Flinders Fatigue Scale: preliminary psychometric properties and clinical sensitivity of a new scale for measuring daytime fatigue associated with insomnia. Journal of Clinical Sleep Medicine, 3(7), 722-728. https://doi.org/10.5664/jcsm.27030

Grandner, M. A. (2017). Sleep, Health, and Society. *Sleep Medicine Clinics, 12*(1), 1-22.

Grandner, M. A. (2018). The cost of sleep lost: implications for health, performance, and the bottom line. *Americal Journal of Health Promotion, 32*(7), 1629-1634.

Graven, M. H. (2014). Poverty, inequality and mathematics performance: The case of South Africa's post-Apartheid context. ZDM, 46(7), 1039-1049. https://doi.org/10.1007/s11858-013-0566-7

Gregory, A. M., Cousins, J. C., Forbes, E. E., Trubnick, L., Ryan, N. D., Axelson, D. A., ... & Dahl, R. E. (2011). Sleep items in the child behavior checklist: a comparison with sleep diaries, actigraphy, and polysomnography. Journal of the American Academy of Child & Adolescent Psychiatry, 50(5), 499-507. https://doi.org/10.1016/j.jaac.2011.02.003

Gudmundsdottir, S. L. (2020). Training Schedule and Sleep in Adolescent Swimmers. Pediatric Exercise Science, 32(1), 16-22. https://doi.org/10.1123/pes.2019-0067

Gupta, N. K., Mueller, W. H., Chan, W., & Meininger, J. C. (2002). Is obesity associated with poor sleep quality in adolescents?. American Journal of Human Biology, 14(6), 762-768. https://doi.org/10.1002/ajhb.10093

Gupta, R., Bhatia, M. S., Chhabra, V., Sharma, S., Dahiya, D., Semalti, K., ... & Dua, R. S. (2008). Sleep patterns of urban school-going adolescents. *Indian pediatrics*, *45*(3).

Gupta, R., Grover, S., Basu, A., Krishnan, V., Tripathi, A., Subramanyam, A., . . . Kumar, P. (2020). Changes in sleep pattern and sleep quality during COVID-19 lockdown. *Indian Journal of Psychiatry, 62*(4), 370-378.

Gupta, C. C., Duncan, M. J., Ferguson, S. A., Rebar, A., Sprajcer, M., Khalesi, S., . . . Vincent, G. E. (2021). The discrepancy between knowledge of sleep recommendations and the actual sleep behaviour of Australian adults. *Behavioral Sleep Medicine*, 1-12.

Hale, L., Hill, T. D., Friedman, E., Javier Nieto, F., Galvao, L. W., Engelman, C. D., … Peppard, P. E. (2013). Perceived neighborhood quality, sleep quality, and health status: Evidence from the Survey of the Health of Wisconsin. Social Science & Medicine, 79, 16 -22. https://doi.org.wam.seals.ac.za/10.1016/j.socscimed.2012.07.021

Hall, K., & De Lannoy, A. (2014). Children's access to education. ChildGauge.

Hall, K., & Mokomane, Z. (2018). The shape of children's families and households: A demographic overview. Children, Families and the State, 32.

Halson, S.L. (2016). Sleep and Athletes. Sports Science Exchange, 28(167), 1-4.

Hasler, G., Buysse, D. J., Klaghofer, R., Gamma, A., Ajdacic, V., Eich, D., ... & Angst, J. (2004). The association between short sleep duration and obesity in young adults: a 13-year prospective study. Sleep, 27(4), 661-666. https://doi.org/10.1093/sleep/27.4.661

Häusler, N., Marques-Vidal, P., Haba-Rubio, J., & Heinzer, R. (2019). Does sleep predict next-day napping or does napping influence same-day nocturnal sleep? Results of a population-based ecological momentary assessment study. *Sleep medicine*, *61*, 31-36.

Hawkins, S. S., & Takeuchi, D. T. (2016). Social determinants of inadequate sleep in US children and adolescents. Public Health, 138, 119-126. doi: 10.1016/j.puhe.2016.03.036. https://doi.org/10.1016/j.puhe.2016.03.036

Heissel, J. A., Sharkey, P. T., Torrats-Espinosa, G., Grant, K., & Adam, E. K. (2017). Violence and vigilance: The acute effects of community violent crime on sleep and cortisol. Child Development. Advance online publication. doi:10.1111/ cdev.12889.

Hendricks, M. (2008). Eastern Cape schools: Resourcing and inequality. The State of the Eastern Cape. Publisher to be determined, 1-14.

Henschel, A., & Lack, L. (1987). Do many adolescents sleep poorly or just too late. Sleep Res, 16, 354.

Hirshkowitz, M., Whiton, K., Albert, S. M., Alessi, C., Bruni, O., DonCarlos, L., Ware, J. C. (2015). National sleep foundation's updated sleep duration recommendations: Final report. Sleep Health, 1(4), 233. https://doi.org/10.1016/j.sleh.2015.10.004

Hofman, W. F., & Steenhof, L. (1997). Sleep characteristics of Dutch adolescents are related to school performance. Sleep-Wake Res Netherlands, 8, 51-5.

Hollmann, S., Heuer, H., & Schmidt, K. H. (2001). Control at work: a generalized resource factor for the prevention of musculoskeletal symptoms?. Work & Stress, 15(1), 29-39. https://doi.org/10.1080/02678370119010

Hoyt, L. T., Deardorff, J., Marceau, K., Laurent, C. A., Windham, G. C., Greenspan, L. C., ... & Hiatt, R. A. (2018). Girls' sleep trajectories across the pubertal transition: Emerging racial/ethnic differences. *Journal of Adolescent Health*, *62*(4), 496-503. http://dx.doi.org/10.1016/j.jadohealth.2017.10.014

Huang, Y. S., Wang, C. H., & Guilleminault, C. (2010). An epidemiologic study of sleep problems among adolescents in North Taiwan. Sleep medicine, 11(10), 1035-1042. https://doi.org/10.1016/j.sleep.2010.04.009

Human Sciences Research Council (HSRC). (2014). Absent teachers 'a serious problem' for the public education system. Cape Town: HSRC Publishers

Hysing, M., Pallesen, S., Stormark, K. M., Lundervold, A. J., & Sivertsen, B. (2013). Sleep patterns and insomnia among adolescents: a population-based study. Journal of sleep research, 22(5), 549-556. https://doi.org/10.1111/jsr.12055

Illingworth, G., Sharman, R., Jowett, A., Harvey, C. J., Foster, R. G., & Espie, C. A. (2019). Challenges in implementing and assessing outcomes of school start time change in the UK: experience of the Oxford Teensleep study. Sleep medicine, 60, 89-95. https://doi.org/10.1016/j.sleep.2018.10.021

Innocenti, P., Puzella, A., Mogavero, M. P., Bruni, O., & Ferri, R. (2020). Letter to the editor: CoVID-19 pandemic and sleep disorders - a web survey in Italy. *Neurological Sciences, 41*(6), 2021-2022.

Irish, L. A., Kline, C. E., Gunn, H. E., Buysse, D. J., & Hall, M. H. (2015). The role of sleep hygiene in promoting public health: A review of empirical evidence. Sleep Medicine Reviews, 22, 23-36. https://doi.org/10.1016/j.smrv.2014.10.001.

Irwin, C. E., & Millstein, S. G. (1986). Biopsychosocial correlates of risk-taking behaviors during adolescence: Can the physician intervene? Journal of Adolescent Health Care, 7(Suppl. 6), 82S–96S.

Jarrin, D. C., McGrath, J. J., & Quon, E. C. (2014). Objective and subjective socioeconomic gradients exist for sleep in children and adolescents. Health Psychology, 33(3), 301.

Jenni, O. G., & Carskadon, M. A. (2004). Spectral analysis of the sleep electroencephalogram during adolescence. Sleep, 27(4), 774-783. https://0-doi.org.wam.seals.ac.za/10.1093/sleep/27.4.774

Johansson, A. E., Petrisko, M. A., & Chasens, E. R. (2016). Adolescent sleep and the impact of technology use before sleep on daytime function. Journal of pediatric nursing, 31(5), 498-504. https://doi.org/10.1016/j.pedn.2016.04.004

John, B., Bellipady, S. S., & Bhat, S. U. (2019). Sleep Deprivation and Risk for Cognitive Vulnerability in School-Going Adolescents: Does the Biopsychosocial Correlates have a Significant Role over Sleep Behavioral Practices?. Childhood Vulnerability Journal, 2(1), 3-28. https://doi.org/10.1007/s41255-020-00010-z

Johns, M. W. (1991). A new method for measuring daytime sleepiness: the Epworth sleepiness scale. sleep, 14(6), 540-545. https://doi.org/10.1093/sleep/14.6.540

Johnson, C. H., Elliot, J. A., & Foster, R. (2003). Entrainment of circadian programs. *Chronobiology International, 20*(4), 741-774. https://doi:10.1081/CBI-120024211

Jonker, L., Elferink-Gemser, M. T., & Visscher, C. (2010). Differences in self-regulatory skills among talented athletes: The significance of competitive level and type of sport. Journal of Sports Sciences, 28(8), 901-908. https://doi.org/10.1080/02640411003797157

Jakubowski, K. P., Hall, M. H., Lee, L., & Matthews, K. A. (2017). Temporal relationships between napping and nocturnal sleep in healthy adolescents. *Behavioral sleep medicine*, *15*(4), 257-269.

Jurewicz, I. (2015). Mental health in young adults and adolescents–supporting general physicians to provide holistic care. *Clinical Medicine*, *15*(2), 151. https://dx.doi.org/10.7861%2Fclinmedicine.15-2-151

Kabrita, C. S., Hajjar-Muça, T. A., & Duffy, J. F. (2014). Predictors of poor sleep quality among Lebanese university students: association between evening typology, lifestyle behaviors, and sleep habits. Nature and science of sleep, 6, 11. https://doi.org/10.2147/NSS.S55538

Kahn, A., Van de Merckt, C., Rebuffat, E., Mozin, M. J., Sottiaux, M., Blum, D., & Hennart, P. (1989). Sleep problems in healthy preadolescents. Pediatrics, 84(3), 542-546.

Kalsbeek, A., Merrow, M., Roenneberg, T., & Foster, R. G. (2012). The neurobiology of circadian timing. Elsevier.

Kang, V., Shao, J., Zhang, K., Mulvey, M., Ming, X., & Wagner, G. C. (2012). Sleep deficiency and sleep health problems in Chinese adolescents. Clinical Medicine Insights: Pediatrics, 6, CMPed-S8407. https://doi.org/10.4137/CMPed.S8407

Kanis, J. B., Schwerdtle, B., Kübler, A., & Schlarb, A. A. (2015). Parent perceptions and practices regarding sleep in children. Somnologie-Schlafforschung und Schlafmedizin, 19(4), 263-270. https://doi.org/10.1007/s11818-015-0033-5

Kantermann, T. (2013). Circadian biology: sleep-styles shaped by light-styles. *Current Biology, 23*(16), R689-R690.

Katz, D. A., & McHorney, C. A. (2002). The relationship between insomnia and health-related quality of life in patients with chronic illness. Journal of Family Practice, 51(3), 229-236.

Kaur, H., & Bhoday, H. S. (2017). Changing Adolescent Sleep Patterns: Factors Affecting them and the Related Problems. The Journal of the Association of Physicians of India, 65(3), 73-77.

Kelley, P., Lockley, S. W., Kelley, J., & Evans, M. D. (2017). Is 8: 30 am still too early to start school? A 10: 00 am school start time improves health and performance of students aged 13-16. Frontiers in human neuroscience, 11, 588. https://doi.org/10.3389/fnhum.2017.00588

Kim, S. J., Lee, Y. J., Cho, S. J., Cho, I. H., Lim, W., & Lim, W. (2011). Relationship between weekend catch-up sleep and poor performance on attention tasks in Korean adolescents. Archives of pediatrics & adolescent medicine, 165(9), 806-812. https://doi.org/10.1001/archpediatrics.2011.128.

King, D. L., Gradisar, M., Drummond, A., Lovato, N., Wessel, J., Micic, G., ... & Delfabbro, P. (2013). The impact of prolonged violent video-gaming on adolescent sleep: an experimental study. Journal of sleep research, 22(2), 137-143. https://doi.org/10.1111/j.1365-2869.2012.01060.x

Kliewer, W., & Lepore, S. J. (2015). Exposure to violence, social cognitive processing, and sleep problems in urban adolescents. Journal of youth and adolescence, 44(2), 507-517. https://doi.org/10.1007/s10964-014-0184-x

Knutson, K. L. (2005). Sex differences in the association between sleep and body mass index in adolescents. The Journal of pediatrics, 147(6), 830-834. https://doi.org/10.1016/j.jpeds.2005.07.019

Knutson, K. L., & Van Cauter, E. (2008). Associations between sleep loss and increased risk of obesity and diabetes. Annals of the New York Academy of Sciences, 1129(1), 287-304. https://doi.org/10.1196/annals.1417.033

Kouzma, N. M., & Kennedy, G. A. (2002). Homework, stress, and mood disturbance in senior high school students. Psychological Reports, 91(1), 193-198. https://0-doi.org.wam.seals.ac.za/10.2466%2Fpr0.2002.91.1.193

Krakow, B., Artar, A., Warner, T. D., Melendrez, D., Johnston, L., Hollifield, M., ... & Koss, M. (2000). Sleep disorder, depression and suicidality in female sexual assault survivors. Crisis: The Journal of Crisis Intervention and Suicide Prevention, 21(4), 163. https://doi.org/10.1027//0227-5910.21.4.163

Kuenstner, S., Langelotz, C., Budach, V., Possinger, K., Krause, B., & Sezer, O. (2002). The comparability of quality of life scores: a multitrait multimethod analysis of the EORTC QLQ-C30, SF-36 and FLIC questionnaires. *European Journal of Cancer*, *38*(3), 339-348.

Kushida, C. A., Chang, A., Gadkary, C., Guilleminault, C., Carrillo, O., & Dement, W. C. (2001). Comparison of actigraphic, polysomnographic, and subjective assessment of sleep parameters in sleep-disordered patients. Sleep medicine, 2(5), 389-396. https://doi.org/10.1016/S1389-9457(00)00098-8

Laberge, L., Petit, D., Simard, C., Vitaro, F., Tremblay, R. E., & Montplaisir, J. (2001). Development of sleep patterns in early adolescence. Journal of sleep research, 10(1), 59-67. https://doi.org/10.1046/j.1365-2869.2001.00242.x

Lacoe, J., & Sharkey, P. T. (2016). Life in a crime scene: Stop, question, and frisk activity in New York City neighborhoods in the aftermath of homicides. Sociological Science, 3, 116-134. https://0-doi.org.wam.seals.ac.za/10.15195/v3.a7.

Lastella, M., Roach, G. D., Halson, S. L., & Sargent, C. (2015). Sleep/wake behaviours of elite athletes from individual and team sports. European journal of sport science, 15(2), 94-100. https://doi.org/10.1080/17461391.2014.932016

LeBourgeois, M. K., Giannotti, F., Cortesi, F., Wolfson, A. R., & Harsh, J. (2005). The relationship between reported sleep quality and sleep hygiene in Italian and American adolescents. Pediatrics, 115(Supplement 1), 257-265.

le Roux-Kemp, A. (2013). Child headed households in South Africa: The legal and ethical dilemmas when children are the primary caregivers in a therapeutic relationship.

Lee, K. A., Mcenany, G., & Weekes, D. (1999). Gender differences in sleep patterns for early adolescents. Journal of adolescent health, 24(1), 16-20. https://doi.org/10.1016/S1054-139X(98)00074-3

Lee, Y. J., Cho, S. J., Cho, I. H., & Kim, S. J. (2012). Insufficient sleep and suicidality in adolescents. *Sleep*, *35*(4), 455-460. https://0-doi.org.wam.seals.ac.za/10.5665/sleep.1722

Lee, J., Kang, J., Rhie, S., & Chae, K. Y. (2013). Impact of sleep duration on emotional status in adolescents. Journal of the Korean Child Neurology Society, 21(3), 100-110.

Leger, D., Beck, F., Richard, J. B., & Godeau, E. (2012). Total sleep time severely drops during adolescence. PloS one, 7(10), e45204. https://doi.org/10.1371/journal.pone.0045204

Lima, S. B. D. S., Ferreira-Lima, W., Lima, F. É. B., Lima, F. B., Santos, A., Fernandes, C. A. M., & Fuentes, J. P. (2020). Sleep Hours: Risk behavior in adolescents from different countries. Ciência & Saúde Coletiva, 25, 957-965. https://doi.org/10.1590/1413-81232020253.15722018

Liu, X. (2004). Sleep and adolescent suicidal behavior. Sleep, 27(7), 1351-1358. https://doi.org/10.1093/sleep/27.7.1351

Liu, X., & Buysse, D. J. (2006). Sleep and youth suicidal behavior: a neglected field. Current Opinion in Psychiatry, 19(3), 288-293. https://doi.org/10.1097/01.yco.0000218600.40593.18

Liu, X., Uchiyama, M., Okawa, M., & Kurita, H. (2000). Prevalence and correlates of selfreported sleep problems among Chinese adolescents. Sleep: Journal of Sleep Research & Sleep Medicine. 23(1), 1-8

Liu, X., Zhao, Z., Jia, C., & Buysse, D. J. (2008). Sleep patterns and problems among Chinese adolescents. Pediatrics, 121(6), 1165-1173. https://doi.org/10.1542/peds.2007-1464

Lockley, S. W., Skene, D. J., & Arendt, J. (1999). Comparison between subjective and actigraphic measurement of sleep and sleep rhythms. Journal of sleep research, 8(3), 175-183. https://doi.org/10.1046/j.1365-2869.1999.00155.x

Loessl, B., Valerius, G., Kopasz, M., Hornyak, M., Riemann, D., Voderholzer, U. (2008). Are adolescents chronically sleep-deprived? An investigation of sleep habits of adolescents in the southwest of Germany. Child Care Health Dev 34(5), 549-556. pmid:18549435. https://doi.org/10.1111/j.1365-2214.2008.00845.x

Longueira, R. (2017). Exploring the functionality of the South African education quintile funding system (Doctoral dissertation, University of Pretoria).

Louzada, F.M., & Menna-Barreto, L. (2004). Sleep-wake cycle in rural populations. Biol. Rhythm Res. 2004; 35: 153– 7. 27

Lovato, N., Short, M. A., Micic, G., Hiller, R. M., & Gradisar, M. (2017). An investigation of the longitudinal relationship between sleep and depressed mood in developing adolescents. Nature and Science of Sleep, 9, 3

Lund, H. G., Reider, B. D., Whiting, A. B., & Prichard, J. R. (2010). Sleep patterns and predictors of disturbed sleep in a large population of college students. Journal of adolescent health, 46(2), 124-132. https://doi.org/10.1016/j.jadohealth.2009.06.016

Lutya, T. M. (2012). The importance of a stable home and family environment in the prevention of youth offending in South Africa. https://doi.org/10.1037/e578342014-080

Lutya, T. M. (2007). “Home and family circumstances of young offenders: A social workers view”. British Journal of Community Justice, 5(3), 63-80.

Lyall, L. M., Sangha, N., Wyse, C., Hindle, E., Haughton, D., Campbell, K., ... & Smith, D. J. (2020). Accelerometry-assessed sleep duration and timing in late childhood and adolescence in Scottish schoolchildren: a feasibility study. medRxiv. https://doi.org/10.1101/2020.04.06.20055434

Maduabuchi, J. C., Obu, H. A., Chukwu, B. F., Aronu, A. E., Manyike, P. C., & Chinawa, A. T. (2014). Sleep pattern and practice among adolescents school children in Nigerian secondary schools. The Pan African medical journal, 19. https://doi.org/10.11604/pamj.2014.19.313.4603

Mallinson, D. C., Kamenetsky, M. E., Hagen, E. W., & Peppard, P. E. (2019). Subjective sleep measurement: comparing sleep diary to questionnaire. Nature and Science of Sleep, 11, 197. https://doi.org/10.2147/NSS.S217867

Malone, S. K. (2011). Early to bed, early to rise: An exploration of adolescent sleep hygiene practices. The Journal of School Nursing, 000(00), 1-7. https://doi.org/10.1177/1059840511410434.

Mandondo, N. (2020). Sleep wake behaviour of South African adolescents. Unpublished masters thesis. Rhodes University: Grahamstown

Marco, C. A., Wolfson, A. R., Sparling, M., & Azuaje, A. (2012). Family socioeconomic status and sleep patterns of young adolescents. Behavioral sleep medicine, 10(1), 70-80. https://doi.org/10.1080/15402002.2012.636298

Markwald, R. R., Melanson, E. L., Smith, M. R., Higgins, J., Perreault, L., Eckel, R. H., & Wright, K. P. (2013). Impact of insufficient sleep on total daily energy expenditure, food

intake, and weight gain. Proceedings of the National Academy of Sciences, 110(14), 5695-5700. https://doi.org/10.1073/pnas.1216951110

Martinez-Gomez, D., Eisenmann, J. C., Gomez-Martinez, S., Hill, E. E., Zapatera, B., Veiga, O. L., ... & AFINOS Study Group. (2011). Sleep duration and emerging cardiometabolic risk markers in adolescents. The AFINOS study. Sleep medicine, 12(10), 997-1002. https://doi.org/10.1016/j.sleep.2011.05.009

Mastin, D. F., Bryson, J., & Corwyn, R. (2006). Assessment of sleep hygiene using the sleep hygiene index. Journal of Behavioral Medicine, 29(3), 223-227. https://doi.org/10.1007/s10865-006-9047-6

Matricciani, L., Bin, Y. S., Lallukka, T., Kronholm, E., Dumuid, D., Paquet, C., & Olds, T. (2017). Past, present, and future: trends in sleep duration and implications for public health. *Sleep Health, 3*(5), 317-323

Maume, D.J. (2013). Social ties and adolescent sleep disruption. J Health Soc Behav, 54 (4), 498-515. https://doi.org/10.1177/0022146513498512

Mazza, S., Bastuji, H., & Rey, A. E. (2020). Objective and Subjective Assessments of Sleep in Children: Comparison of Actigraphy, Sleep Diary Completed by Children and Parents' Estimation. Frontiers in Psychiatry, 11. https://doi.org/10.3389/fpsyt.2020.00495

Mbajiorgu, C. A., Oguttu, J. W., Maake, M. S., Heeralal, P. J. H., Ngoepe, M. G., Masafu, M. M., & Kaino, L. M. (2014). Factors that impact on the teaching and learning of Agriculture Science in FET Schools in Mpumalanga, South Africa: A case of Mandlethu FET School. Journal of Human Ecology, 45(2), 137-145. https://doi.org/10.1080/09709274.2014.11906687

McCall, C., & McCall, W. V. (2012). Comparison of actigraphy with polysomnography and sleep logs in depressed insomniacs. Journal of sleep research, 21(1), 122-127. https://doi.org/10.1111/j.1365-2869.2011.00917.x

Mednick, S. C., Christakis, N. A., & Fowler, J. H. (2010). The spread of sleep loss influences drug use in adolescent social networks. PloS one, 5(3), e9775. https://doi.org/10.1371/journal.pone.0009775

Meerlo, P., Sgoifo, A., & Suchecki, D. (2008). Restricted and disrupted sleep: Effects on autonomic function, neuroendocrine stress systems and stress responsivity. Sleep Medicine Reviews, 12(3), 197-210. https://0-doi.org.wam.seals.ac.za/10.1016/j.smrv.2007.07.007

Mei, X., Hu, Z., Zhou, D., Zhou, Q., Li, X., Wang, X., & Jing, P. (2019). Sleep patterns, mobile phone use and psychological symptoms among adolescents in coastal developed city of China: an exploratory cross-sectional study. Sleep and Biological Rhythms, 17(2), 233-241.https://doi.org/10.1007/s41105-019-00208-1

Meintjes, H., Hall, K., Marera, D., & Boulle, A. (2009). Child-headed households in South Africa: A statistical brief. Cape Town: The Children's Institute.

Mellalieu, S. D., Neil, R., Hanton, S., & Fletcher, D. (2009). Competition stress in sport performers: Stressors experienced in the competition environment. Journal of Sports Sciences, 27(7), 729-744.https://doi.org/10.1080/02640410902889834

Merikanto, I., Lahti, T., Puusniekka, R., & Partonen, T. (2013). Late bedtimes weaken school

Meyer, J., McDowell, C., Lansing, J., Brower, C., Smith, L., Tully, M., & Herring, M. (2020). Changes in physical activity and sedentary behavior in response to COVID-19 and their associations with mental health in 3052 US adults. *International Journal of Environmental Research and Public Health, 17*(18), 6469.

Mgushelo, L. (2018). The Scholar Transport Programme in the Eastern Cape: a case study of the beneficiaries at a secondary school in the Idutywa district (Doctoral dissertation, University of Pretoria).

Milewski, M. D., Skaggs, D. L., Bishop, G. A., Pace, J. L., Ibrahim, D. A., Wren, T. A., & Barzdukas, A. (2014). Chronic lack of sleep is associated with increased sports injuries in adolescent athletes. Journal of Pediatric Orthopaedics, 34(2), 129-133. https://doi.org/10.1097/BPO.0000000000000151

Miller, K., Danner, F., & Staten, R. (2008). Relationship of work hours with selected health behaviors and academic progress among a college student sample. Journal of American College Health, 56, 675-679. https://doi.org/10.3200/JACH.56.6.675-679

Minges, K. E., & Redeker, N. S. (2016). Delayed school start times and adolescent sleep: a systematic review of the experimental evidence. Sleep medicine reviews, 28, 86-95.

Mogotlane, S. M., Chauke, M. E., Van Rensburg, G. H., Human, S. P., & Kganakga, C. M. (2010). A situational analysis of child-headed households in South Africa. Curationis, 33(3), 24-32. https://doi.org/10.4102/curationis.v33i3.4

Mollayeva, T., Thurairajah, P., Burton, K., Mollayeva, S., Shapiro, C. M., & Colantonio, A. (2016). The Pittsburgh sleep quality index as a screening tool for sleep dysfunction in clinical and non-clinical samples: A systematic review and meta-analysis. Sleep medicine reviews, 25, 52-73. https://doi.org/10.1016/j.smrv.2015.01.009

Morin, C. M. (1993). *Insomnia: psychological assessment and management*. Guilford press.

Mortimer, J. T. (2003). Working and growing up in America (Vol. 2). Harvard University Press.

Motha, K. C., & Frempong, G. (2014). The lived experiences of orphaned learners in South Africa: implications for the provision of quality education. International Journal of Inclusive Education, 18(7), 686-697.https://0-doi.org.wam.seals.ac.za/10.1080/13603116.2013.817616

Nahmod, N. G., Lee, S., Master, L., Chang, A. M., Hale, L., & Buxton, O. M. (2019). Later high school start times associated with longer actigraphic sleep duration in adolescents. Sleep, 42(2), zsy212.https://doi.org/10.1093/sleep/zsy212

National Institute of Neurological Disorders and Stroke. (2017). *Brain Basics: Understanding Sleep.* Bethesda: National Institutes of Health.

National Research Council. (2000). Sleep needs, patterns, and difficulties of adolescents: Summary of a workshop. National Academies Press.

Ndlovu, S. (2013). Long walk to education. Accessed on 11/04/2020 https://www.groundup.org.za/article/long-walk-education_2046/.

Noronha, L. (2016). Implication of Academic Stress in Adolescents. International Journal of Scientific Research and Modern Education, 1(1), 2455-5630.

Norval, M., & Wright, C. Y. (2017). The epidemiology of cutaneous melanoma in the white and black African population groups in South Africa. *Exon Publications*, 23-38.

O'Brien, E. M., & Mindell, J. A. (2005). Sleep and risk-taking behavior in adolescents. Behavioral Sleep Medicine, 3(3), 113-133. doi:10.1207/s15402010bsm0303_1 https://doi.org/10.1207/s15402010bsm0303_1

Ofcom. (2018). Children and Parents: Media Use and Attitudes.

Oginska, H., & Pokorski, J. (2006). Fatigue and mood correlates of sleep length in three age-social groups: School children, students, and employees. Chronobiology international, 23(6), 1317-1328. https://doi.org/10.1080/07420520601089349

Ohayon, M. M. (2004). Interactions between sleep normative data and sociocultural characteristics in the elderly. *Journal of Psychomatic Research, 56*(5), 479-486.

Ohida, T., Osaki, Y., Doi, Y., Tanihata, T., Minowa, M., Suzuki, K., ... & Kaneita, Y. (2004). An epidemiologic study of self-reported sleep problems among Japanese adolescents. Sleep, 27(5), 978-985. https://doi.org/10.1093/sleep/27.5.978

Ong, S. H., Wickramaratne, P., Tang, M., & Weissman, M. M. (2006). Early childhood sleep and eating problems as predictors of adolescent and adult mood and anxiety disorders. Journal of affective disorders, 96(1-2), 1-8. https://0-doi.org.wam.seals.ac.za/10.1016/j.jad.2006.05.025

Orben, A., & Przybylski, A. K. (2020). Teenage sleep and technology engagement across the week. PeerJ, 8, e8427. https://doi.org/10.7717/peerj.8427

Orben, A., Etchells, P. J., & Przybylski, A. K. (2018). Three problems with the debate around screen time. Kings Place: The Guardian.

Orbeta, R. L., Overpeck, M. D., Ramcharran, D., Kogan, M. D., & Ledsky, R. (2006). High caffeine intake in adolescents: associations with difficulty sleeping and feeling tired in the morning. Journal of Adolescent Health, 38(4), 451-453. https://doi.org/10.1016/j.jadohealth.2005.05.014

Otto, D. (2017). Lived experience of climate change-a digital storytelling approach. International Journal of Global Warming, 12(3-4), 331-346. https://doi.org/10.1504/IJGW.2017.10005886

Owens, J. (2014). Insufficient sleep in adolescents and young adults: An update on causes and consequences. Pediatrics, 134(3), e932. https://doi.org/10.1542/peds.2014-169

Owens, J. A., & Weiss, M. R. (2017). Insufficient sleep in adolescents: causes and consequences. Minerva pediatrica, 69(4), 326-336. https://doi.org/10.23736/S0026-4946.17.04914-3

Owens, J. A., Spirito, A., McGuinn, M., & Nobile, C. (2000). Sleep habits and sleep disturbance in elementary school-aged children. Journal of Developmental and Behavioral Pediatrics, 21(1), 27-36. https://doi.org/10.1097/00004703-200002000-00005

Paiva, T., Gaspar, T., & Matos, M. G. (2015). Sleep deprivation in adolescents: correlations with health complaints and health-related quality of life. Sleep Medicine, 16(4), 521-527. https://0-doi.org.wam.seals.ac.za/10.1016/j.sleep.2014.10.010

Pan, X., Taylor, M. J., Cohen, E., Hanna, N., & Mota, S. (2020). Circadian Clock, Time-Restricted Feeding and Reproduction. International Journal of Molecular Sciences, 21(3), 831. paper presented at the "Conference for Organization of Ministries of Education, International Institute for Educational Planning (IIEP)". https://doi.org/10.3390/ijms21030831

Paruthi, S., Brooks, L. J., D'Ambrosio, C., Hall, W. A., Kotagal, S., Lloyd, R. M., & Wise, M. S. (2016). Recommended amount of sleep for pediatric populations: A consensus statement of the american academy of sleep medicine. Journal of Clinical Sleep Medicine: JCSM: Official Publication of the American Academy of Sleep Medicine, 12(6), 785-786. doi:10.5664/jcsm.5866. https://doi.org/10.5664/jcsm.5866

Patte, K. A., Qian, W., & Leatherdale, S. T. (2017). Sleep duration trends and trajectories among youth in the COMPASS study. Sleep health, 3(5), 309-316. https://doi.org/10.1016/j.sleh.2017.06.006

Peixoto, C.A., Silva, A.G., Carskadon, M.A., & Louzada, F.M. (2009). Adolescents living in homes without electric lighting have earlier sleep times. Behav. Sleep Med. 7: 73–80.

Pennington, N., Johnson, M., Delaney, E., & Blankenship, M. B. (2010). Energy drinks: a new health hazard for adolescents. *The Journal of School Nursing*, *26*(5), 352-359.

Pereira, E. F., Moreno, C., & Louzada, F. M. (2014). Increased commuting to school time reduces sleep duration in adolescents. Chronobiology international, 31(1), 87-94. https://doi.org/10.3109/07420528.2013.826238

performance and predispose adolescents to health hazards. Sleep Medicine, 14(11), 1105-1111. https://0-doi.org.wam.seals.ac.za/10.1016/j.sleep.2013.06.009

Pillay, J. (2016). Problematising child-headed households: The need for children's participation in early childhood interventions. South African Journal of Childhood Education, 6(1), 1-8. https://dx.doi.org/10.4102/sajce.v6i1.359

Pollak, C. P., & Bright, D. (2003). Caffeine consumption and weekly sleep patterns in US seventh-, eighth-, and ninth-graders. Pediatrics, 111(1), 42-46. https://doi.org/10.1542/peds.111.1.42

Pope, D. C. (2008). Doing school: How we are creating a generation of stressed out, materialistic, and miseducated students. Yale University Press.

Porkka-Heiskanen, T., & Kalinchuk, A. V. (2011). Adenosine, energy metabolism and sleep homeostasis. Sleep Medicine Reviews, 15, 123-135. https://doi.org/10.1016/j.smrv.2010.06.005

Powell, D. (2011). The National Treasury 2011 Local Government Review: the key barometer of local government. Local Government Bulletin, 13(4), 4-6.

Pradhan, R. K., & Sinha, N. (2017). Impact of commuting distance and school timing on sleep of school students. Sleep and Biological Rhythms, 15(2), 153-158. https://doi.org/10.1007/s41105-017-0091-0

Quante, M., Kaplan, E. R., Cailler, M., Rueschman, M., Wang, R., Weng, J., ... & Redline, S. (2018). Actigraphy-based sleep estimation in adolescents and adults: a comparison with polysomnography using two scoring algorithms. Nature and science of sleep, 10, 13. https://doi.org/10.2147/NSS.S151085.

Quine, L. (2001). Sleep problems in primary school children: comparison between mainstream and special school children. Child: care, health and development, 27(3), 201-221. https://doi.org/10.1046/j.1365-2214.2001.00213.x

Radoševic-Vidacek, B., & Košcec, A. (2004). Shiftworking families: parents' working schedule and sleep patterns of adolescents attending school in two shifts. Revista de saude publica, 38, 38-47.

Raniti, M. B., Waloszek, J. M., Schwartz, O., Allen, N. B., & Trinder, J. (2018). Factor structure and psychometric properties of the Pittsburgh Sleep Quality Index in community-based adolescents. Sleep, 41(6), zsy066. https://doi.org/10.1093/sleep/zsy066

Reddy, P., Sewpaul, R., & Jonas, K. (2016). Teenage pregnancy in South Africa: Reducing prevalence and lowering maternal mortality rates.

Reid, A., Maldonado, C. C., & Baker, F. C. (2002). Sleep behavior of south african adolescents. Sleep, 25(4), 423-421. https://doi.org/10.1093/sleep/25.4.417

Reis, H. T., Gable, S. L., & Maniaci, M. R. (2014). Methods for studying everyday experience in its natural context. Handbook of research methods in social and personality psychology, 2, 373-403. https://doi.org/10.1017/CBO9780511996481.019

Roberts, R. E., Roberts, C. R., & Xing, Y. (2011). Restricted sleep among adolescents: prevalence, incidence, persistence, and associated factors. Behavioral sleep medicine, 9(1), 18-30. https://doi.org/10.1080/15402002.2011.533991

Roche, J., Rae, D. E., Redman, K. N., Knutson, K. L., Von Schantz, M., Gómez-Olivé, F. X., & Scheuermaier, K. (2021). Impact of obstructive sleep apnea on cardiometabolic health in a random sample of older adults in rural South Africa: building the case for the treatment of sleep disorders in underresourced settings. *Journal of Clinical Sleep Medicine*, *17*(7), 1423-1434.

Romeo, R. D. (2013). The teenage brain: The stress response and the adolescent brain. Current Directions in Psychological Science, 22(2), 140-145. https://0-doi.org.wam.seals.ac.za/10.1177/0963721413475445

Roenneberg, T., Kuehnle, T., Juda, M., Kantermann, T., Allebrandt, K., Gordijn, M., & Merrow, M. (2007). Epidemiology of the human circadian clock. Sleep Medicine Reviews, 11(6), 429-438.

Roenneberg, T., & Merrow, M. (2007a). Entrainment of human circadian clock. *Cold Spring Habor symposia on quantitative biology, 72*, 293-299.

Roenneberg, T., & Merrow, M. (2016). The circadian clock and human health. *Current Biology, 26*(10), R432-R443.

Roth, T., Jaeger, S., Jin, R., Kalsekar, A., Stang, P. E., & Kessler, R. C. (2006). Sleep problems, comorbid mental disorders, and role functioning in the national comorbidity survey replication. Biological psychiatry, 60(12), 1364-1371. https://doi.org/10.1016/j.biopsych.2006.05.039

Rundo, J. V., & Downey, R., 3rd (2019). Polysomnography. *Handbook of clinical neurology*, *160*, 381–392. https://doi.org/10.1016/B978-0-444-64032-1.00025-4

Russo, P. M., Bruni, O., Lucidi, F., Ferri, R., & Violani, C. (2007). Sleep habits and circadian preference in Italian children and adolescents. Journal of sleep research, 16(2), 163-169. https://doi.org/10.1111/j.1365-2869.2007.00584.x

Saarenpää-Heikkilä, O. A., Rintahaka, P. J., Laippala, P. J., & Koivikko, M. J. (1995). Sleep habits and disorders in Finnish schoolchildren. Journal of Sleep Research, 4(3), 173-182. https://0- doi.org.wam.seals.ac.za/10.1111/j.1365-2869.1995.tb00166.x

Sadeh, A. (2011). The role and validity of actigraphy in sleep medicine: an update. Sleep medicine reviews, 15(4), 259-267. https://doi.org/10.1016/j.smrv.2010.10.001

Sadeh, A., & Acebo, C. (2002). The role of actigraphy in sleep medicine. Sleep medicine reviews, 6(2), 113-124. https://doi.org/10.1053/smrv.2001.0182

Sadeh, A., Raviv, A., & Gruber, R. (2000). Sleep patterns and sleep disruptions in school-age children. Developmental psychology, 36(3), 291. https://doi.org/10.1037/0012-1649.36.3.291

Sampasa-Kanyinga, H., Hamilton, H.A., & Chaput, J.P. (2018). Use of social media is associated with short sleep duration in a dose-response manner in students aged 11 to 20 years. Acta Paediatrica, 107(4), 694-700. https://doi.org/10.1111/apa.14210

Samson, R., & Blunden, S. (2013). What Constitutes Normal Sleeping Patterns ? Childhood to Adolescence 2 . 1 Developmental Patterns in Sleep Duration : Birth to Adolescence.

Santos, J. S., & Louzada, F. M. (2022). Changes in adolescents' sleep during COVID-19 outbreak reveal the inadequacy of early morning school schedules. *Sleep Science*, *15*(Spec 1), 74. https://doi.org/10.1016/j.slccp.2021.04.016

Santos, J. S., Pereira, S. I. R., & Louzada, F. M. (2021). Chronic sleep restriction triggers inadequate napping habits in adolescents: a population-based study. *Sleep Medicine*, *83*, 115-122. Https://doi.org/10.5935/1984-0063.20200127

Sarantakos, S. (2013). Social research, 4th edition. London. Palgrave Macmillan: London. https://doi.org/10.1007/978-1-137-29247-6

Sargent, C., Halson, S., & Roach, G. D. (2014). Sleep or swim? Early-morning training severely restricts the amount of sleep obtained by elite swimmers. European journal

of sport science, 14(sup1), S310-S315. https://doi.org/10.1080/17461391.2012.696711

Sateia, M. J. (2002). Sleep in patients with cancer and HIV/AIDS. Sleep medicine. Lee-Chiong TL, Satela MJ, Carskadon MA (eds). Philadelphia PA: Hanley & Belfus, 489-496.

Sawczuk, T., Jones, B., Scantlebury, S., & Till, K. (2018). Relationships between training load, sleep duration, and daily well-being and recovery measures in youth athletes. Pediatric exercise science, 30(3), 345-352. https://doi.org/10.1123/pes.2017-0190

Schlafer, O., Wenzel, V., & Hogl, B. (2014). Sleep disorders among physicians on shift work. Anaesthesist, Der, 63(11), 844-851. https://doi.org/10.1007/s00101-014-2374-z

Schmeer, K. K., Tarrence, J., Browning, C. R., Calder, C. A., Ford, J. L., & Boettner, B. (2019). Family contexts and sleep during adolescence. SSM - Population Health, 7, 004. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/30581955. https://doi.org/10.1016/j.ssmph.2018.11.004

Schmidt, C., Collette, F., Cajochen, C., & Peigneux, P. (2007). A time to think: circadian rhythms in human cognition. Cognitive neuropsychology, 24(7), 755-789. https://doi.org/10.1080/02643290701754158

Scott, H., Biello, S., & Woods, H. (2018). Identifying drivers for bedtime social media use despite sleep costs: the adolescent perspective. https://doi.org/10.31234/osf.io/2xb36.

Shahid, A., Wilkinson, K., Marcu, S., & Shapiro, C. M. (2011). School sleep habits survey. In STOP, THAT and one hundred other sleep scales (pp. 303-312). Springer, New York, NY. https://doi.org/10.1007/978-1-4419-9893-4_74

Shochat, T., Cohen-Zion, M., & Tzischinsky, O. (2014). Functional consequences of inadequate sleep in adolescents: a systematic review. Sleep Medicine Reviews, 18(1), 75-87. https://doi.org/10.1016/j.smrv.2013.03.005

Shochat, T., Flint-Bretler, O., & Tzischinsky, O. (2010). Sleep patterns, electronic media exposure and daytime sleep-related behaviours among Israeli adolescents. Acta Paediatrica, 99(9), 1396-1400. https://doi.org/10.1111/j.1651-2227.2010.01821.x

Short, M. A., & Weber, N. (2018). Sleep duration and risk-taking in adolescents: A systematic review and meta-analysis. Sleep medicine reviews, 41, 185-196. https://doi.org/10.1016/j.smrv.2018.03.006

Short, M. A., Gradisar, M., Lack, L. C., Wright, H. R., & Dohnt, H. (2013). The sleep patterns and well-being of Australian adolescents. Journal of adolescence, 36(1), 103-110.

Short, M. A., Gradisar, M., Lack, L. C., Wright, H., & Carskadon, M. A. (2012). The discrepancy between actigraphic and sleep diary measures of sleep in adolescents. Sleep medicine, 13(4), 378-384. https://doi.org/10.1016/j.sleep.2011.11.005

Short, M. A., Weber, N., Reynolds, C., Coussens, S., & Carskadon, M. A. (2018). Estimating adolescent sleep need using dose-response modeling. Sleep, 41(4), zsy011. https://doi.org/10.1093/sleep/zsy011

Singh, G. K., & Kenney, M. K. (2013). Rising prevalence and neighborhood, social, and behavioral determinants of sleep problems in US children and adolescents, 2003-2012. Sleep Disorders. Article ID 394320. doi:10.1155/2013/394320

Singleton, R. A., & Wolfson, A. R. (2009). Alcohol consumption, sleep, and academic performance among college students. Journal of studies on alcohol and drugs, 70(3), 355-363. https://doi.org/10.15288/jsad.2009.70.355

Sitnick, S. L., Goodlin-Jones, B. L., & Anders, T. F. (2008). The use of actigraphy to study sleep disorders in preschoolers: some concerns about detection of nighttime awakenings. Sleep, 31(3), 395. https://doi.org/10.1093/sleep/31.3.395

Skein, M., Harrison, T., & Clarke, D. (2019). Sleep characteristics, sources of perceived stress and coping strategies in adolescent athletes. Journal of sleep research, 28(4), e12791. https://doi.org/10.1111/jsr.12791

Snyman, S., & Truter, I. (2012). Children and adolescents with attention deficit/hyperactivity disorder (ADHD) in the Eastern Cape, South Africa: aetiology, diagnosis and treatment. African Journal of Pharmacy and Pharmacology, 6(43), 2994-2999. https://doi.org/10.5897/AJPP12.428

Spilsbury, J. C., Drotar, D., Rosen, C. L., & Redline, S. (2007). The Cleveland adolescent sleepiness questionnaire: A new measure to assess excessive daytime sleepiness in adolescents. Journal of clinical sleep medicine: JCSM: official publication of the American Academy of Sleep Medicine, 3(6), 603-612. https://doi.org/10.5664/jcsm.26971

Spilsbury, J. C., Storfer-Isser, A., Drotar, D., Rosen, C. L., Kirchner, H. L., & Redline, S. (2005). Effects of the home environment on school-aged children's sleep. Sleep, 28(11), 1419-1427. https://doi.org/10.1093/sleep/28.11.1419

Stanton, R., To, Q. G., Khalesi, S., Williams, S. L., Alley, S. J., Thwaite, T. L., . . . Vandelanotte, C. (2020). Depression, anxiety and stress during COVID-19: associations with changes in physical activity, sleep, tobacco and alcohol use in

Australian adults. *International Journal of Environmental Research and Public Health, 17*(11), 4065.

Statistics South Africa (StatsSA), 2016a, Mid-year population estimates 2016 (Online), Statistics South Africa, viewed 09 June 2020, from https://www.statssa.gov.za/publications/P0302/P03022016.pdf.

Statistics South Africa. (2013). Census 2011. Http://interactive.statssa.gov.za/Superweb.

Steenekamp, T., Zaslona, J., Gander, P., Rowlands, D., & Signal, T. L. (2020). Sleep/wake behaviour of competitive adolescent athletes in New Zealand: insight into the impact of early morning training. Sleep Medicine, 77, 88-95. https://doi.org/10.1016/j.sleep.2020.11.023

Stores, G. (2001). A clinical guide to sleep disorders in children and adolescents. Cambridge University Press. https://doi.org/10.1017/CBO9780511544309

Stuurman, C., Joseph, S., (April, 2015). Long walk to education. Accessed from https://berthafoundation.org/long-walk-to-education-the-struggles-of-rural-students/

Suldo, S. M., Shaunessy, E., Thalji, A., Michalowski, J., & Shaffer, E. (2009). Sources of stress for students in high school college preparatory and general education programs: group differences and associations with adjustment. Adolescence, 44(176), 925-948.

Sun, W. Q., Spruyt, K., Chen, W. J., Jiang, Y. R., Schonfeld, D., Adams, R., ... & Jiang, F. (2014). The relation among sleep duration, homework burden, and sleep hygiene in chinese school-aged children. Behavioral sleep medicine, 12(5), 398-411. https://doi.org/10.1080/15402002.2013.825837

Suppiah, H. T., Low, C. Y., & Chia, M. (2015). Effects of sports training on sleep characteristics of Asian adolescent athletes. *Biological Rhythm Research*, *46*(4), 523-536. https://0- doi.org.wam.seals.ac.za/10.1080/09291016.2015.1026673

Taheri, S., Lin, L., Austin, D., Young, T., & Mignot, E. (2004). Short sleep duration is associated with reduced leptin, elevated ghrelin, and increased body mass index. PLoS Med, 1(3), e62. https://doi.org/10.1371/journal.pmed.0010062

Tarokh, L., Short, M., Crowley, S. J., Fontanellaz-Castiglione, C. E., & Carskadon, M. A. (2019). Sleep and Circadian Rhythms in Adolescence. Current sleep medicine reports, 5(4), 181-192. https://doi.org/10.1007/s40675-019-00155-w

Taylor, D. J., Jenni, O. G., Acebo, C., & Carskadon, M. A. (2005). Sleep tendency during extended wakefulness: insights into adolescent sleep regulation and behavior. Journal of Sleep Research, 14(3), 239-244. https://0-doi.org.wam.seals.ac.za/10.1111/j.1365-2869.2005.00467.x

Teixeira, L. R., Lowden, A., Turte, S. L., Nagai, R., Moreno, C. R., Latorre, M. D. O. R., & Fischer, F. M. (2007). Sleep and sleepiness among working and non-working high school evening students. Chronobiology International, 24, 99-113. doi:10.1080/07420520601139763.

Teixeira, L. R., Fischer, F. M., & Lowden, A. (2006). Sleep deprivation of working adolescents—a hidden work hazard. *Scandinavian journal of work, environment & health*, 328-330.

Thomas, M., Sing, H., Belenky, G., Holcomb, H., Mayberg, H., Dannals, R., ... & Welsh, A. (2000). Neural basis of alertness and cognitive performance impairments during sleepiness. I. Effects of 24 h of sleep deprivation on waking human regional brain activity. Journal of sleep research, 9(4), 335-352. https://doi.org/10.1046/j.1365-2869.2000.00225.x

Tomita, S., Kitajima, T., Mekata, T., Tsuchiya, A., Sano, W., Esaki, Y., ... & Iwata, N. (2013). Comparison of sleep diary and actigraphy to evaluate total sleep time in hypersomnia patients. Sleep and Biological Rhythms, 11(2), 65-73. https://doi.org/10.1111/sbr.12004

Toh, S. H., Howie, E. K., Coenen, P., & Straker, L. M. (2019). "From the moment I wake up I will use it… every day, very hour": a qualitative study on the patterns of adolescents' mobile touch screen device use from adolescent and parent perspectives. *BMC pediatrics*, *19*(1), 1-16. https://dx.doi.org/10.1186%2Fs12887-019-1399-5

Toth, L. A., & Jhaveri, K. (2003). Sleep mechanisms in health and disease. Comparative medicine, 53(5), 473-486.

Touitou, Y. (2013). Adolescent sleep misalignment: a chronic jet lag and a matter of public health. Journal of Physiology-Paris, 107(4), 323-326. https://0-doi.org.wam.seals.ac.za/10.1016/j.jphysparis.2013.03.008

Treur, J. L., Gibson, M., Taylor, A. E., Rogers, P. J., & Munafò, M. R. (2018). Investigating genetic correlations and causal effects between caffeine consumption and sleep behaviours. Journal of sleep research, 27(5), e12695. https://doi.org/10.1111/jsr.12695

Truter, I., & Kotze, T. J. V. W. (2005). Prescribing patterns of methylphenidate in a South African patient population who are members of a private medical aid. Health SA Gesondheid, 10(4), 75-84.

Tustin, D., (2017, May 16). Is cell phone overuse morphing into an addiction among our youth?. UNISA. Accessed on https://www.unisa.ac.za/sites/corporate/default/News-

&-Media/Articles/Is-cell-phone-overuse-morphing-into-an-addiction-among-our-youth%3F/ 09/08/2020

van den Bos, W. (2013). Neural mechanisms of social reorientation across adolescence. Journal of Neuroscience, 33(34), 13581-13582. https://doi.org/10.1523/JNEUROSCI.2667-13.2013

Van den Bulck, J. (2003). Text messaging as a cause of sleep interruption in adolescents, evidence from a cross-sectional study. https://doi.org/10.1046/j.1365-2869.2003.00362.x

Van den Bulck, J. (2004). Television viewing, computer game playing, and Internet use and self-reported time to bed and time out of bed in secondary-school children. Sleep, 27(1), 101-104. https://doi.org/10.1093/sleep/27.1.101

Van den Bulck, J. (2007). Adolescent use of mobile phones for calling and for sending text messages after lights out: results from a prospective sample study with a one-year follow-up. Sleep, 30(9), 1220-1223. https://doi.org/10.1093/sleep/30.9.1220

Van Dongen, H. P., Rogers, N. L., & Dinges, D. F. (2003). Sleep debt: Theoretical and empirical issues. Sleep and Biological Rhythms, 1(1), 5-13.

Verhulst, S. L., Schrauwen, N., De Backer, W. A., & Desager, K. N. (2006). First night effect for polysomnographic data in children and adolescents with suspected sleep disordered breathing. Archives of disease in childhood, 91(3), 233-237. https://doi.org/10.1136/adc.2005.085365

Vidal, H., & Shochat, T. (2017). Early to bed, early to rise: sleep perceptions, patterns and related behaviors in ultra-orthodox Jewish adolescents in Israel. Sleep Health, 3(6), 458-464.https://doi.org/10.1016/j.sleh.2017.08.002

Vitaterna, M. H., Shimomura, K., & Jiang, P. (2019). Genetics of Circadian Rhythms. *Neurologic clinics*, *37*(3), 487–504. https://doi.org/10.1016/j.ncl.2019.05.002

Voulgaris, C. T., Smart, M. J., & Taylor, B. D. (2019). Tired of commuting? Relationships among journeys to school, sleep, and exercise among american teenagers. Journal of Planning Education and Research, 39(2), 142-154. https://doi.org/10.1177/0739456X17725148

Wagner, U., Gais, S., Haider, H., Verleger, R., & Born, J. (2004). Sleep inspires insight. Nature, 427(6972), 352-355. https://doi.org/10.1038/nature02223

Wahlstrom, K. L. (2002). Accommodating the sleep patterns of adolescents within current educational structures: an uncharted path. https://psycnet.apa.org/doi/10.1017/CBO9780511499999.014

Weaver, E., Gradisar, M., Dohnt, H., Lovato, N., Douglas, P. (2010). The effect of presleep video-game playing on adolescent sleep. Journal of Clinical Sleep Medicine, 6, 184-189. https://doi.org/10.5664/jcsm.27769

Willan, S. (2013). A review of teenage pregnancy in South Africa. Partners in Sexual Health, 2013.

Williams, J., Greene, S., Doyle, E., Harris, E., Layte, R., McCoy, S., ... & O'Moore, M. (2009). Growing up in Ireland national longitudinal study of children. The lives of 9 year olds. https://doi.org/10.1037/e530882013-001

Winnebeck, E. C., Vuori-Brodowski, M. T., Biller, A. M., Molenda, C., Fischer, D., Zerbini, G., & Roenneberg, T. (2019). Later school start times in a flexible system improve teenage sleep. Sleep. https://doi.org/10.1093/sleep/zsz307

Wolfson, A. R., & Carskadon, M. A. (1998). Sleep schedules and daytime functioning in adolescents. Child Development, 69(4), 875-887. doi:10.1111/j.1467-8624.1998.tb06149. https://doi.org/10.1111/j.1467-8624.1998.tb06149.x

Wolfson, A. R., Carskadon, M. A., Acebo, C., Seifer, R., Fallone, G., Labyak, S. E., & Martin, J. L. (2003). Evidence for the validity of a sleep habits survey for adolescents. Sleep, 26(2), 213-216. https://doi.org/10.1093/sleep/26.2.213

Wolfson, A. R., & Carskadon, M. A. (2005). A survey of factors influencing high school starttimes. *NASSP Bulletin*, *89*(642), 47-66.

Wolfson, A. R., Spaulding, N. L., Dandrow, C., & Baroni, E. M. (2007). Middle school start times: the importance of a good night's sleep for young adolescents. Behavioral sleep medicine, 5(3), 194-209. https://0-doi.org.wam.seals.ac.za/10.1080/15402000701263809

Wolfson, A. R., Harkins, E., Johnson, M., & Marco, C. (2015). Effects of the young adolescent sleep smart program on sleep hygiene practices, sleep health efficacy, and behavioral well- being. Sleep Health, 1(3), 197-204. https://doi.org/10.1016/j.sleh.2015.07.002

Wong, A. Y., Ling, S. K., Louie, L. H., Law, G. Y., So, R. C., Lee, D. C., Yau, F. C., & Yung, P. S. (2020). Impact of the COVID-19 pandemic on sports and exercise. *Asia-Pacific journal of sports medicine, arthroscopy, rehabilitation and technology*, *22*, 39–44. https://doi.org/10.1016/j.asmart.2020.07.006

World Health Organisation. (2019). Definition young people. Accessed from; www.britsnnivs.com/science/adolescence on 07/12/2019.

Wright Jr, K. P., McHill, A. W., Birks, B. R., Griffin, B. R., Rusterholz, T., & Chinoy, E. D. (2013). Entrainment of the human circadian clock to the natural light-dark cycle. *Current Biology, 23*(16), 1554-1558.

Yang, C. K., Kim, J. K., Patel, S.R., & Lee, J. H. (2005). Age-related changes in sleep/wake patterns among Korean teenagers. Pediatrics 115(1), 250-256. pmid:15866859 https://doi.org/10.1542/peds.2004-0815G

Yoon, J. S., Shin, S. M., Kook, S. H., & Lee, H. Y. (1997). A preliminary study on the Korean translation of composite scale (KtCS) to measure morningness: eveningness. Journal of Korean Neuropsychiatric Association, 36(1), 122-134.

Zhou, H. Q., Shi, W. B., Wang, X. F., Yao, M., Cheng, G. Y., Chen, P. Y., & Li, D. G. (2012). An epidemiological study of sleep quality in adolescents in South China: A school-based study. Child: Care, Health and Development, 38, 581-587. https://doi.org/10.1111/j.1365-2214.2011.01300.

Zhou, S. J., Zhang, L. G., Wang, L. L., Guo, Z. C., Wang, J. Q., Chen, J. C., ... & Chen, J. X. (2020). Prevalence and socio-demographic correlates of psychological health problems in Chinese adolescents during the outbreak of COVID-19. European Child & Adolescent Psychiatry, 29, 749- 758. 1-10. https://doi.org/10.1007/s00787-020-01541-4

Ziporyn, T. D., Owens, J. A., Wahlstrom, K. L., Wolfson, A. R., Troxel, W. M., Saletin, J. M., ... & Carskadon, M. A. (2022). Adolescent sleep health and school start times: Setting the research agenda for California and beyond: A research summit summary: A research summit summary. *Sleep Health*, 661. https://doi.org/10.1016/j.sleh.2021.10.008

Zisapel, N. (2007). Sleep and sleep disturbances: biological basis and clinical implications. Cellular and Molecular Life Sciences, 64(10), 1174-1186. https://doi.org/10.1007/s00018-007-6529-9

Zuckerman, D. (2015). Early morning classes, sleepy students and risky behaviours. National Center for Health Research. http://center4research. org/child-teen-health/early-morning-classes-sleepy-students-and-risky-behaviors/. Accessed May, 20, 201

8 APPENDICES

8.1 Appendix A: The original School Sleep Habits Survey

Bradley Hospital

School Sleep Habits Survey

INSTRUCTIONS

Please answer the questions on the following pages as accurately and honestly as you can. There are no right or wrong answers.

- **When you mark a response, please be sure to mark it neatly.**
- **Darken the bubbles as completely as possible using a pencil.**
- **Avoid stray marks and treat forms gently.**
- **Do not spend too much time on any one answer. Your first impression is usually best.**
- **Answer each question in the order that it appears. Do not go back and check your answers.**
- **Place an X beside any item that YOU DO NOT UNDERSTAND or that DOES NOT APPLY TO YOU or for which you CANNOT GIVE A TRUTHFUL ANSWER.**
- **Be sure to complete BOTH SIDES of every page.**

1. Today's Date:

Month	Day	Year
○ Jan		
○ Feb		
○ Mar	0 0	0 0
○ April	1 1	1 1
○ May	2 2	2 2
○ June	3 3	3 3
○ July	4 4	4 4
○ Aug	5 5	5 5
○ Sept	6 6	6 6
○ Oct	7 7	7 7
○ Nov	8 8	8 8
○ Dec	9 9	9 9

2. Birth Date:

Month	Day	Year
○ Jan		
○ Feb		
○ Mar	0 0	0 0
○ April	1 1	1 1
○ May	2 2	2 2
○ June	3 3	3 3
○ July	4 4	4 4
○ Aug	5 5	5 5
○ Sept	6 6	6 6
○ Oct	7 7	7 7
○ Nov	8 8	8 8
○ Dec	9 9	9 9

3. What time is it now? _____ ○ A.M. ○ P.M.

4. What is your sex?
○ Male
○ Female

5. What is your height?_____ feet _____ inches

6. What is your weight?_____ pounds

7. What is your age in years?
○ 9 ○ 10 ○ 11 ○ 12 ○ 13 ○ 14 ○ 15 ○ 16 ○ 17 ○ 18 ○ 19

8. What grade are you in?
○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 ○ 11 ○ 12

FOR OFFICE USE ONLY

3	5	6
0 0 0 0	0 0 0	0 0 0
1 1 1 1	1 1 1	1 1 1
2 2 2 2	2 2 2	2 2 2
3 3 3 3	3 3 3	3 3 3
4 4 4 4	4 4 4	4 4 4
5 5 5 5	5 5 5	5 5 5
6 6 6 6	6 6 6	6 6 6
7 7 7 7	7 7 7	7 7 7
8 8 8 8	8 8 8	8 8 8
9 9 9 9	9 9 9	9 9 9

00381

DO NOT WRITE IN THIS AREA

9. What best describes your racial/ethnic background?

- ◯ White/Caucasian
- ◯ Black/African American
- ◯ Hispanic/Latino
- ◯ Asian/Asian American
- ◯ Native American/Amerindian
- ◯ Multiracial (please specify) _____
- ◯ Other (please specify) _____

10. In the last two weeks, have you slept in the same bed?

- ◯ Every night
- ◯ Almost every night
- ◯ A few nights
- ◯ Not at all

11. Who lives in your home other than you? Please indicate yes or no for every category below:

	Yes	No
Mother/step-mother	◯	◯
Father/step-father	◯	◯
Older brother(s)/sister(s)	◯	◯
Younger brother(s)/sister(s)	◯	◯
Other family member(s)	◯	◯

12. Does your mother work outside of the home?

- ◯ Yes
- ◯ No

If yes, mark each label that best describes her work:

- ◯ Day shift
- ◯ Evening shift
- ◯ Night shift (graveyard)
- ◯ Changing shifts
- ◯ Full time
- ◯ Part time
- ◯ One job
- ◯ More than one job

13. Does your father work outside of the home?

- ◯ Yes
- ◯ No

If yes, mark each label that best describes his work:

- ◯ Day shift
- ◯ Evening shift
- ◯ Night shift (graveyard)
- ◯ Changing shifts
- ◯ Full time
- ◯ Part time
- ◯ One job
- ◯ More than one job

14. Are your grades in school mostly?:

- ◯ A's
- ◯ A's and B's
- ◯ B's
- ◯ B's and C's
- ◯ C's
- ◯ C's and D's
- ◯ D's
- ◯ D's and F's

15. What is the highest grade in school you expect to complete? (mark one)

- ◯ May not finish high school
- ◯ Will finish high school
- ◯ Will get a college degree
- ◯ Will get a degree beyond college

16. Do you have any disabilities or chronic illnesses (for example, asthma, diabetes, deafness, loss of the use of a limb, etc.)?

- ◯ Yes
- ◯ No

If yes, please specify: _____

17. Compared to other people your age, would you say that your health is:

- ◯ Poor
- ◯ Fair
- ◯ Good
- ◯ Excellent

18. Do you have attention deficit hyperactivity disorder (ADHD) or a learning disability?

- ◯ Yes
- ◯ No

19. Do you take Ritalin or some other medication to help with concentration or a learning problem?

- ◯ Yes
- ◯ No

20. Do you have an individualized education program or receive special help for difficulties with school work?

- ◯ Yes
- ◯ No

21. During the last two weeks, how many days did you stay home from school because you were:

a. sick? ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

b. other? ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩

Why did you stay home from school?

_____

FOR OFFICE USE ONLY

21

ID NUMBER

There are no right or wrong answers. Be careful to choose the **one** answer that **best** describes the way your sleep has been in the last two school weeks (unless otherwise instructed).

The next set of questions has to do with your usual schedule on days when you have school.

22. What time do you usually go to bed on school days?

List ONE time, not a range.

_____ ○ A.M. ○ P.M.

23. There are many reasons for doing things at one time or another. What is the main reason you usually go to bed at this time on school days? (mark one)

- ○ My parents have set my bedtime
- ○ I feel sleepy
- ○ I finish my homework
- ○ My TV shows are over
- ○ My brother(s) or sister(s) go to bed
- ○ I finish socializing
- ○ I get home from my job
- ○ Other: _____

24. What time do you usually wake up on school days?

_____ ○ A.M. ○ P.M.

25. What is the main reason you usually wake up at this time on school days? (choose one)

- ○ Noises or my pet wakes me up
- ○ My alarm clock wakes me up
- ○ My parents or other family members wake me up
- ○ I need to go to the bathroom
- ○ I don't know, I just wake up
- ○ Other: _____

26. What time do you usually leave home on school days?

_____ ○ A.M. ○ P.M.

27. How do you usually get to school?

- ○ Walk
- ○ Take the bus
- ○ Get a ride with parent
- ○ Get a ride with friend(s)
- ○ Drive my car

28. Figure out how long you usually sleep on a normal school night and fill it in here. [Do not include time you spend awake in bed. Remember to mark hours and minutes, even if minutes are zero.]

_____ hours _____ minutes

29. On school days, after you go to bed at night, about how long does it usually take you to fall asleep?

_____ minutes

The next set of questions has to do with your usual schedule on days when you do not have school, such as on the weekend.

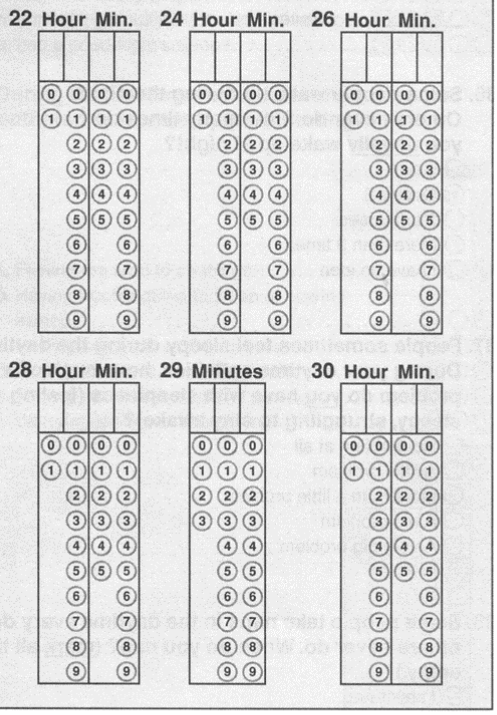
30. What time do you usually go to bed on weekends?

_____ ○ A.M. ○ P.M.

31. There are many reasons for doing things at one time or another. What is the main reason you usually go to bed at this time on weekends? (choose one)

- ○ My parents have set my bedtime
- ○ I feel sleepy
- ○ I finish my homework
- ○ My TV shows are over
- ○ My brother(s) or sister(s) go to bed then
- ○ I finish socializing
- ○ I get home from my job
- ○ Other: _____

FOR OFFICE USE ONLY



00381

DO NOT WRITE IN THIS AREA

32. What time do you usually wake up on weekends?

_____ ○ A.M. ○ P.M.

33. What is the main reason you usually wake up at this time on weekends? (choose one)

- ○ Noises or my pet wakes me up
- ○ My alarm clock wakes me up
- ○ My parents wake me up
- ○ I need to go to the bathroom
- ○ I don't know, I just wake up
- ○ Other: _____

34. Figure out how long you usually sleep on a night when you do not have school the next day (such as a weekend night) and fill it in here. [Do not include time you spend awake in bed. Remember to mark hours and minutes, even if minutes are zero.]

_____ hours _____ minutes

35. On weekends, after you go to bed at night, about how long does it usually take you to fall asleep?

_____ minutes

36. Some people wake up during the night. Others never do. How many times do you usually wake up at night?

- ○ Never
- ○ Once
- ○ 2 or 3 times
- ○ More than 3 times
- ○ I have no idea

37. People sometimes feel sleepy during the daytime. During your daytime activities, how much of a problem do you have with sleepiness (feeling sleepy, struggling to stay awake)?

- ○ No problem at all
- ○ A little problem
- ○ More than a little problem
- ○ A big problem
- ○ A very big problem

38. Some people take naps in the daytime every day, others never do. When do you nap? (mark all that apply.)

- ○ I never nap.
- ○ I sometimes nap on school days.
- ○ I sometimes nap on weekends.
- ○ I never nap unless I am sick.

39. Can you figure out how much sleep you need? Fill out below how much sleep you think you would need each night to feel your best every day. [Remember to mark hours and minutes, even if minutes are zero.]

_____ hours _____ minutes

40. In general, do you feel you usually get . . .

- ○ too much sleep?
- ○ enough sleep?
- ○ too little sleep?

41. Do you consider yourself to be . . .

- ○ a good sleeper?
- ○ a poor sleeper?

42. How often do you think that you get enough sleep?

- ○ Always
- ○ Usually
- ○ Sometimes
- ○ Rarely
- ○ Never

FOR OFFICE USE ONLY

32 Hour Min.

34 Hour Min.

35 Minutes

39 Hour Min.

ID Number

Questions 43 to 46 are about things that have happened in the last two weeks.

43. During the last two weeks, have you struggled to stay awake (fought sleep) or fallen asleep in the following situations? (Mark one answer for every item.)

	Both struggled to stay awake and fallen asleep	Fallen asleep	Struggled to stay awake	No
• in a face-to-face conversation with another person?	○	○	○	○
• traveling in a bus, train, plane or car?	○	○	○	○
• attending a performance (movie, concert, play)?	○	○	○	○
• watching television or listening to the radio or stereo?	○	○	○	○
• reading, studying or doing homework?	○	○	○	○
• during a test?	○	○	○	○
• in a class at school?	○	○	○	○
• while doing work on a computer or typewriter?	○	○	○	○
• playing video games?	○	○	○	○
• driving a car?	○	○	○	○

Do you drive? ○ Yes ○ No

44. During the last two weeks, how often did you . . . (Mark one answer for every item.)

	Every day	Several times every day	Once or twice a day	Never
a. drink soda with caffeine [like Coke, Pepsi; not like root beer, orange soda or Sprite]?	○	○	○	○
b. drink coffee or tea with caffeine?	○	○	○	○
c. use tobacco? [cigarettes, cigar, chewing tobacco, etc.]?	○	○	○	○
d. drink alcohol [beer, wine, liquor]?	○	○	○	○
e. use drugs [like marijuana, cocaine]? please specify type: _____	○	○	○	○

45. In the last two weeks, how often have you . . . (Mark one answer for every item.)

	Never	Once	Twice	Several times	Everyday/night
a. felt satisfied with your sleep?	○	○	○	○	○
b. arrived late to class because you overslept?	○	○	○	○	○
c. fallen asleep in a morning class?	○	○	○	○	○
d. fallen asleep in an afternoon class?	○	○	○	○	○
e. awakened too early in the morning and couldn't get back to sleep?	○	○	○	○	○
f. stayed up until at least 3 a.m.?	○	○	○	○	○
g. stayed up all night?	○	○	○	○	○
h. slept in past noon?	○	○	○	○	○
i. felt tired, dragged out, or sleepy during the day?	○	○	○	○	○
j. needed more than one reminder to get up in the morning?	○	○	○	○	○
k. had an extremely hard time falling asleep?	○	○	○	○	○
l. had nightmares or bad dreams during the night?	○	○	○	○	○
m. gone to bed because you just could not stay awake any longer?	○	○	○	○	○
n. done dangerous things without thinking?	○	○	○	○	○
o. had a good night's sleep?	○	○	○	○	○

46. During the last two weeks, how often were you bothered or trouble by the following?

	Much	Somewhat	Not at all
a. Feeling too tired to do things	○	○	○
b. Having trouble going to sleep or staying asleep	○	○	○
c. Feeling unhappy, sad, or depressed	○	○	○
d. Feeling hopeless about the future	○	○	○
e. Feeling nervous or tense	○	○	○
f. Worrying too much about things	○	○	○

ID Number

0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

Questions 47 - 56 have to do with how you might organize the timing of various activities if you were free to plan your day according to when you feel your best. Please answer the questions based on your body's "feeling best" times.

47. Imagine: School is cancelled! You can get up whenever you want to. When would you get out of bed? Between:
- ○ 5:00 and 6:30 a.m.
- ○ 6:30 and 7:45 a.m.
- ○ 7:45 and 9:45 a.m.
- ○ 9:45 and 11:00 a.m.
- ○ 11:00 a.m. and noon

48. Is it easy for you to get up in the morning?
- ○ No way!
- ○ Sort of.
- ○ Pretty easy.
- ○ It's a cinch!

49. Gym class is set for 7:00 in the morning. How do you think you'll do?
- ○ My best!
- ○ Okay.
- ○ Worse than usual.
- ○ Awful!

50. The bad news: You have to take a two-hour test. The good news: You can take it when you think you'll do your best. What time is that?
- ○ 8:00 to 10:00 a.m.
- ○ 11:00 a.m. to 1:00 p.m.
- ○ 3:00 p.m. to 5:00 pm.
- ○ 7:00 p.m. to 9:00 p.m.

51. When do you have the most energy to do your favorite things?
- ○ Morning! I am tired in the evening.
- ○ Morning more than evening.
- ○ Evening more than morning.
- ○ Evening! I am tired in the morning.

52. Your parents have decided to let you set your own bed time. What time would you pick? Between:
- ○ 8:00 and 9:00 p.m.
- ○ 9:00 and 10:15 p.m.
- ○ 10:15 p.m. and 12:30 a.m.
- ○ 12:30 and 1:45 a.m.
- ○ 1:45 and 3:00 a.m.

53. How alert are you in the first half hour you're up?
- ○ Out of it.
- ○ A little dazed.
- ○ Okay.
- ○ Ready to take on the world.

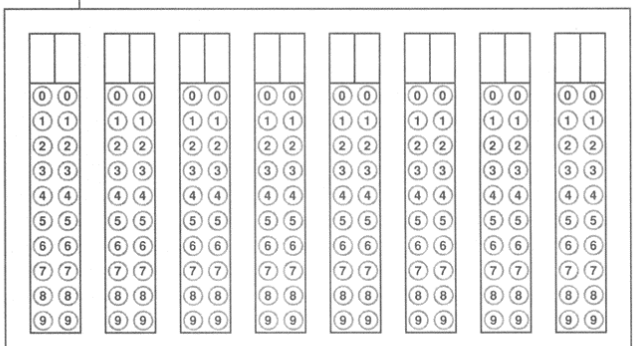
54. When does your body start to tell you it's time for bed (even if you ignore it)? Between:
- ○ 8:00 and 9:00 p.m.
- ○ 9:00 and 10:15 p.m.
- ○ 10:15 p.m. and 12:30 a.m.
- ○ 12:30 and 1:45 a.m.
- ○ 1:45 and 3:00 a.m.

55. Say you had to get up at 6:00 a.m. every morning: What would it be like?
- ○ Awful!
- ○ Not so great.
- ○ Okay (if I have to).
- ○ Fine, no problem!

56. When you wake up in the morning how long does it take for you to be totally "with it"?
- ○ 0 to 10 minutes
- ○ 11 to 20 minutes
- ○ 21 to 40 minutes
- ○ More than 40 minutes

57. Would you say that your growth in height:
- ○ Has not begun to spurt ("spurt" means faster growth than usual)
- ○ Has barely started
- ○ Is definitely underway
- ○ Seems complete
- ○ I don't know

58. Would you say that your other signs of physical maturation:
- ○ Have not yet started to show
- ○ Have barely started to show
- ○ Are definitely underway
- ○ Seem complete
- ○ I don't know



00381

DO NOT WRITE IN THIS AREA

59. **During the last week, did you work at a job for pay? (If no, skip to number 60.)**
○ Yes ○ No

What kind of job? _____

How many days did you work at the following times?
in the morning before school 0 1 2 3 4 5
in the afternoon after school 0 1 2 3 4 5
in the evening on days that you have school . . 0 1 2 3 4 5
on the weekend 0 1 2

How many hours did you work at your paying job this week?

during the school week: _____ **hours**

during the weekend: _____ **hours**

During the last two weeks, have you struggled to stay awake (fought sleep) or fallen asleep at your job?
○ no ○ struggled to stay awake
○ fallen asleep ○ both struggled to stay awake and fallen asleep

If you did not have your job, would you go to bed:
○ earlier than you do. ○ the same as you do.
○ later than you do.

If you did not have your job, would you wake up:
○ earlier than you do. ○ the same as you do.
○ later than you do.

60. **During the last week, did you engage in organized sports or a regularly scheduled physical activity? (If no, skip to number 61.)**
○ Yes ○ No

What kind of sport? _____

How many days did you practice at the following times?
in the morning before school 0 1 2 3 4 5
in the afternoon after school 0 1 2 3 4 5
in the evening on days that you have school . . 0 1 2 3 4 5
on the weekend 0 1 2

How many hours did you practice this week?

during the school week: _____ **hours**

during the weekend: _____ **hours**

During the last two weeks, have you struggled to stay awake (fought sleep) or fallen asleep during practice?
○ no ○ struggled to stay awake
○ fallen asleep ○ both struggled to stay awake and fallen asleep

If you did not have your sports activity, would you go to bed:
○ earlier than you do. ○ the same as you do.
○ later than you do.

If you did not have your sports activity, would you wake up:
○ earlier than you do. ○ the same as you do.
○ later than you do.

61. **During the last week, did you participate in organized extracurricular activities? (For example, committees, clubs, volunteer work, musical groups, church groups, etc.) (If no, skip to number 62.)**
○ Yes ○ No

What kind of activity? _____

How many days did you participate at the following times?
in the morning before school 0 1 2 3 4 5
in the afternoon after school 0 1 2 3 4 5
in the evening on days that you have school . . 0 1 2 3 4 5
on the weekend 0 1 2

How many hours did you participate this week?

during the school week: _____ **hours**

during the weekend: _____ **hours**

During the last two weeks, have you struggled to stay awake (fought sleep) or fallen asleep during this participation?
○ no ○ struggled to stay awake
○ fallen asleep ○ both struggled to stay awake and fallen asleep

If you did not have your organized activity, would you go to bed:
○ earlier than you do. ○ the same as you do.
○ later than you do.

If you did not have your organized activity, would you wake up:
○ earlier than you do. ○ the same as you do.
○ later than you do.

62. **During the last week, did you study/do homework?**
○ Yes ○ No (If no, skip to number 63.)

How many days did you study at the following times?
in the morning before school 0 1 2 3 4 5
in the afternoon after school 0 1 2 3 4 5
in the evening on days that you have school . . 0 1 2 3 4 5
on the weekend 0 1 2

How many hours did you study this week?

during the school week: _____ **hours**

during the weekend: _____ **hours**

During the last two weeks, have you struggled to stay awake (fought sleep) or fallen asleep during studying?
○ no ○ struggled to stay awake
○ fallen asleep ○ both struggled to stay awake and fallen asleep

If you did not have your homework, would you go to bed:
○ earlier than you do. ○ the same as you do.
○ later than you do.

If you did not have your homework, would you wake up:
○ earlier than you do. ○ the same as you do.
○ later than you do.

FOR OFFICE USE ONLY ID NUMBER

0 0 0 0
1 1 1 1
2 2 2 2
3 3 3 3
4 4 4 4
5 5 5 5
6 6 6 6
7 7 7 7
8 8 8 8
9 9 9 9

63. **Below are some ways that people get hurt or injured. If you answer Yes in the first column to any item, please fill in an answer to each of the follow-up questions. IN THE PAST 6 MONTHS:**

	Were you injured this way?		IF YES, then: Were you treated by a doctor or nurse for the injury?			Did this injury limit your physical activity?		Had you been drinking alcohol or using drugs at the time of the injury?		Where did the injury occur? H = home W = work S = school O = other
	Yes	No		Yes	No	Yes	No	Yes	No	
A. By being in a physical fight with someone?	(Y)	(N)	If Yes:	(Y)	(N)	(Y)	(N)	(Y)	(N)	(H) (W) (S) (O)
B. By getting cut?	(Y)	(N)	If Yes:	(Y)	(N)	(Y)	(N)	(Y)	(N)	(H) (W) (S) (O)
C. By a gun, BB gun, or pellet gun?	(Y)	(N)	If Yes:	(Y)	(N)	(Y)	(N)	(Y)	(N)	(H) (W) (S) (O)
D. By being hit by something, like a rock or glass?	(Y)	(N)	If Yes:	(Y)	(N)	(Y)	(N)	(Y)	(N)	(H) (W) (S) (O)
E. By nearly drowning?	(Y)	(N)	If Yes:	(Y)	(N)	(Y)	(N)	(Y)	(N)	(H) (W) (S) (O)
F. By falling?	(Y)	(N)	If Yes:	(Y)	(N)	(Y)	(N)	(Y)	(N)	(H) (W) (S) (O)
G. By being burned by fire, chemicals, electricity, or hot liquids?	(Y)	(N)	If Yes:	(Y)	(N)	(Y)	(N)	(Y)	(N)	(H) (W) (S) (O)
H. By an animal bite or serious insect bite?	(Y)	(N)	If Yes:	(Y)	(N)	(Y)	(N)	(Y)	(N)	(H) (W) (S) (O)
I. While driving a car, truck, or bus?	(Y)	(N)	If Yes:	(Y)	(N)	(Y)	(N)	(Y)	(N)	(H) (W) (S) (O)
J. While riding in a car, truck, or bus?	(Y)	(N)	If Yes:	(Y)	(N)	(Y)	(N)	(Y)	(N)	(H) (W) (S) (O)
K. While riding a bicycle, skateboard, rollerblades, or rollerskates?	(Y)	(N)	If Yes:	(Y)	(N)	(Y)	(N)	(Y)	(N)	(H) (W) (S) (O)
L. While riding a moped, motorcycle, all-terrain vehicle (ATV), or snowmobile?	(Y)	(N)	If Yes:	(Y)	(N)	(Y)	(N)	(Y)	(N)	(H) (W) (S) (O)
M. During a team sport, athletic activity, or exercise?	(Y)	(N)	If Yes:	(Y)	(N)	(Y)	(N)	(Y)	(N)	(H) (W) (S) (O)
N. By being hit by a moving vehicle while walking?	(Y)	(N)	If Yes:	(Y)	(N)	(Y)	(N)	(Y)	(N)	(H) (W) (S) (O)
O. By drinking or eating a dangerous substance?	(Y)	(N)	If Yes:	(Y)	(N)	(Y)	(N)	(Y)	(N)	(H) (W) (S) (O)
P. By being physically attacked?	(Y)	(N)	If Yes:	(Y)	(N)	(Y)	(N)	(Y)	(N)	(H) (W) (S) (O)
Q. Injured in some other way?	(Y)	(N)	If Yes:	(Y)	(N)	(Y)	(N)	(Y)	(N)	(H) (W) (S) (O)

If yes to Q, please describe how you were injured: _____

_____

FOR OFFICE USE ONLY	
	(0) (1) (2) (3) (4) (5) (6) (7) (8) (9)
	(0) (1) (2) (3) (4) (5) (6) (7) (8) (9)

00381

DO NOT WRITE IN THIS AREA

R8492-PFI-54321

8.2 Appendix B: Mandondo Modified SSHS

School Sleep Habits Survey

Instructions

Please answer the questions on the following pages as accurately and honestly as you can. There are no right or wrong answers.

NB: Participation in this research is completely voluntary; you may choose to withdraw from the research at any time or not answer questions that you do not feel comfortable answering.

- When you mark a response, please be sure to mark it
- Darken the bubbles as completely as possible using a pencil
- Avoid stray marks and treat forms gently
- Do not spend too much time on any one answer. Your first impression is usually best.
- Answer each question in the order that it appears. Do not go back and check your answers.
- Place an X beside any item that you DO NOT UNDERSTAND or that DOES NOT APPLY TO YOU or for which you CANNOT GIVE A TRUTHFUL ANSWER.
- Be sure to complete BOTH SIDES of every page

1. Age: _____
2. Sex: _____
3. Height (cm/m): _____
4. Weight (kg): _____
5. Grade: _____
6. Racial/Ethinic background:
   - ◯ White
   - ◯ Black/African
   - ◯ Colored
   - ◯ Indian
   - ◯ Other (please specify) _____
7. In the last two weeks, have you slept in the same bed?
   - ◯ Every night
   - ◯ Almost every night
   - ◯ A few nights
   - ◯ Not at all
8. Who lives in your home other than you? Please indicate yes or no for every category below:

	Yes	No
Mother/step mother.....	◯	◯

Father/step father.....
Sibling(s).....
Other family member(s).
Hostel/Boarding school..

9. Does your mother/guardian work outside of the home?

Yes
No

If yes, mark each label that best describes her work:

Day shift
Evening shift
Night shift
Changing shift
Full time
Part time
One Job
More than 1 job

10. Does your father/guardian work outside of the home?

Yes
No

If yes, mark each label that best describes his work:

Day shift
Evening shift
Night shift
Changing shift
Full time
Part time
One Job
More than 1 job

11. Are your grades in school mostly?:

80-100%
70-79.99%
60-69.99%
50-59.99%
40-49.99%
30-39.99%
20-29.99%

12. What is the highest grade in school you expect to complete? (mark one)

May not finish high school
Will finish high school
Will get a university/college degree
Will get a degree beyond university or College

13. Do you have any disabilities or chronic illnesses (e.g. asthma, diabetes, deafness, loss of the use of a limb, etc.)?

Yes
No
If yes, please specify: _____

14. Compared to other people your age, would you say that your health is:

Poor
Fair
Good
Excellent

15. Do you have attention deficit hyperactivity disorder (ADHD) or a learning disability?

◯ Yes ◯ No

16. Do you take Ritalin/Concerta or some other medication to help with concentration or a learning problem?

◯ Yes ◯ No

17. Do you take extra lessons or receive special help for difficulties with school work?

◯ Yes ◯ No

18. During the last 2 weeks, how many days did you stay home from school because you were:

a. Sick? 0 1 2 3 4 5 6 7 8 9 10
b. Other? 0 1 2 3 4 5 6 7 8 9 10

Why did you stay home from school?

_____

There are no right or wrong answers. Be careful to choose the one answer that best describes the way your sleep has been in the last 2 weeks (unless otherwise instructed).

The next set of questions has to do with your usual schedule on days when you have school.

19. What time do you usually go to bed on school days? List ONE time, not a range.

◯ A.M.
_____ ◯ P.M.

20. There are many reasons for doing things at one time or another. What is the main reason you usually go to bed at this time on school days? (mark one)

◯ My parents have set my bedtime
◯ I feel sleepy
◯ I finish my homework
◯ My TV shows are over
◯ My brothers(s) or sisters(s) go to bed
◯ I finish socializing
◯ I get home from my job
◯ Lights out at hostel/boarding school
◯ Other:

_____

21. What time do you usually wake up on school days? List ONE time, not a range.

◯ A.M.
_____ ◯ P.M.

22. What is the main reason you usually wake up at this time on school days? (mark one)

◯ Noises or my pet wakes me up
◯ My alarm clock wakes me up
◯ My parents or other family members wake me up
◯ I need to go to the bathroom
◯ I don't know. I just wake up
◯ The bell in hostel/boarding school

Other:

_____

23. What time do you usually leave home/hostel on school days? List ONE time, not a range.

_____ A.M.
P.M.

24. How do you usually get to school?

- Walk
- Get a ride with friend(s)
- Take the school bus
- Drive my car/ ride my bicycle
- Take a taxi
- Get a ride with parent/family member

25. Figure out how long you usually sleep on a normal school night and fill it in here. (Do not include time you spend awake in bed. Remember to mark hours and minutes, even if minutes are zero.)

_____ hours _____ minutes

26. On school days, after you go to bed at night, about how long does it usually take you to fall asleep?

_____ minutes

The next set of questions has to do with your usual schedule on days when you do not have school, such as the weekend

27. What time do you usually go to bed on the weekends ? List ONE time, not a range.

A.M.
_____ P.M.

28. What is the main reason you usually go to bed at this time on the weekends? (mark one)

- My parents have set my bedtime
- I feel sleepy
- I finish my homework
- My TV shows are over
- My brothers(s) or sisters(s) go to bed
- I finish socializing
- I get home from my job
- Lights out at hostel/boarding school
- Other:

_____

29. What time do you usually wake up on school days? List ONE time, not a range.

A.M.
_____ P.M.

30. What is the main reason you usually wake up at this time on weekends? (mark one)

- Noises or my pet wakes me up
- My alarm clock wakes me up
- My parents or other family members wake me up

Good

Excellent

15. Do you have attention deficit hyperactivity disorder (ADHD) or a learning disability?

Yes No

16. Do you take Ritalin/Concerta or some other medication to help with concentration or a learning problem?

Yes No

17. Do you take extra lessons or receive special help for difficulties with school work?

Yes No

18. During the last 2 weeks, how many days did you stay home from school because you were:

a. Sick? 0 1 2 3 4 5 6 7 8 9 10

b. Other? 0 1 2 3 4 5 6 7 8 9 10

Why did you stay home from school?

_____

There are no right or wrong answers. Be careful to choose the one answer that best describes the way your sleep has been in the last 2 weeks (unless otherwise instructed).

The next set of questions has to do with your usual schedule on days when you have school.

19. What time do you usually go to bed on school nights ? List ONE time, not a range.

A.M

_____ P.M

20. There are many reasons for doing things at one time or another. What is the main reason you usually go to bed at this time on school nights? (mark one)

My parents have set my bedtime

I feel sleepy

I finish my homework

My TV shows are over

My brothers(s) or sister(s) go to bed

I finish socializing (in person or on social media apps)

I get home from my job

Lights out at hostel/boarding school

Other:

_____

21. What time do you usually wake up on school days? List ONE time, not a range.

A.M

_____ P.M

22. What is the main reason you usually wake up at this time on school days? (mark one)

Noises or my pet wakes me up

My alarm clock wakes me up

- My parents or other family members wake me up
- I need to go to the bathroom
- I don't know. I just wake up
- The bell in hostel/boarding school
- Other: _____

23. What time do you usually leave home/hostel on school days? List ONE time, not a range.

_____ A.M. / P.M.

24. How do you usually get to school?

- Walk
- Get a ride with a friend(s)
- Take the school bus
- Drive/ride my bicycle
- Take a taxi
- Get a ride with parent/family member

25. How long do you usually sleep on a normal school night? (Do not include time you spend awake in bed. Remember to mark hours and minutes, even if minutes are zero.)

_____hours _____minutes

26. On school days, after you go to bed at night, about how long does it usually take you to fall asleep?

_____minutes

The next set of questions has to do with your usual schedule on days when you do not have school, such as the weekend

27. What time do you usually go to bed on weekend nights? List ONE time, not a range.

_____ A.M. / P.M.

28. What is the main reason you usually go to bed at this time on weekend nights? (mark one)

- My parents have set my bedtime
- I feel sleepy
- I finish my homework
- My TV shows are over
- My brother(s) or sister(s) go to bed
- I finish socializing (in person or on social media)
- I get home from my job
- Lights out at hostel/boarding school
- Other: _____

29. What time do you usually wake up on the weekend? List ONE time, not a range.

_____ A.M. / P.M.

30. What is the main reason you usually wake up at this time on weekends? (mark one)

- Noises or my pet wakes me up
- My alarm clock wakes me up
- My parents or other family members wake me up
- I need to go to the bathroom
- I don't know. I just wake up
- The bell in house/boarding school
- Other

31. How long do you usually sleep on a night when you do not have school the next day (such as a weekend night)? (Do not include time you spend awake in bed. Remember to mark hours and minutes, even if minutes are zero.)

_____ hours _____ minutes

32. On weekends, after you go to bed at night, about how long does it usually take you to fall asleep?

_____ minutes

33. Some people wake up during the night. Others never do. How many times do you usually wake up at night?

- Never
- Once
- 2 or 3 times
- More than 3 times
- I have no idea

34. People sometimes feel sleepy during the daytime. During your daytime activities, how much of a problem do you have with sleepiness (feeling sleepy, struggling to stay awake)?

- No problem at all
- A little problem
- More than a little problem
- A big problem
- A very big problem

35. Some people take naps in the daytime every day, others never do. When do you nap? (Mark all that apply)

- I never nap
- I sometimes nap on school days
- I sometimes nap on weekends
- I never nap unless I am sick

36. Fill out below how much sleep you think you would need each night to feel your best every day. (Remember to mark hours and minutes, even if minutes are zero)

_____ hours _____ minutes

37. In general, do you feel when you usually get up....

- Too much sleep?
- enough sleep?
- too little sleep?

38. Do you consider yourself to be...

a good sleeper?

a poor sleeper?

39. How often do you think that you get enough sleep?

Always

Usually

Sometimes

Rarely

Never

Questions 40 to 42 are about things that have happened in the last 2 weeks.

40. During the last 2 weeks, have you struggled to stay awake (fought sleep) or fallen asleep in the following situations? (Mark one answer for every item.)

	4. Both struggled to stay awake and fallen asleep	3. Fallen asleep	2. Struggled to stay awake	1. No
In a face-to-face conversation with another person				
Travelling in a bus, train, plane, or car				
Attending a performance (movie, concert, play)				
Watching TV or listening to the radio or music				
Reading, studying or doing homework				
During a test				
In a class at school				
While doing work on a computer				
Playing video games				
Driving a car				

Do you drive? Yes

No

41. During the last 2 weeks, how often did you ...(Mark 1 answer for every item.)

	4. Every day	3. Several times every day	2. Once or twice a day	1. Never
a. Drink soda with caffeine(E.g. coke, pepsi, not like Orange soda and sprite)?				
b. Drink coffee or tea with caffeine				

42. In the last 2 weeks, how often have you... (Mark one answer for every 1 item)

	5. Never	4. Once	3. Twice	2. Several times	1. Everyday/night
a. felt satisfied with your sleep?					
b. arrived late to class because you overslept?					
c. fallen asleep in a morning					

tired?

c. fallen asleep in an afternoon class?

e. awakened too early in the morning and couldn't get back to sleep?

f. stayed up until at least 3 a.m.

g.stayed up all night?

h.slept in past noon?

i. felt tired, dragged out, or sleepy during the day?

j. needed more than 1 reminder to get up in the morning?

k. had an extremely hard time falling asleep?

l. had nightmares or bad dreams during the night?

m. gone to bed because you just could not stay awake any longer?

n. done dangerous things without thinking?

o. had a good night's sleep?

43. During the last 2 weeks, how often were you bothered or troubled by the following?

	3. Much	2. Somewhat	1. Not at all
a. Feeling too tired to do things	◯	◯	◯
b. Having trouble going to sleep or staying asleep	◯	◯	◯
c. Feeling unhappy, sad, or depressed	◯	◯	◯
d. Feeling hopeless about the future	◯	◯	◯
e. Feeling nervous or tense	◯	◯	◯
f. Worrying too much about things	◯	◯	◯

Questions 44 - 53 have to do with how you might organize the timing of various activities if you were free to plan your day according to when you feel your best. Please answer the questions based on your body's "feeling best" times. Circle the answer that is most applicable to you

44. Imagine: School is cancelled! You can get up whenever you want to: When would you get out of bed? Between:

- ◯ 05:00 and 06:30 a.m
- ◯ 06:30 and 07:45 a.m
- ◯ 07:45 and 09:45 a.m
- ◯ 09:45 and 11:00 a.m
- ◯ 11:00 a.m. and noon

45. Is it easy for you to get up in the morning?

- ◯ No way!
- ◯ Sort of
- ◯ Pretty easy
- ◯ Very easy

46. Physical Education (PE) is set for 7:00 in the morning. How do you think you'll do?

- ◯ My best!
- ◯ Okay
- ◯ Worse than usual
- ◯ Awful!

47. The bad news: You have to take a 2 hour test. The good news: You can take

it when you think you'll do best. What time is that?

- ◯ 08:00 to 10:00 a.m.
- ◯ 11:00 a.m. to 1:00 p.m.
- ◯ 3:00 p.m. to 5:00 p.m.
- ◯ 7:00 p.m. to 9:00 p.m.

48. When do you have the most energy to do your favorite things?

- ◯ Morning! I am tired in the evening.
- ◯ Morning more than evening.
- ◯ Evening more than morning.
- ◯ Evening! I am tired in the morning.

49. Your parents or hostel master has decided to let you set your own bed time. What time would you pick? Between:

- 8:00 and 9:00 p.m.
- 9:00 and 10:15 p.m.
- 10:15 p.m. and 12:30 a.m.
- 12:30 and 1:45 a.m.
- 1:45 and 3:00 a.m.

50. How alert are you in the first half hour you're up?

- Out of it
- A little dazed
- Okay
- Ready to take on the world

51. When does your body start to tell you it's time for bed (even if you ignore it)? Between:

- 8:00 and 9:00 p.m.
- 9:00 and 10:15 p.m.
- 10:15 p.m. and 12:30 a.m.
- 12:30 and 1:45 a.m.
- 1:45 and 3:00 a.m.

52. Say you had to get up at 6:00 a.m. every morning: What would it be like?

- Awful!
- Not so great
- Okay (if I have to).
- Fine, no problem!

53. When you wake up in the morning, how long does it take for you to be totally "with it"?

- 0 to 10 minutes
- 11 to 20 minutes
- 21 to 40 minutes
- More than 40 minutes

54. Would you say that your growth in height:

- Has not begun to spurt ("spurt" means faster growth than usual)
- Has barely started
- Is definitely underway
- Seems complete
- I don't know

55. Would you say that your other signs of physical maturation:

- Have not yet started to show
- Have barely started to show
- Are definitely underway
- Seem complete
- I don't know

56. During the last week, did you work at a job for pay? (If no, skip to number 57.)

Yes No

What kind of job?

How many days did you work at the following times?

In the morning before school 0 1 2 3 4 5
In the afternoon after school 0 1 2 3 4 5
In the evening on days you have school 0 1 2 3 4 5
On the weekend 0 1 2

How many hours did you work at your paying job this week?

During the school week: hours
During the weekend: hours

During the last 2 weeks, have you struggled to stay awake (fought sleep) or fallen asleep at your job?

no struggled to stay awake
fallen asleep both struggled to stay awake and fallen asleep

If you did not have your job, would you go to bed:

earlier than you do the same as you do
later than you do

If you did not have your job, would you wake up:

earlier than you do the same as you do
later than you do

57. During the last week, did you engage in organized sports or a regularly scheduled physical activity (If no, skip to number 58.)

Yes No

What kind of sport?

How many days did you practice at the following times?

In the morning before school 0 1 2 3 4 5
In the afternoon after school 0 1 2 3 4 5
In the evening on days you have school 0 1 2 3 4 5
On the weekend 0 1 2

How many hours did you practice this week?

During the school week: hours
During the weekend: hours

During the last 2 weeks, have you struggled to stay awake (fought sleep) or fallen asleep during practice?

no struggled to stay awake
fallen asleep both struggled to stay awake and fallen asleep

If you did not have your organized activity, would you go to bed:

earlier than you do the same as you do
later than you do

If you did not have your organized activity, would you wake up:

earlier than you do the same as you do
later than you do

58. During the last week, did you study/do homework? (If no, skip to number 59.)

Yes No

How many days do you study/do homework at the following times?

In the morning before school 0 1 2 3 4 5
In the afternoon after school 0 1 2 3 4 5
In the evening on days you have school 0 1 2 3 4 5
On the weekend 0 1 2

How many hours did you study/do homework this week?

During the school week: hours
During the weekend: hours

During the last 2 weeks, have you struggled to stay awake (fought sleep) or fallen asleep during studying/homework?

no struggled to stay awake

fallen asleep both struggled to stay awake and fallen asleep

If you did not have to study/do homework, would you go to bed:

earlier than you do. the same as you do.

later than you do.

If you did not have to study/do homework, would you wake up:

earlier than you do. the same as you do.

later than you do.

The following section is meant to assess your use of electrical devices (EDs) before bedtime.

	Smartphone/Mobile Cell phone	**Laptop/ Computer**	**Tablet**	**Television**	**Video games e.g playstation, xbox**
59. Please place an x on the device(s) you have /use					
60. Place an X on the device(s) you have/ use in your room/hostel/ dorm before bedtime?					
61. What do you usually use device(s) for before bedtime? Place an X next to the appropriate reason	Calling; Texting; Browsing through social media; Browsing the internet; Homework/Assignments; Movies; Other	Chatting; Browsing through social media; Browsing the internet; Homework /Assignments; Listening to or downloading music; Movies/series Other;	Chatting; Browsing through social media; Browsing the internet; Homework /Assignments; Listening to or downloading music; Movies/series Other;	Watching movies or TV shows; Other;	

62. How often do you use these devices before bedtime? Write: • Never • Sometimes • Usually • Always					
63. How much time do you spend using these devices before bedtime (Hours and minutes)?					

8.3 Appendix C: Modified School Sleep Habits Survey

School Sleep Habits Survey

Instructions

Please answer the questions on the following pages as accurately and honestly as you can. There are no right or wrong answers.

NB: Participation in this research is completely voluntary; you may choose to withdraw from the research at any time or not answer questions that you do not feel comfortable answering.

- **When you mark a response, please be sure to mark it**
- **Darken the bubbles as completely as possible using a pencil**
- **Avoid stray marks and treat forms gently**
- **Do not spend too much time on any one answer. Your first impression is usually best.**
- **Answer each question in the order that it appears. Do not go back and check your answers.**
- **Place an X beside any item that you DO NOT UNDERSTAND or that DOES NOT APPLY TO YOU or for which you CANNOT GIVE A TRUTHFUL ANSWER.**
- **Be sure to complete BOTH SIDES of every page**

1. Age: _____

2. Sex:_____

3. Grade: _____

4. What is your weight? (kg)

_____

5.What is your height? (cm/m)

_____

6. Racial/Ethnic background

- White
- Black/African
- Colored
- Indian
- Other (please specify)

_____

7. In the last two weeks, have you slept in the same bed?

- Every night
- Almost every night
- A few nights
- Not at all

8. Who lives in your home other than you?

- Mother/stepmother
- Father/stepfather
- Sibling(s)
- Other family member(s)

9. Does your mother/guardian work outside of the home?

- Yes
- No

10. If yes, mark each label that best describes her work:

- Day shift
- Evening shift
- Night shift
- Changing shift
- One job
- More than 1 job
- Full time
- Part time

11. Does your father/guardian work outside of the home?

- Yes
- No

12. If yes, mark each label that best describes his work:

- Day shift
- Evening shift
- Night shift
- Full time
- Part time

Changing shift

More than 1 job

One job

Good

Excellent

17. Do you have attention deficit hyperactivity disorder (ADHD) or any learning disability?

Yes

No

13. Are your grades in school <u>mostly?:</u>

80-100%

70-79.99%

60-69.99%

50-59.99%

40-49.99%

30-39.99%

20-29.99%

14. What is the highest grade in school you expect to complete? (<u>mark</u> one)

May not finish high school

Will finish high school

Will get a university/college degree

Will get a degree beyond university/college

15. Do you have any disabilities or chronic illnesses (e.g. asthma, diabetes, deafness, loss of the use of a limb, etc.)?

Yes

No

If yes, please specify:

_____

16. Compared to other people your age, would you say that your health is:

Poor

Fair

18. Do you take Ritalin/Concerta or some other medication to help with concentration or a learning problem?

Yes

No

19. Do you take extra lessons or receive special help for difficulties with schoolwork?

Yes

No

20. During the last 2 weeks, how many days did you stay home from school because you were:

a. Sick? 0 1 2 3 4 5 6 7 8 9 10

b. Other? 0 1 2 3 4 5 6 7 8 9 10

Why did you stay home from school?

_____

There are no right or wrong answers. Be careful to choose the one answer that best describes the way your sleep has been in the <u>last 2 weeks</u> (unless otherwise instructed).

<u>The next set of questions has to do with your usual schedule on days when you have school.</u>

21. What time do you usually go to bed on school days? List ONE time, not a range.

_____ A.M.

P.M

22. There are many reasons for doing things at one time or another. What is the main reason you usually go to bed at this time on school days? (mark one)

- My parents have set my bedtime
- I feel sleepy
- I finish my homework
- My TV shows are over
- My brothers(s) or sisters(s) go to bed
- I finish socializing
- I get home from my job
- Other

_____

23. What time do you usually wake up on school days? List ONE time, not a range.

_____ A.M.

P.M

24. What is the main reason you usually wake up at this time on school days? (mark one)

- Noises or my pet wakes me up
- My alarm clock wakes me up
- My parents or other family members wake me up
- I need to go to the bathroom,
- I don't know, I just wake up
- Other:

_____

25. What time do you usually leave home on school days? List ONE time, not a range.

_____ A.M.

P.M

26. How do you usually get to school?

- Walk
- Take the bus
- Ride my bicycle
- Take the taxi
- Take the scholar transport taxi
- Get a ride with a parent or family member
- Other:

_____

27. Figure out how long you usually sleep on a normal school night and fill it in here. (Do not include time you spend awake in bed. Remember to mark hours and minutes, even if minutes are

zero.)

_____hours _____ minutes

28. On school days, after you go to bed at night, about how long does it usually take you to fall asleep?

_____hours _____ minutes

<u>The next set of questions has to do with your usual schedule on days when you do not have school, such as the weekend</u>

29. What time do you <u>usually</u> go to bed on the weekends? List ONE time, not a range.

_____ ☐ A.M. ☐ P.M

30. What is the <u>main reason</u> you usually go to bed at this time on the weekends? (mark one)

☐ My parents have set my bedtime
☐ I feel sleepy
☐ I finish my homework
☐ My TV shows are over
☐ My brothers(s) or sisters(s) go to bed
☐ I finish socializing
☐ I get home from my job
☐ Other:

_____

31. What time do you <u>usually</u> wake up on weekends? List ONE time, not a range.

_____ ☐ A.M. ☐ P.M

32. What is the <u>main reason</u> you usually wake up at this time on weekends? (mark one)

☐ Noises or my pet wakes me up
☐ My alarm clock wakes me up
☐ My parents or other family members wake me up
☐ I need to go to the bathroom
☐ I don't know. I just wake up
☐ Other:

_____

33. Figure out how long you usually sleep on a night when you do <u>not</u> have school the next day (such as a weekend night) and fill it in here. (Do not include time you spend awake in bed. Remember to mark hours and minutes, even if minutes are zero.)

_____hours _____ minutes

34. On weekends, after you go to bed at night, about how long does it usually take you to fall asleep?

_____hours _____ minutes

35. Some people wake up during the night. Others never do. How

many times do you usually wake up at night?

- Never
- Once
- 2 or 3 times
- More than 3 times
- I have no idea

36. People sometimes feel sleepy during the daytime. During your daytime activities, how much of a problem do you have with sleepiness (feeling sleepy, struggling to stay awake)?

- No problem at all
- A little problem
- More than a little problem
- A big problem
- A very big problem

37. Some people take naps in the daytime every day, others never do. When do you nap? (Mark all that apply.)

- I never nap
- I sometimes nap on school days
- I sometimes nap on weekends.
- I never nap unless I am sick.

38. Can you figure out how much sleep you need? Fill out below how much sleep you think you would need each night to feel your best every day. (Remember to mark hours and minutes, even if minutes are zero)

_____ hours _____ minutes

39. In general, do you feel when you usually get up….

- Too much sleep?
- enough sleep?
- too little sleep?

40. Do you consider yourself to be…

- a good sleeper?
- a poor sleeper?

41. How often do you think that you get enough sleep?

- Always
- Usually
- Sometimes
- Rarely
- Never

Questions 42 to 45 are about things that have happened in the last 2 weeks.

42. During the last 2 weeks, have you struggled to stay awake (fought sleep) or fallen asleep in

the following situations? (Put the number that applies to you for <u>every</u> item)

1. Both struggled to stay awake and fallen asleep
2. Fallen asleep
3. Struggled to stay away
4. No

In a face-to-face conversation with another person

Travelling in a bus, train, plane, or car?

Attending a performance (movie, concert, play)?

Watching tv or listening to the radio or music?

Reading, studying, or doing homework?

During a test?

In a class at school?

While doing work on a computer?

Playing video games?

Driving a car?

Do you drive? Yes / No

43. During the last 2 weeks, how often did you? (Put the number that applies to you for <u>every</u> item.)

1. Every day
2. Several times every day
3. Once or twice a day
4. Never

Drink soda with caffeine (E.g., coke; pepsi; monster; score; dragon; redbull; not sprite)?

Drink coffee or tea with caffeine

44. In the last 2 weeks, how often have you? (Put the number that applies to you for <u>every</u> item.)

1. Never
2. Once
3. Twice
4. Several times
5. Everyday/night

felt satisfied with your sleep?

arrived late to class because you overslept?

fallen asleep in a morning class?

fallen asleep in an afternoon class?

awakened too early in the morning and could not get back to sleep

stayed up until at least 3 a.m?

stayed up all night?

felt tired, dragged out, or sleepy during the day?

done dangerous things without thinking?

had a good night's sleep?

needed more than 1 reminder to get up in the morning?

had an extremely hard time falling asleep?

had nightmares or bad dreams during the night?

gone to bed because you just could not stay awake any longer?

done dangerous things without thinking?

had a good night's sleep?

45. During the last 2 weeks, how often were you bothered or troubled by the following? (Put the number that applies to you for <u>every</u> item)

1. Much
2. Somewhat
3. Not at all

Feeling too tired to do things

Having trouble going to sleep or staying asleep

Feeling unhappy, sad, or depressed

Feeling hopeless about the future

Feeling nervous or tense

Worrying too much about things

Questions 46 - 55 have to do with how you might organize the timing of various activities if you were free to plan your day according to when you feel your best.

<u>Please answer the questions based on your body's "feeling best" times.</u>

46. Imagine: School is cancelled! You can get up whenever you want to: When would you get out of bed? Between:

05:00 and 06:30 a.m.

06:30 and 07:45 a.m.

07:45 and 09:45 a.m.

09:45 and 11:00 a.m.

11:00 a.m. and noon

47. Is it easy for you to get up in the morning?

No way!

Sort of

Pretty easy

Very easy

48. Physical Education (PE) is set for 7:00 in the morning. How do you think you'll do?

My best!

Okay

Worse than usual.

Awful!

49. The bad news: You have to take a 2hour test. The good news: You can take it when you think you'll do best.

What time is that?

- 08:00 to 10:00 a.m.
- 11:00 a.m. to 1:00 p.m.
- 3:00 p.m. to 5:00 p.m.
- 7:00 p.m. to 9:00 p.m.

50. When do you have the most energy to do your favourite things?

- Morning! I am tired in the evening.
- Morning more than evening
- Evening more than morning
- Evening! I am tired in the morning

51. Your parents or guardian has decided to let you set your own bedtime. What time would you pick? Between:

- 8:00 and 9:00 p.m.
- 9:00 and 10:15 p.m.
- 10:15 p.m. and 12:30 a.m.
- 12:30 and 1:45 a.m.
- 1:45 and 3:00 a.m.

52. How alert are you in the first half hour you're up?

- Out of it
- A little dazed
- Okay
- Ready to take on the world

53. When does your body start to tell you it's time for bed (even if you ignore it)? Between:

- 8:00 and 9:00 p.m.
- 9:00 and 10:15 p.m.
- 10:15 p.m. and 12:30 a.m.
- 12:30 and 1:45 a.m.
- 1:45 and 3:00 a.m.

54. Say you had to get up at 6:00 a.m. every morning: What would it be like?

- Awful!
- Not so great.
- Okay (If I have to).
- Fine, no problem!

55. When you wake up in the morning, how long does it take for you to be totally "with it"?

- 0 to 10 minutes
- 11 to 20 minutes
- 21 to 40 minutes
- More than 40 minutes

56. Would you say that your growth in height:

- Has not begun to spurt ("spurt" means faster growth than usual)
- Has barely started
- Is definitely underway
- Seems complete
- I don't know

57. Would you say that your other signs of physical maturation:

- Have not yet started to show
- Have barely started to show
- Are definitely underway
- Seem complete
- I don't know

58. During the last week, did you work at a job for pay? (If no, skip to number 59.)

- Yes
- No

What kind of job?

_____

How many days did you work at the following times?

In the morning before school……0 1 2 3 4 5
In the afternoon after school……..0 1 2 3 4 5
In the evening on days you have school..0 1 2 3 4 5
On the weekend……...0 1 2

How many hours did you work at your paying job this week?

During the school week: _____ hours

During the weekend: _____ hours

During the last 2 weeks, have you struggled to stay awake (fought sleep) or fallen asleep at your job?

- no
- struggled to stay awake
- fallen asleep
- both struggled to stay awake and fallen asleep

If you did not have your job, would you go to bed:

- earlier than you do.
- The same as you do.
- later than you do.

If you did not have your job, would you wake up:

- earlier than you do
- the same as you do
- later than you do.

59. During the last week, did you engage in organized sports or a regularly scheduled physical activity (If no, skip to number 60.)

- Yes
- No

What kind of sport?

_____

How many days did you practice at the following times?

In the morning before school…….
0 1 2 3 4 5
In the afternoon after school……..
0 1 2 3 4 5
In the evening on days you have school
0 1 2 3 4 5
On the weekend……0 1 2

How many hours did you practice <u>this week?</u>

During the school week: _____ hours

During the weekend: _____ hours

During the last 2 weeks, have you struggled to stay awake (fought sleep) or fallen asleep during practice?

- no struggled to stay awake
- fallen asleep
- both struggled to stay awake and fallen asleep

- Yes
- No

If you did not have your homework, would you go to bed

- earlier than you do
- the same as you do
- later than you do

If you did not have to study/do homework, would you wake up:

- earlier than you do
- the same as you do
- later than you do.

If you did not have your organized activity, would you go to bed:

- earlier than you do
- the same as you do
- later than you do.

If you did not have your organized activity, would you wake up:

- earlier than you do
- the same as you do
- later than you do.

60. During the last week, did you study/do homework? (If no, leave the rest of the questions unanswered)

How many days do you study/do homework at the following times?

In the morning before school
0 1 2 3 4 5
In the afternoon after school
`0 1 2 3 4 5
In the evening on days you have school
0 1 2 3 4 5
On the weekend…….
0 1 2

How many hours did you study/do homework <u>this</u> <u>week?</u>

During the school week: _____hours

During the weekend: _____hours

During the last 2 weeks, have you struggled to stay awake (fought sleep) or fallen asleep

during studying/homework?

- no
- fallen asleep
- both struggled to stay awake and fallen
- struggled to stay awake

8.4 Appendix D: Rhodes University Clearance Letter

RHODES UNIVERSITY
Where leaders learn

Rhodes University Human Ethics Committee
PO Box 94, Makhanda, 6140, South Africa
t: +27 (0) 46 603 7727
f: +27 (0) 46 603 8822
e: s.manqele@ru.ac.za
NHREC Registration number: RC-241114-045

https://www.ru.ac.za/researchgateway/ethics/

19/04/2021

Dr. Jonathan Davy

Human Kinetics and Ergonomics

Email: Jonathan.davy@ru.ac.za

Review Reference: 2021-2800-6017

Dear Dr. Jonathan Davy

Re: Characterising the sleep-wake behaviour of adolescents living in rural and township areas surrounding Alice in the Eastern Cape

Principal Investigator: Dr. Jonathan Davy

Collaborators: Miss Phelokazi Dlepu, Dr Swantje Zschernack,

This letter confirms that the above research proposal has been reviewed by the Rhodes University Human Ethics Committee (RU-HEC) and **PROVISIONALLY APPROVED PENDING PERMISSION/GATEKEEPER LETTER(S)**.

Gatekeeper permission is required from:

a) Department of Education, Eastern Cape

Once the Gatekeeper permission letter/s has been received please forward it to the Ethics Coordinator, (s.manqele@ru.ac.za) in order to finalize your ethics approval. Sincerely,

Prof. Arthur Webb

Chair: Rhodes University

Human Ethics Committee, RU-

HEC cc: Mr. Siyanda Manqele,

Ethics Coordinator

8.5 Appendix E: Department of Education Clearance Letter

Province of the
EASTERN CAPE
EDUCATION

CORPORATE PLANNING MONITORING POLICY AND RESEARCH COORDINATION
Steve Vukile Tshwete Complex • Zone 6 • Zwelitsha • Eastern Cape
Private Bag X0032 • Bhisho • 5605 • REPUBLIC OF SOUTH AFRICA
Tel: +27 (0)40 608 4537/4773 • Fax: +27 (0)86 579 7182 • Website: www.ecdoe.gov.za

Enquiries: F. Pakade Email: fundiswa.pakade@ecdoe.gov.za Date: 28 May 2021

Ms. Phelokazi Dlepu

4844 Golf Course

Alice

5700

Dear Ms. Dlepu

PERMISSION TO UNDERTAKE A MASTERS RESEARCH: CHARACTERISING THE SLEEP WAKE BEHAVIOUR OF ADOLESCENTS LIVING IN RURAL AND TOWNSHIP AREAS SURROUNDING ALICE IN THE EASTERN CAPE

1. Your application to conduct the above-mentioned research involving grade 12 adolescents in 4 (four) rural and township public high schools in Amathole West district under the jurisdiction of the Eastern Cape Department of Education (ECDoE) is hereby approved based on the following conditions:

   a. there will be no financial implications for the Department;

   b. institutions and respondents must not be identifiable in any way from the results of the investigation;

   c. no minors will participate;

   d. it is not going to interrupt educators' time and task;

   e. the research may not be conducted during official contact time;

   f. no physical contact with educators and learners, only virtual means of communication should be used and that should be arranged and agreed upon in writing with the Principal and the affected teacher/s;

   g. you present a copy of the written approval letter of the Eastern Cape Department of Education (ECDoE) to the Cluster and District Directors before any research is undertaken at any institutions within that particular district;

h. you will make all the arrangements concerning your research;

i. should you wish to extend the period of research after approval has been granted, an application to do this must be directed to Chief Director: Corporate Strategy Management;

j. you present the Department with a copy of your final paper/report/dissertation/thesis free of charge in hard copy and electronic format. This must be accompanied by a separate synopsis (maximum 2 – 3 typed pages) of the most important findings and recommendations if it does not already contain a synopsis;

k. you present the findings to the Research Committee and/or Senior Management of the Department when and/or where necessary;

l. you are requested to provide the above to the Chief Director: Corporate Strategy Management upon completion of your research;

m. you comply with all the requirements as completed in the Terms and Conditions to conduct Research in the ECDoE document duly completed by you;

n. you comply with your ethical undertaking (commitment form);

o. You submit on a six-monthly basis, from the date of permission of the research, concise reports to the Chief Director: Corporate Strategy Management.

2. The Department reserves a right to withdraw the permission should there be non-compliance to the approval letter and contract signed in the Terms and Conditions to conduct Research in the ECDoE and/or legal requirements to do so.

3. The Department will publish the completed Research on its website.

4. The Department wishes you well in your undertaking. You can contact Mrs Fundiswa Pakade on the numbers indicated in the letterhead or email fundiswa.pakade@ecdoe.gov.za should you need any assistance.

T MASOEU
CHIEF DIRECTOR: CORPORATE STRATEGY MANAGEMENT

FOR SUPERINTENDENT-GENERAL: EDUCATION

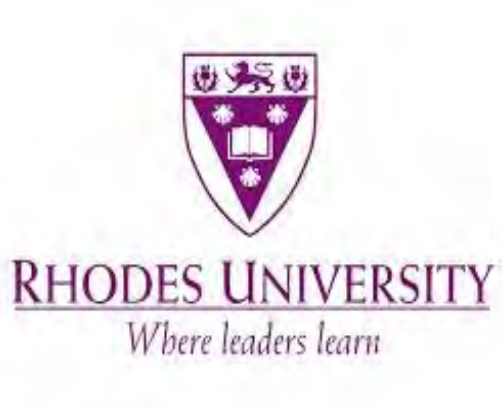
8.6 Appendix F: Letter of invitation to principals

Department of Human Kinetics & Ergonomics

Tel: (046) 603 8471

Fax: (046) 603 8934

E-mail: J.mcdougall@ru.ac.za



Letter of invitation for learners participate in a research study on adolescents' sleep patterns

Research Title: Characterising the sleep wake behaviour of adolescents living in rural and township areas in Alice, Eastern Cape.

Researcher: Phelokazi Dlepu

Supervisors: Dr Jonathan Davy & Dr Swantje Zschernack

Dear Principal

My name is Phelokazi Dlepu, I live in Alice, and I am a master's student in the Human Kinetics & Ergonomics department at Rhodes University. I am conducting a research study that seeks to understand and characterise the sleep-wake behaviour of a sample of Grade 12 adolescents in rural and township public high schools in Alice, Eastern Cape.

I would like to extend an invitation to the Grade 12 learners of your school to kindly participate in the study. The ethical clearance for this study has been granted by the Rhodes University Ethical Review Committee and the Department of Basic Education in Zwelitsha has also granted permission to approach your school (letters of approval are attached). The main aim of this study is to extensively characterise the sleep of adolescents from the areas mentioned above in Alice.

Background:

There is a growing and worrying trend emerging in that adolescents have been identified as a population that is at more risk for chronic sleep loss. This is especially true for Grade 12 learners because they are faced with increased academic, social and other pressures. The sleep-wake behaviour of adolescents in global north and urban areas has been extensively researched, but there little to nothing in literature on the sleep-wake behaviour of adolescents from rural areas, particularly in a South African context. The everyday life of adolescents in rural and township areas along with the challenges they face from their schools has been highlighted in literature. Challenges such as commuting to school, unstable home environment and violent neighbourhood which may affect their sleep. Therefore, this has shown a need for the sleepwake behaviour of adolescents in these areas to be characterised and understood, to contribute to the gap in the literature.

The study:

The study is a cross-sectional study that will employ the use of a School Sleep Habits Survey (SSHS) which will be administered to public high school Grade 12 learners in rural and townships areas preferably at a time when there are no scheduled examinations. The School Sleep Habits Survey (SSHS) will gather information regarding sleep/wake patterns over the past two weeks. The questionnaire will include questions that are related to demographic information such as age, sex, height, weight, grade, race, school performance, as well as scales to assess daytime sleepiness, sleep-wake behaviour problems, depressive mood and chronotype i.e., self-assessed preferred time of day for activities.

Risks associated with the study:

Asking learners questions about their sleep patterns may put them at the psychological risk of experiencing negative affective states such as anxiety and worry about their sleeping habits, which may also have an impact on their sleep. It is important to note that the effects of the above-mentioned risk are relatively minor and expected to subside over a relatively short period of time.

Management of risks associated with the study:

- Mask wearing, social distancing, and frequent sanitizing will be done to ensure that participants are not put at risk for contracting COVID-19.
- Furthermore, the risk of learners feeling pressured into participating in the classroom may arise but will be curbed by emphasizing that participation in the study is completely voluntary and that no one is forced to participate in the study**.**

Benefits associated with the study:

Grade 12 learners participating in the research will be crucial in bridging the gap in literature regarding adolescent sleep patterns in the South African context. If we understand the problems that are faced by adolescents and especially those of Grade 12s then future research or studies can work at finding suitable intervention methods if need be. This study will also increase awareness on adolescents' sleep habits and may motivate thoughts on improving their sleep.

All learners willing to participate in the study will be asked to take home a letter of consent to their parents for the study if they are under the age of 18 years. The letter to the parents will explain the research study and it will ask parents to grant permission that their child fill in the survey.

The research is for academic purposes only and information will be kept private and confidential. Participation in this research is completely voluntary; learners may choose to withdraw from the research at any time or not answer questions that they do not feel comfortable answering. Please also note that coded (anonymous) data will be archived by the Human Kinetics and Ergonomics at Rhodes University in computer format after the project and may be subject to future use for academic purposes.

Should you be interested in your Grade 12 learners taking part in the study please indicate on the statement below;

Statement of Consent

I _____ the principal of the _____ high school

have read the above information. I am positive I fully understand the study well enough to make a decision about the involvement of my learners in the study at my appointed school. By signing below, on the _____ day of _____ 2021, I consent to understanding and agreeing to the terms described above and give permission for my learners to participate in the research study by Phelokazi Dlepu in the department of Human Kinetics and Ergonomics of Rhodes University.

Signature:_____

Stamp:

If you have questions now or at a later time, please use the contacts below;

Contacts

Phelokazi Dlepu

0764551538

G19d7743@campus.ru.ac.za

You may also contact the researcher's supervisors:

Dr. Jonathan Davy

(046)-603-7369

Jonathan.Davy@ru.ac.za

Dr Swantje Zschernack

(046)-603-8472

s.zschernack@ru.ac.za

You may also contact the Rhodes Ethics Coordinator

Mr Siyanda Manqele

Tel: (046) 603 7727

Fax: (046) 603 8822

E-mail: s.manqele (a) ru.ac.za

Thank you for your time and participation.

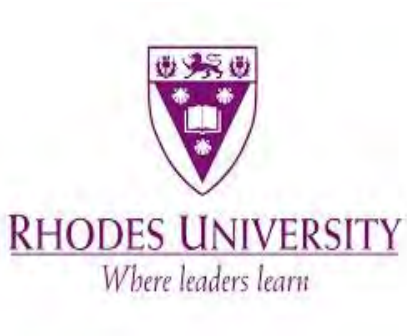
8.7 Appendix G: Letter of invitation to parents

Department of Human Kinetics & Ergonomics

Tel: (046) 603 8471

Fax: (046) 603 8934

E-mail: J.mcdougall@ru.ac.za



Letter of invitation for learners in Alice to participate in a research study on adolescents sleep patterns.

Research Title: Characterising the sleep wake behaviour of adolescents living in rural and township areas in Alice, Eastern Cape.

Researcher: Phelokazi Dlepu

Supervisors: Dr Jonathan Davy & Dr Swantje Zschernack

Dear parents/guardians

My name is Phelokazi Dlepu, I live in Alice and I am a master's student in the Human Kinetics & Ergonomics department at Rhodes University. I am conducting a research study that seeks to understand and characterise the sleep-wake behaviour of a sample of Grade 12 adolescents in rural and township public high schools in Alice, Eastern Cape.

I would like to request your permission for your child to kindly participate in this research study. Please note that the ethical clearance for this study has been granted by the Rhodes University Ethical Review Committee and that permission has been granted by the Department of Education in the Eastern Cape. The main aim of this study is to extensively characterise the sleep of adolescents from the areas mentioned above in Alice.

Background:

There is a growing and worrying trend emerging in that adolescents have been identified as a population that is at more risk for chronic sleep loss. This is especially true for Grade 12 learners because they are faced with increased academic, social and other pressures. The sleep-wake behaviour of adolescents in global north and urban areas has been extensively researched, but there little to nothing in literature on the sleep-wake behaviour of adolescents from rural areas, particularly in a South African context. The everyday life of adolescents in rural and township areas along with the challenges they face from their schools has been highlighted in literature. Challenges such as commuting to school, unstable home environment and violent neighbourhood which may affect their sleep. Therefore, this has shown a need for the sleepwake behaviour of adolescents in these areas to be characterised and understood, to contribute to the gap in the literature.

The study:

The study is a cross-sectional study that will employ the use of a School Sleep Habits Survey (SSHS) which will be administered to public high school Grade 12 learners in rural and townships areas preferably at a time when there are no scheduled examinations. The School Sleep Habits Survey (SSHS) will gather information regarding sleep/wake patterns over the past two weeks. The questionnaire will include questions that are related to demographic information such as age, sex, height, weight, grade, race, school performance, as well as scales to assess daytime sleepiness, sleep-wake behaviour problems, depressive mood and chronotype i.e. self-assessed preferred time of day for activities.

Risks associated with the study:

Asking your child questions about their sleep patterns may put them at the psychological risk of experiencing negative affective states such as anxiety and worry about their sleeping habits, which may also have an impact on their sleep. It is important to note that the effects of the above-mentioned risk are relatively minor and expected to subside over a relatively short period of time.

Management of risks associated with the study:

- Mask wearing, social distancing, and frequent sanitizing will be done to ensure that participants are not put at risk for contracting COVID-19.

- Furthermore, the risk of learners feeling pressured into participating in the classroom may arise but will be curbed by emphasizing that participation in the study is completely voluntary and that no one is forced to participate in the study.

Benefits associated with the study:

Your child's participation in the research will be crucial in bridging the gap in literature regarding adolescent sleep patterns in the South African context. If we understand the problems that are faced by teenagers and especially those of Grade 12s then future research or studies can work at finding suitable intervention methods if need be. This study will also increase awareness on adolescents' sleep habits and may motivate thoughts on improving their sleep.

The research is for academic purposes only and information will be kept private and confidential. Participation in this research is completely voluntary; your child may choose to withdraw from the research at any time or not answer questions that they do not feel comfortable answering. Please also note that coded (anonymous) data will be archived by the Human Kinetics and Ergonomics at Rhodes University in computer format after the project and may be subject to future use for academic purposes.

If you are interested in having your child involved in the research study, please consent below, cut the statement, and give it to your child to return to the researcher.

Statement of consent

I have read the above information. I feel I understand the study well enough to decide about the voluntary and anonymous involvement of my child. I consent to understanding and agreeing to the terms described above. I consent to the use of my child's data for study purposes.

I_____ hereby give permission for my child _____to fill in the surveys and to voluntarily participate in the study.

Signed:_____

If there are any questions, you may contact the researcher;

Phelokazi Dlepu

0764551538

G19d7743@campus.ru.ac.za

You may also contact the researcher's supervisors:

Dr. Jonathan Davy and Dr Swantje Zschernack

(046)-603-7369 & (046)-603-8472

Jonathan.Davy@ru.ac.za & S.zschernack@ru.ac.za

You may also contact the Rhodes Ethics Coordinator

Mr Siyanda Manqele

Tel: (046) 603 7727

Fax: (046) 603 8822

E-mail: s.manqele (a) ru.ac.za

Thank you for your time.

8.8 Appendix H: Letter of invitation to learners

Department of Human Kinetics & Ergonomics

Tel: (046) 603 8471

Fax: (046) 603 8934

E-mail: J.mcdougall@ru.ac.za

RHODES UNIVERSITY
Where leaders learn

Letter of invitation to learners in high schools to participate in a research study on adolescents' sleep patterns.

Research Title: Characterising the sleep-wake behaviour of adolescents living in rural and township areas in Alice, Eastern Cape.

Researcher: Phelokazi Dlepu

Supervisors: Dr Jonathan Davy & Dr Swantje Zschernack

Dear Grade 12 learner

My name is Phelokazi Dlepu, I live in Alice, and I am a master's student in the Human Kinetics & Ergonomics department at Rhodes University. I am conducting a research study that seeks to understand and characterise the sleep-wake behaviour of a sample of Grade 12 adolescents in rural and township public high schools in Alice, Eastern Cape.

I would like to extend an invitation to you as a Grade 12 learners in public high schools located in rural and township areas around the area of Alice to kindly participate in the study. Please note that the ethical clearance for this study has been granted by the Rhodes University Ethical Review Committee and that permission has been granted by the Department of Education in the Eastern Cape. The main aim of this study is to extensively characterise the sleep of adolescents from the areas mentioned above in Alice.

Background:

There is a growing and worrying trend emerging in that adolescent have been identified as a population that is at more risk for chronic sleep loss. This is especially true for Grade 12 learners because they are faced with increased academic, social, and other pressures. The sleep-wake behaviour of adolescents in global north and urban areas has been extensively researched, but there little to nothing in literature on the sleep-wake behaviour of adolescents from rural areas, particularly in a South African context. The everyday life of adolescents in rural and township areas along with the challenges they face from their schools has been highlighted in literature. Challenges such as commuting to school, unstable home environment and violent neighbourhood which may

affect their sleep. Therefore, this has shown a need for the sleepwake behaviour of adolescents in these areas to be characterised and understood, to contribute to the gap in the literature.

The study:

The study is a cross-sectional study that will employ the use of a School Sleep Habits Survey (SSHS) which will be administered to public high school Grade 12 learners in rural and townships areas preferably at a time when there are no scheduled examinations. The School Sleep Habits Survey (SSHS) will gather information regarding sleep/wake patterns over the past two weeks. The questionnaire will include questions that are related to demographic information such as age, sex, height, weight, grade, race, school performance, as well as scales to assess daytime sleepiness, sleep-wake behaviour problems, depressive mood and chronotype i.e. self-assessed preferred time of day for activities.

Risks associated with the study:

The questions about your sleep patterns may put you at the psychological risk of experiencing negative affective states such as anxiety and worrying about your sleeping habits, which may also have an impact on their sleep. It is important to note that the effects of the above-mentioned risk are relatively minor and expected to subside over a relatively short period of time.

Management of risks associated with the study:

- Mask wearing, social distancing, and frequent sanitizing will be done to ensure that participants are not put at risk for contracting COVID-19.
- Furthermore, the risk of learners feeling pressured into participating in the classroom may arise but will be curbed by emphasizing that participation in the study is completely voluntary and that no one is forced to participate in the study.

Benefits associated with the study:

Your participation in the research will be crucial in bridging the gap in literature regarding adolescent sleep patterns in the South African context. If we understand the problems, if there are any, that are faced by youngsters like yourself and especially those of Grade 12s then future research or studies can work at finding suitable intervention methods if need be. This study will also increase your awareness on sleep habits and may motivate thoughts on improving your sleep.

The research is for academic purposes only and information will be kept private and confidential. Your participation in this research is completely voluntary; you may choose to withdraw from the research at any time or not answer questions that you do not feel comfortable answering. Please also note that coded (anonymous) data will be archived by the Human Kinetics and Ergonomics at Rhodes University in computer format after the project and may be subject to future use for academic purposes.

Your participation in the research will be crucial in bridging the gap in literature regarding adolescent sleep patterns in the South African context. If we understand the problems that are faced by teenagers your age, and especially those of Grade 12s like yourself then future research or studies can work at finding suitable intervention methods if need be.

If you are willing to participate in the study, please sign the declaration below. Upon completion, please tear it off and return to the researcher.

Statement of Consent

I _____ have read the above information. I am positive I fully understand the study well enough to decide about my involvement in the study at my appointed school. By signing below, on the _____ day of _____ 2021, I consent to understanding and agreeing to the terms described above and give permission to participate in the research study by Phelokazi Dlepu in the department of Human Kinetics and Ergonomics of Rhodes University.

Signed:_____

8.9 Appendix I: Data analysis: Statistica

Median time reported for leaving to school for sex and type of learner differences

variable	Mann-Whitney U Test (w/ continuity correction) (Copy of Clean data set_JD 1 Oct 2021) By variable School Marked tests are significant at p <,05000									
	Rank Sum Group 1	Rank Sum Group 2	U	Z	p-value	Z adjusted	p-value	Valid N Group 1	Valid N Group 2	2*1sided exact p
reported time for leaving home decimals equivalent	4763,500	1791,500	847,5000	-1,99897	0,045613	-2,03292	0,042061	88	26	0,044789

Means of getting to school for rural and township

variable	Mann-Whitney U Test (w/ continuity correction) (Copy of Clean data set_JD 1 Oct 2021) By variable Means of getting to school Marked tests are significant at p <,05000									
	Rank Sum Group 1	Rank Sum Group 2	U	Z	p-value	Z adjusted	p-value	Valid N Group 1	Valid N Group 2	2*1sided exact p
School	951,0000	84,00000	48,00000	-0,659773	0,509400	-0,916020	0,359657	42	3	0,529246
Grouping	975,0000	60,00000	54,00000	0,386763	0,698932	0,656723	0,511360	42	3	0,714870
Sex	991,5000	43,50000	37,50000	1,137539	0,255314	1,448653	0,147435	42	3	0,259479

Reported times for weekdays and weekends

Variable	Descriptive Statistics (Copy of Clean data set_JD 1 Oct 2021)			
	Valid N	Median	Lower Quartile	Upper Quartile
Weekday bed-time decimals equiv	115	9,50000	9,000000	10,50000
Weekday wake-time decimals equiv	115	5,50000	5,000000	6,00000
Weekday time spent in bed	111	8,00000	7,000000	9,00000
Average week day sleep duration with fixed times included	91	7,00000	6,000000	8,00000
Weekend bed time	112	10,25000	9,000000	11,50000
Weekend wake time	112	5,50000	5,000000	6,50000
weekend time spent in bed	108	7,50000	6,205000	8,50000
Average weekend day sleep duration with fixed times included	70	7,00000	5,500000	8,50000
Perceived sleep need	80	8,23000	8,000000	10,00000

Reported differences in weekday and weekend bedtimes

Pair of Variables	Wilcoxon Matched Pairs Test (Copy of Clean data set_JD 1 Oct 2021) Marked tests are significant at p <,05000			
	Valid N	T	Z	p-value
Weekday bed-time decimals equiv & Weekend bed time	88	1053,500	3,763494	0,000168

Reported differences in weekday and weekend risetimes

Pair of Variables	Sign Test (Copy of Clean data set_JD 1 Oct 2021) Marked tests are significant at p <,05000			
	No. of Non-ties	Percent v < V	Z	p-value
Weekday wake-time decimals equiv & Weekend wake time	76	60,52632	1,720618	0,085320

Reported differences in weekday and weekend sleep duration

Pair of Variables	Wilcoxon Matched Pairs Test (Copy of Clean data set_JD 1 Oct 2021) Marked tests are significant at p <,05000 Valid N	T	Z	p-value
Average week day sleep duration with fixed times included & Average weekend day sleep duration with fixed times included	59	809,5000	0,569872	0,568765

Reported differences in weekday and weekend time spent in bed

Pair of Variables	Wilcoxon Matched Pairs Test (Copy of Clean data set_JD 1 Oct 2021) Marked tests are significant at p <,05000 Valid N	T	Z	p-value
Weekday time spent in bed & weekend time spent in bed	93	1967,500	0,835287	0,403557

Differences between perceived sleep need and sleep duration on weekdays and weekends

Pair of Variables	Wilcoxon Matched Pairs Test (Copy of Clean data set_JD 1 Oct 2021) Marked tests are significant at p <,05000 Valid N	T	Z	p-value
Average weekend day sleep duration with fixed times included & Perceived sleep need	57	257,5000	4,520823	0,000006
Average week day sleep duration with fixed times included & Perceived sleep need	61	160,5000	5,638479	0,000000

Comparison of sleep variables during the weekend and weekdays for rural and township scholars.

Rural descriptive

Variable	Descriptive Statistics (Copy of Clean data set_JD 1 Oct 2021) Valid N	Median	Minimum	Maximum	Lower Quartile	Upper Quartile
Average weekday sleep duration (hours)	23	7,00000	1,000000	9,00000	5,500000	8,00000
Average weekend sleep duration (hours)	16	6,28000	0,500000	9,50000	4,650000	7,87500
weekend time spent in bed	23	8,00000	3,000000	11,00000	6,060000	8,50000
weekend wake time decimals equivalent	25	6,00000	4,500000	11,00000	5,500000	6,00000
weekend bedtime decimals equivalent	23	10,00000	8,000000	15,00000	9,000000	11,83000
Weekday time spent in bed	22	8,00000	5,000000	10,50000	7,000000	8,50000
Weekday wake-time	23	5,50000	4,500000	6,50000	5,000000	6,00000
Weekday bed-time	27	9,50000	7,000000	12,00000	9,000000	11,00000

Township descriptive

Variable	Descriptive Statistics (Copy of Clean data set_JD 1 Oct 2021) Valid N	Median	Lower Quartile	Upper Quartile
Weekday bed-time	88	9,50000	9,000000	10,00000
Weekday wake-time	92	5,50000	5,000000	6,00000
Average weekday sleep duration (hours)	73	7,50000	6,000000	8,00000
Weekday time spent in bed	85	8,00000	7,000000	8,50000
weekend bedtime decimals equivalent	89	10,50000	9,500000	11,50000
weekend wake time	87	5,50000	5,000000	6,50000
average weekend sleep duration (hours)	70	7,00000	5,500000	8,50000
weekend time spent in bed	83	7,00000	6,000000	8,50000

Rural and township comparison

Mann-Whitney U Test (w/ continuity correction) (Copy of Clean data set_JD 1 Oct 2021)
By variable School
Marked tests are significant at p <,05000

variable	Rank Sum Group 1	Rank Sum Group 2	U	Z	p-value	Z adjusted	p-value	Valid N Group 1	Valid N Group 2	2*1sided exact p
Weekday bed-time decimals equiv	5105,500	1564,500	1186,500	0,00660	0,994735	0,00672	0,994637	88	27	0,992150
Weekday wake-time decimals equiv	5232,000	1438,000	954,000	-0,72368	0,469265	-0,74695	0,455095	92	23	0,471804
Weekday time spent in bed	4803,500	1412,500	887,500	-0,90219	0,366957	-0,90823	0,363756	88	23	0,367456
Average week day sleep duration with fixed times included	3137,000	1049,000	581,000	-1,23156	0,218114	-1,24373	0,213601	71	20	0,219971
Weekend bed time	5077,000	1251,000	975,000	0,34573	0,729548	0,34905	0,727052	89	23	0,731272
Weekend wake time	4823,000	1505,000	995,000	-0,64285	0,520322	-0,65616	0,511720	87	25	0,522639
weekend time spent in bed	4633,000	1253,000	977,000	0,00000	1,000000	0,00000	1,000000	85	23	1,000000
Average weekend day sleep duration with fixed times included	2117,500	367,500	289,500	0,90383	0,366088	0,90586	0,365008	58	12	0,366580

Type of learner differences in the main reasons given for weekday bedtimes

Statistic	Statistics: School(2) x Main reason reported for bedtime on school days(6) (Copy of Clean data set_JD 1 Oct 2021) Chi-square	df	p
Pearson Chi-square	2,173071	df=5	p=,82472
M-L Chi-square	2,755371	df=5	p=,73764

Type of learner differences in the main reasons given for weekend bedtimes

Statistic	Statistics: School(2) x Main reason reported for weekend bed-time(8) (Copy of Clean data set_JD 1 Oct 2021) Chi-square	df	p
Pearson Chi-square	5,490581	df=7	p=,60032
M-L Chi-square	7,029028	df=7	p=,42586

Type of learner differences in the main reasons given for weekday risetimes

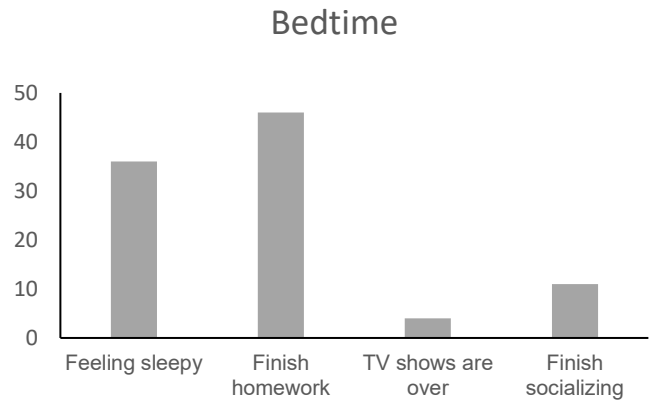
Statistic	Statistics: School(2) x Main reason reported for wake-time on school days(6) (Copy of Clean data set_JD 1 Oct 2021) Chi-square	df	p
Pearson Chi-square	3,733724	df=5	p=,58835
M-L Chi-square	3,963773	df=5	p=,55464

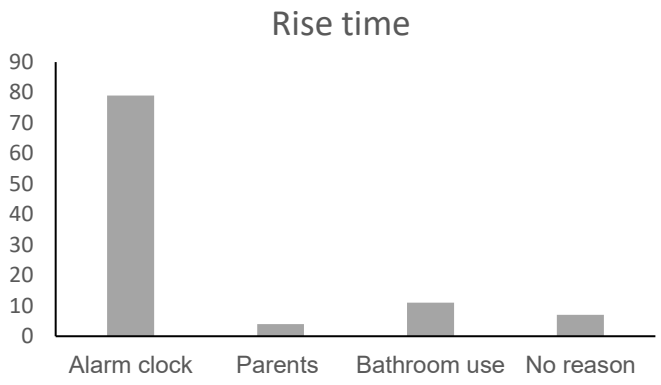
Type of learner differences in the main reasons given for weekend risetimes

Statistic	Statistics: School(2) x Main reason reported for weekend wake-time(6) (Copy of Clean data set_JD 1 Oct 2021) Chi-square	df	p
Pearson Chi-square	11,83902	df=5	p=,03706
M-L Chi-square	13,41596	df=5	p=,01978

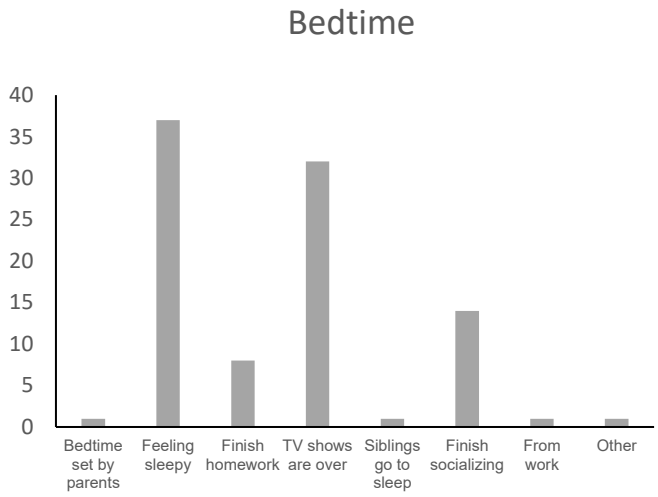
Reported reasons for bed and rise time for type of learner on weekdays

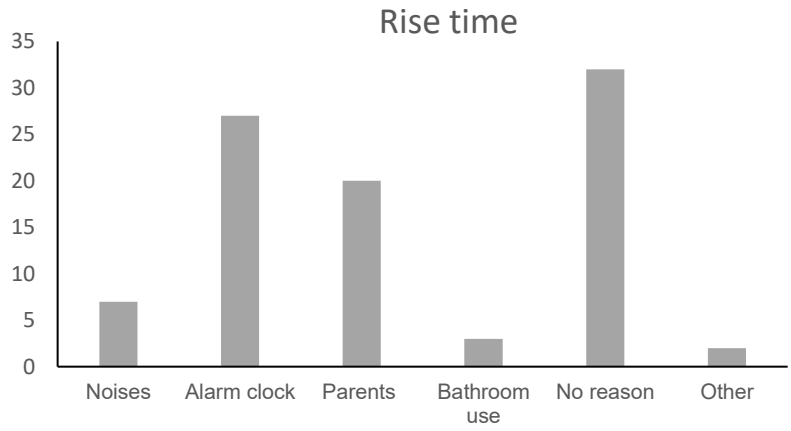
RURAL





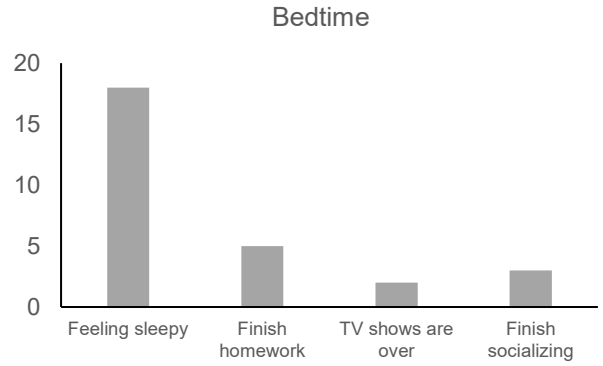
TOWNSHIP

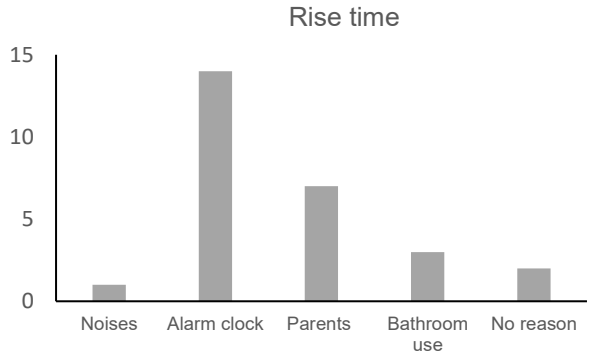




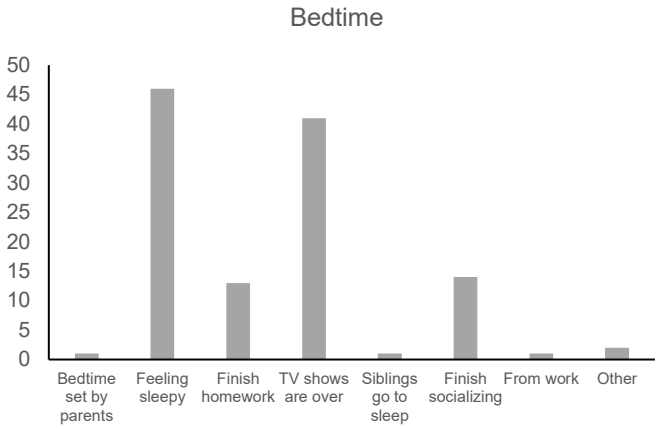
Reported reasons for bed and rise time for type of learner on weekends

RURAL





TOWNSHIP



Comparison of sleep variables during the weekend and weekdays for age group

Adolescents descriptive times

Variable	Descriptive Statistics (Copy of Clean data set_JD 1 Oct 2021)			
	Valid N	Median	Lower Quartile	Upper Quartile
Weekday bed-time decimals equiv	94	9,50000	9,00000	10,50000
Weekday wake-time decimals equiv	99	5,50000	5,00000	6,00000
Average weekday sleep duration (hours)	79	7,00000	6,00000	8,00000
weekday time spent in bed	92	8,00000	7,00000	8,50000
weekend bed time	92	10,75000	10,00000	11,79000
weekend wake time	92	5,50000	5,00000	6,50000
Average weekend sleep duration (hours)	68	7,00000	5,50000	8,50000
weekend time spent in bed	86	7,25000	6,00000	8,50000

Non-adolescents' descriptive times

Variable	Descriptive Statistics (Copy of Clean data set_JD 1 Oct 2021)			
	Valid N	Median	Lower Quartile	Upper Quartile
Weekday bed-time decimals equiv	21	9,50000	8,500000	10,00000
Weekday wake-time decimals equiv	16	5,50000	5,000000	6,00000
Average weekday sleep duration (hours)	19	7,50000	6,000000	9,00000
weekday time spent in bed	15	8,00000	7,500000	9,00000
weekend bed time	20	10,00000	8,500000	10,50000
weekend wake time	20	5,50000	5,000000	6,00000
Average weekend sleep duration (hours)	16	6,25000	3,800000	8,00000
weekend time spent in bed	19	7,00000	7,000000	9,50000

Comparison of sleep variables during the weekend and weekdays for age group

variable	Mann-Whitney U Test (w/ continuity correction) (Copy of Clean data set_JD 1 Oct 2021) By variable Grouping Marked tests are significant at p <,05000									
	Rank Sum Group 1	Rank Sum Group 2	U	Z	p-value	Z adjusted	p-value	Valid N Group 1	Valid N Group 2	2*1sided exact p
Weekday bed-time decimals equiv	5550,500	1119,500	888,5000	0,70944	0,478054	0,72263	0,469907	94	21	0,478566
Weekday wake-time decimals equiv	5752,500	917,500	781,5000	0,08081	0,935590	0,08341	0,933524	99	16	0,933026
Weekday time spent in bed	5321,500	894,500	758,5000	0,00840	0,993301	0,00845	0,993256	95	16	0,990049
Average week day sleep duration with fixed times include	3194,500	991,500	419,5000	-2,12815	0,033325	-2,14918	0,031621	74	17	0,032034
Weekend bed time	5509,500	818,500	608,5000	2,36267	0,018144	2,38537	0,017062	92	20	0,017152
Weekend wake time	5340,500	987,500	777,5000	1,07877	0,280689	1,10111	0,270848	92	20	0,281326
weekend time spent in bed	4804,500	1081,500	799,5000	-0,36713	0,713524	-0,36842	0,712558	89	19	0,712693
Average weekend day sleep duration with fixed times inclu	2080,000	405,000	327,0000	0,31946	0,749381	0,32018	0,748835	58	12	0,752440

Age group differences in the main reasons given for weekday bedtimes

Statistic	Statistics: Grouping(2) x Main reason reported for bedtime on school days(6) (Copy of Clean data set_JD 1 Oct 2021)		
	Chi-square	df	p
Pearson Chi-square	3,890185	df=5	p=,56533
M-L Chi-square	4,783849	df=5	p=,44283

Age group in the main reasons given for weekend bedtimes

Statistic	Statistics: Grouping(2) x Main reason reported for weekend bed-time(8) (Copy of Clean data set_JD 1 Oct 2021)		
	Chi-square	df	p
Pearson Chi-square	11,84871	df=7	p=,10565
M-L Chi-square	9,786577	df=7	p=,20099

Age group in the main reasons given for weekday risetimes

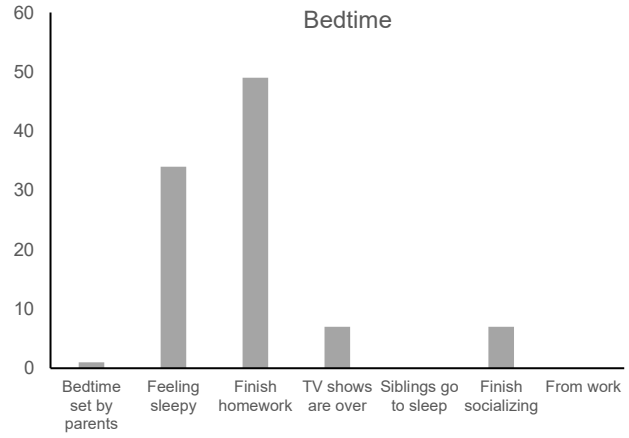
Statistic	Statistics: Grouping(2) x Main reason reported for wake-time on school days(6) (Copy of Clean data set_JD 1 Oct 2021)		
	Chi-square	df	p
Pearson Chi-square	5,495495	df=5	p=,35844
M-L Chi-square	4,618151	df=5	p=,46423

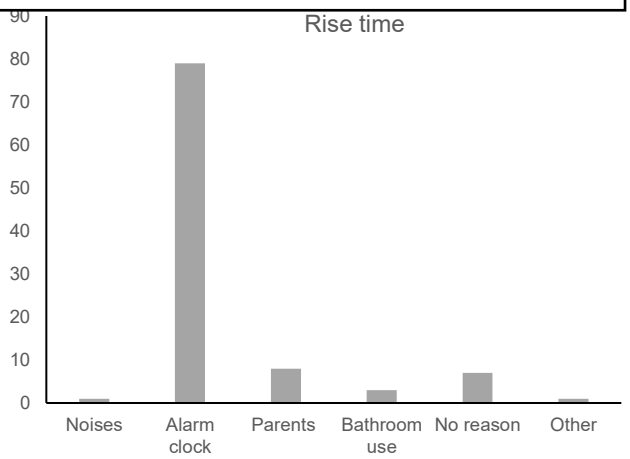
Age group in the main reasons given for weekend risetimes

Statistic	Statistics: Grouping(2) x Main reason reported for weekend wake-time(6) (Copy of Clean data set_JD 1 Oct 2021)		
	Chi-square	df	p
Pearson Chi-square	4,484753	df=5	p=,48193
M-L Chi-square	4,784145	df=5	p=,44279

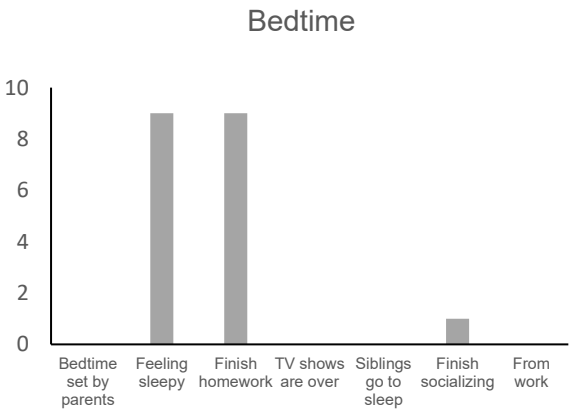
Reported reasons for bed and rise time for age group on weekdays

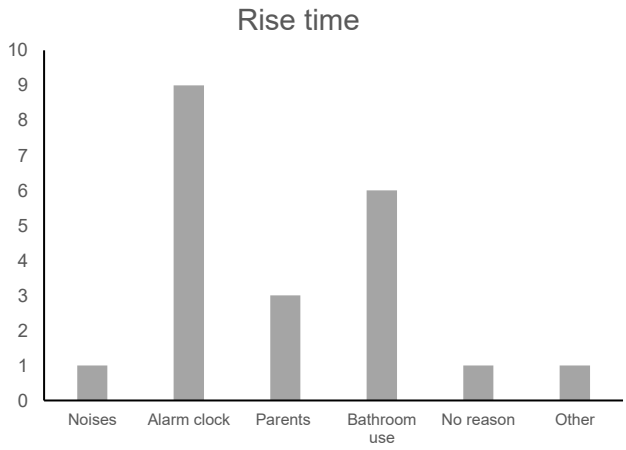
ADOLESCENTS





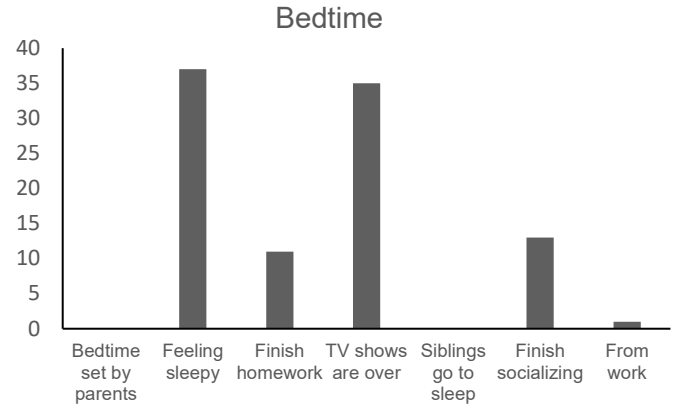
NON-ADOLESCENTS

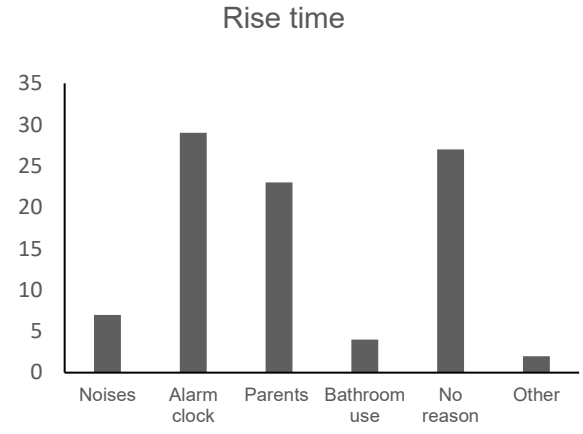




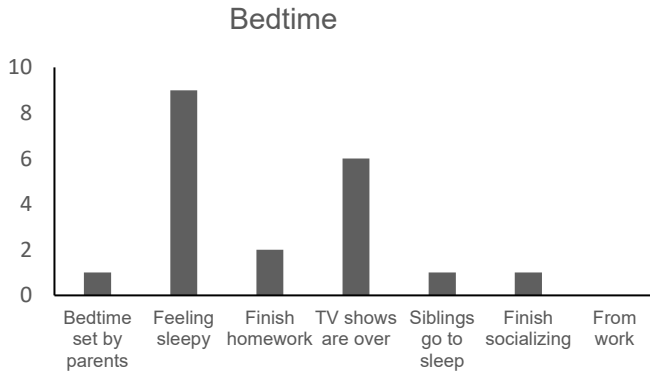
Reported reasons for bed and rise time for age group on weekends

ADOLESCENTS





NON-ADOLESCENTS



Comparisons between gender for sleep variables

Females descriptive times

Variable	Descriptive Statistics (Copy of Clean data set_JD 1 Oct 2021) Valid N	Median	Lower Quartile	Upper Quartile
weekend bed time	68	10,00000	9,000000	11,00000
weekend rise time	67	5,50000	5,000000	6,50000
Num - Cont- Average weekend sleep duration (hours)	48	7,00000	5,500000	8,75000
weeekend time spent in bed	61	7,00000	6,500000	8,50000
Num - Cont Weekday wake-time decimals equiv	71	5,50000	5,000000	6,00000
Num - Cont Weekday bed-time decimals equiv	69	9,50000	9,000000	10,00000
Num - Cont -Average weekday sleep duration (hours)	56	7,00000	6,000000	8,00000
weekday time spent in bed	66	8,00000	7,500000	9,00000

Males descriptive times

Variable	Descriptive Statistics (Copy of Clean data set_JD 1 Oct 2021) Valid N	Median	Lower Quartile	Upper Quartile
Num - Cont Weekday bed-time decimals equiv	46	9,50000	9,000000	11,00000
Num - Cont Weekday wake-time decimals equiv	44	5,50000	5,000000	5,80000
Num - Cont -Average weekday sleep duration (hours)	39	7,50000	6,000000	8,00000
weekday time spent in bed	41	8,00000	7,000000	8,50000
weekend bed time	44	10,62500	9,455000	12,00000
weekend rise time	45	5,50000	5,000000	6,50000
weekend time spent in bed	41	7,00000	6,160000	8,00000
Num - Cont- Average weekend sleep duration (hours)	35	6,50000	5,000000	8,00000

Comparison between gender and sleep variables

variable	Mann-Whitney U Test (w/ continuity correction) (Copy of Clean data set_JD 1 Oct 2021) By variable Sex Marked tests are significant at p <,05000 Rank Sum Group 1	Rank Sum Group 2	U	Z	p-value	Z adjusted	p-value	Valid N Group 1	Valid N Group 2	2*1sided exact p
Weekday bed-time decimals equiv	3995,000	2675,000	1580,000	-0,037108	0,970399	-0,037798	0,969848	69	46	0,970521
Weekday wake-time decimals equiv	4306,000	2364,000	1374,000	1,078965	0,280604	1,113663	0,265424	71	44	0,281860
Weekday time spent in bed	3681,000	2535,000	1335,000	-0,765744	0,443829	-0,770873	0,440783	68	43	0,445435
Average week day sleep duration with fixed times included	2437,000	1749,000	1006,000	-0,004024	0,996789	-0,004064	0,996758	53	38	0,996806
Weekend bed time	3680,000	2648,000	1334,000	-0,962151	0,335975	-0,971397	0,331351	68	44	0,337418
Weekend wake time	3977,000	2351,000	1316,000	1,133551	0,256984	1,157025	0,247263	67	45	0,258149
weekend time spent in bed	3727,500	2158,500	1212,500	1,157931	0,246893	1,162018	0,245229	65	43	0,246776
Average weekend day sleep duration with fixed times included	1398,500	1086,500	525,500	0,994169	0,320141	0,996412	0,319051	37	33	0,319405

Gender differences in the main reasons given for weekday bedtimes

Statistic	Statistics: Sex(2) x Main reason reported for bedtime on school days(6) (Copy of Clean data set_JD 1 Oct 2021) Chi-square	df	p
Pearson Chi-square	7,937874	df=5	p=,15969
M-L Chi-square	8,261469	df=5	p=,14240

Gender differences in the main reasons given for weekend bedtimes

	Statistics: Sex(2) x Main reason reported for wake-time on school days(6) (Copy of Clean data set_JD 1 Oct 2021)		
Statistic	Chi-square	df	p
Pearson Chi-square	7,965907	df=5	p=,15812
M-L Chi-square	9,151787	df=5	p=,10316

Gender differences in the main reasons given for weekday risetimes

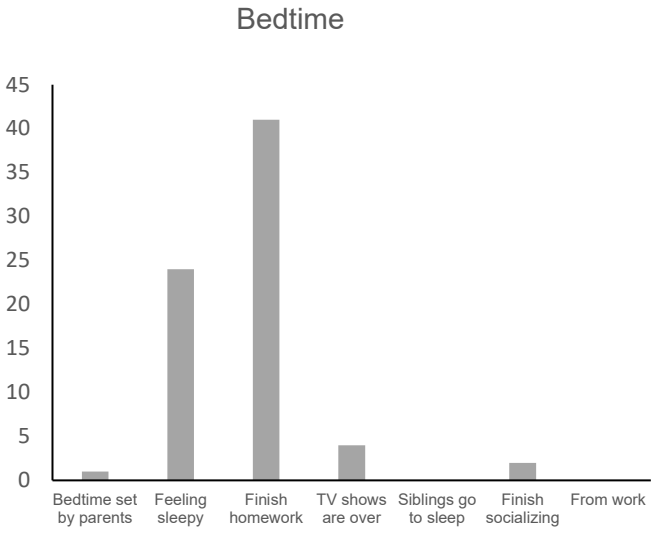
	Statistics: Sex(2) x Main reason reported for weekend bed-time(8) (Copy of Clean data set_JD 1 Oct 2021)		
Statistic	Chi-square	df	p
Pearson Chi-square	5,423604	df=7	p=,60841
M-L Chi-square	6,433350	df=7	p=,49016

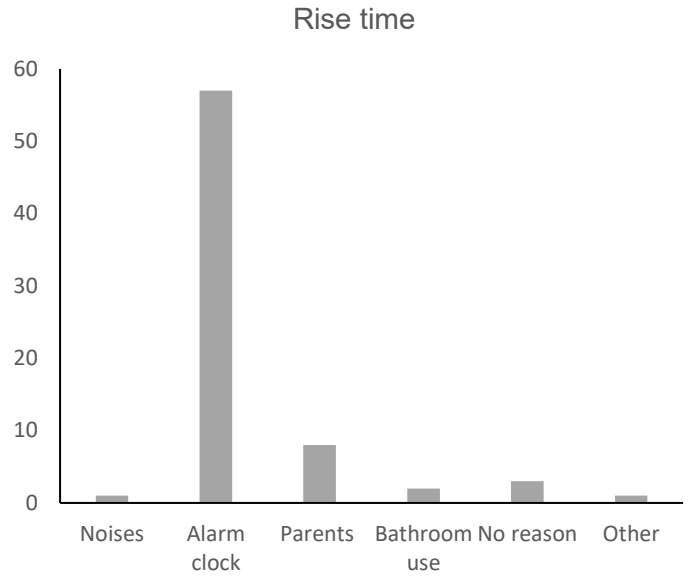
Gender differences in the main reasons given for weekend risetimes

	Statistics: Sex(2) x Main reason reported for weekend wake-time(6) (Copy of Clean data set_JD 1 Oct 2021)		
Statistic	Chi-square	df	p
Pearson Chi-square	13,15721	df=5	p=,02195
M-L Chi-square	14,49187	df=5	p=,01277

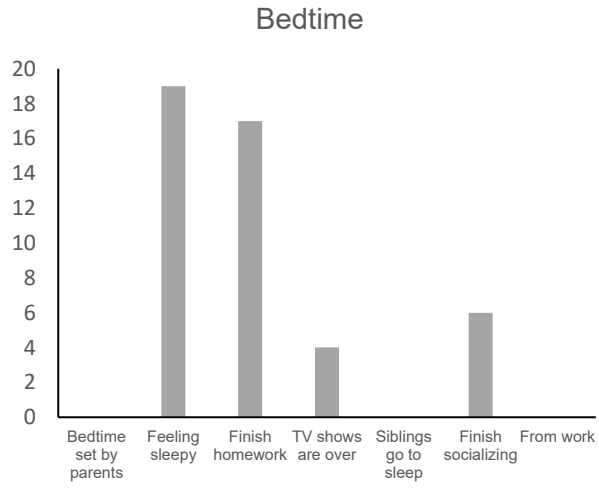
Reported reasons for bed and rise time for gender on weekdays

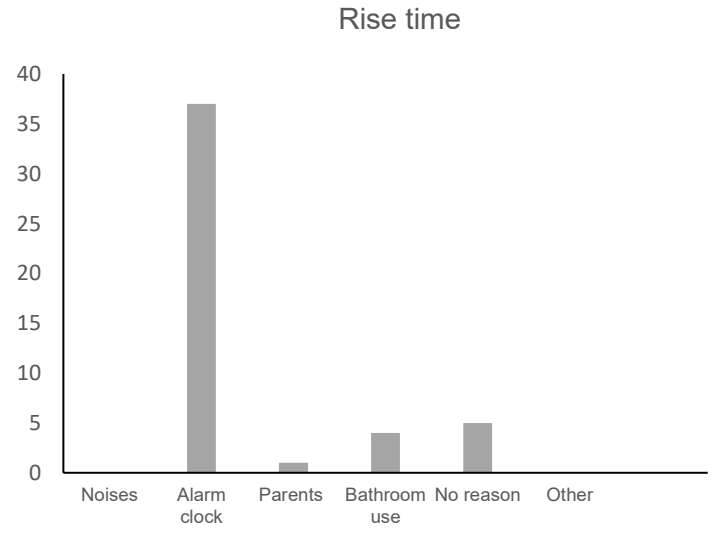
FEMALES





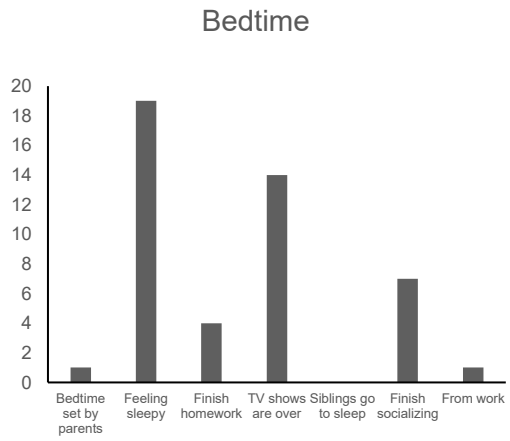
MALES



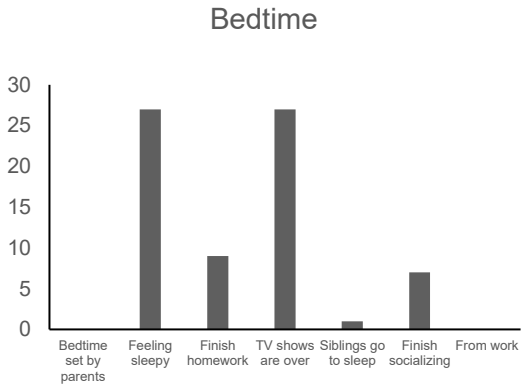


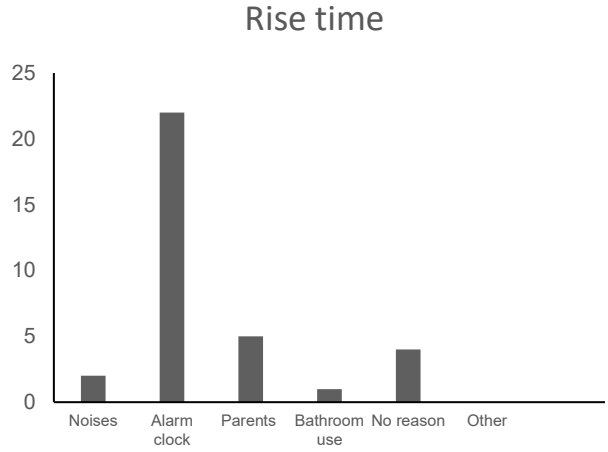
Reported reasons for bed and rise time for gender on weekends

FEMALES



MALES





Other sleep variables and comparisons

Perceived sleep quantity

Type of learner

Statistic	Statistics: School(2) x Perceived sleep quantity(3) (Copy of Clean data set_JD 1 Oct 2021)		
	Chi-square	df	p
Pearson Chi-square	5,004354	df=2	p=,08191
M-L Chi-square	4,926723	df=2	p=,08515

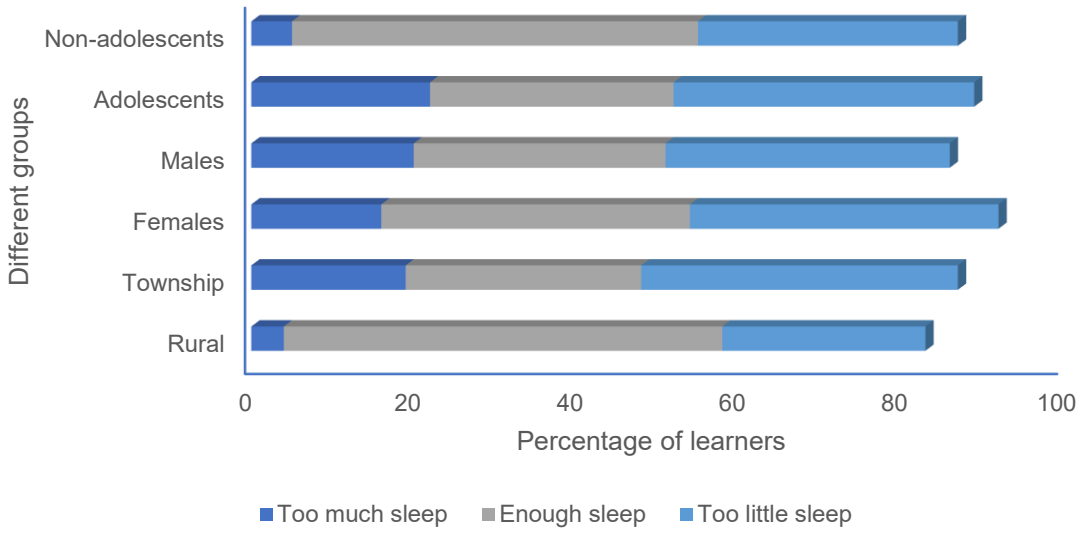
Age group

Statistic	Statistics: Grouping(2) x Perceived sleep quantity(3) (Copy of Clean data set_JD 1 Oct 2021)		
	Chi-square	df	p
Pearson Chi-square	5,692492	df=2	p=,05806
M-L Chi-square	6,356146	df=2	p=,04167

Gender

Statistic	Statistics: Sex(2) x Perceived sleep quantity(3) (Copy of Clean data set_JD 1 Oct 2021)		
	Chi-square	df	p
Pearson Chi-square	,6942725	df=2	p=,70671
M-L Chi-square	,6868090	df=2	p=,70935

Perceived sleep quantity for the different groups



Perceived sleep quality

Type of learner

	Statistics: School(2) x Perceived sleep quality(2) (Copy of Clean data set_JD 1 Oct 2021)		
Statistic	Chi-square	df	p
Pearson Chi-square	,0865866	df=1	p=,76856
M-L Chi-square	,0872619	df=1	p=,76769

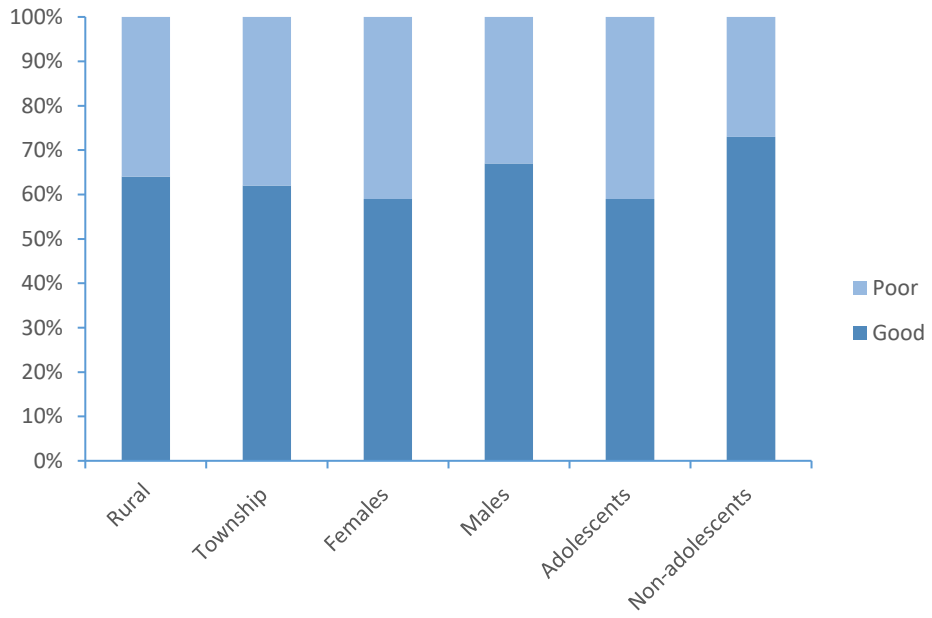
Age group

	Statistics: Grouping(2) x Perceived sleep quality(2) (Copy of Clean data set_JD 1 Oct 2021)		
Statistic	Chi-square	df	p
Pearson Chi-square	1,643429	df=1	p=,19986
M-L Chi-square	1,735715	df=1	p=,18768

Gender

	Statistics: Sex(2) x Perceived sleep quality(2) (Copy of Clean data set_JD 1 Oct 2021)		
Statistic	Chi-square	df	p
Pearson Chi-square	2,324442	df=1	p=,12736
M-L Chi-square	2,371939	df=1	p=,12353

Perceived sleep quality for the different groups



Frequency of daytime naps

Type of learner

Statistic	Statistics: School(2) x Frequency of daytime naps(4) (Copy of Clean data set_JD 1 Oct 2021)		
	Chi-square	df	p
Pearson Chi-square	5,154755	df=3	p=,16081
M-L Chi-square	5,380151	df=3	p=,14599

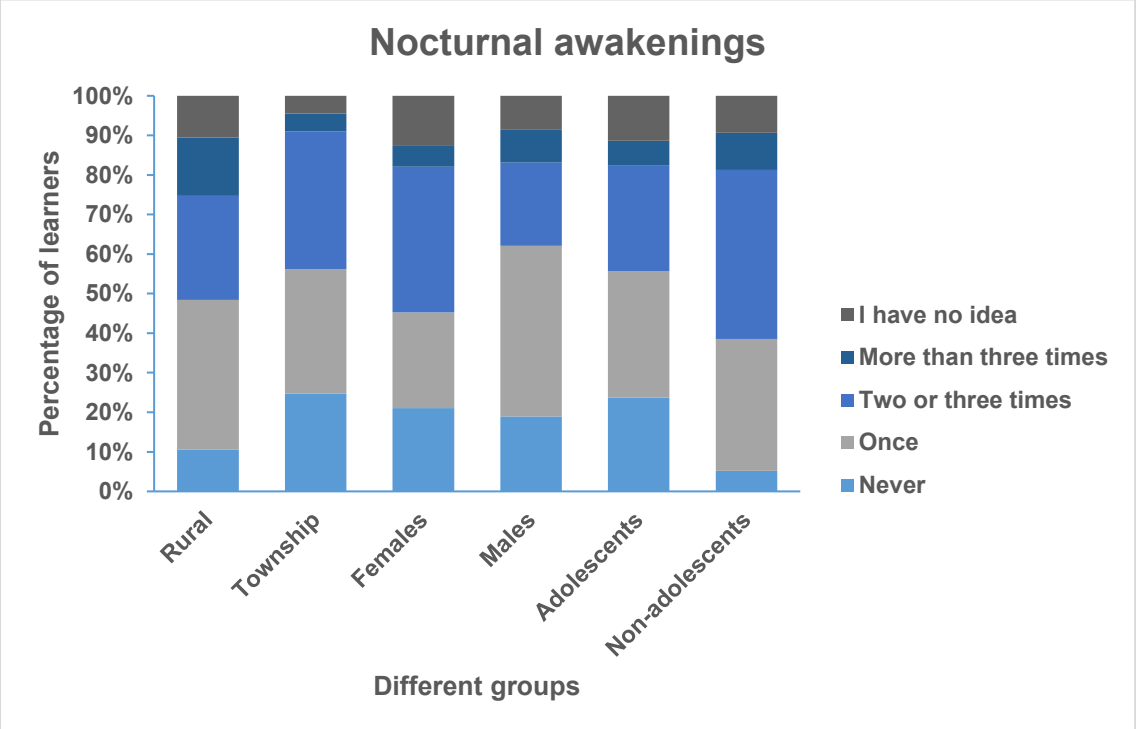
Age group

Statistic	Statistics: Grouping(2) x Frequency of daytime naps(4) (Copy of Clean data set_JD 1 Oct 2021)		
	Chi-square	df	p
Pearson Chi-square	5,518295	df=3	p=,13755
M-L Chi-square	5,517761	df=3	p=,13758

Gender

Statistic	Statistics: Sex(2) x Frequency of daytime naps(4) (Copy of Clean data set_JD 1 Oct 2021)		
	Chi-square	df	p
Pearson Chi-square	3,943435	df=3	p=,26764
M-L Chi-square	4,000580	df=3	p=,26140

Nocturnal awakenings for the different groups



Perceived sleepiness problems

Type of learner

Statistic	Statistics: School(2) x Perceived sleepiness problem(5) (Copy of Clean data set_JD 1 Oct 2021)		
	Chi-square	df	p
Pearson Chi-square	1,447893	df=4	p=,83583
M-L Chi-square	1,507880	df=4	p=,82524

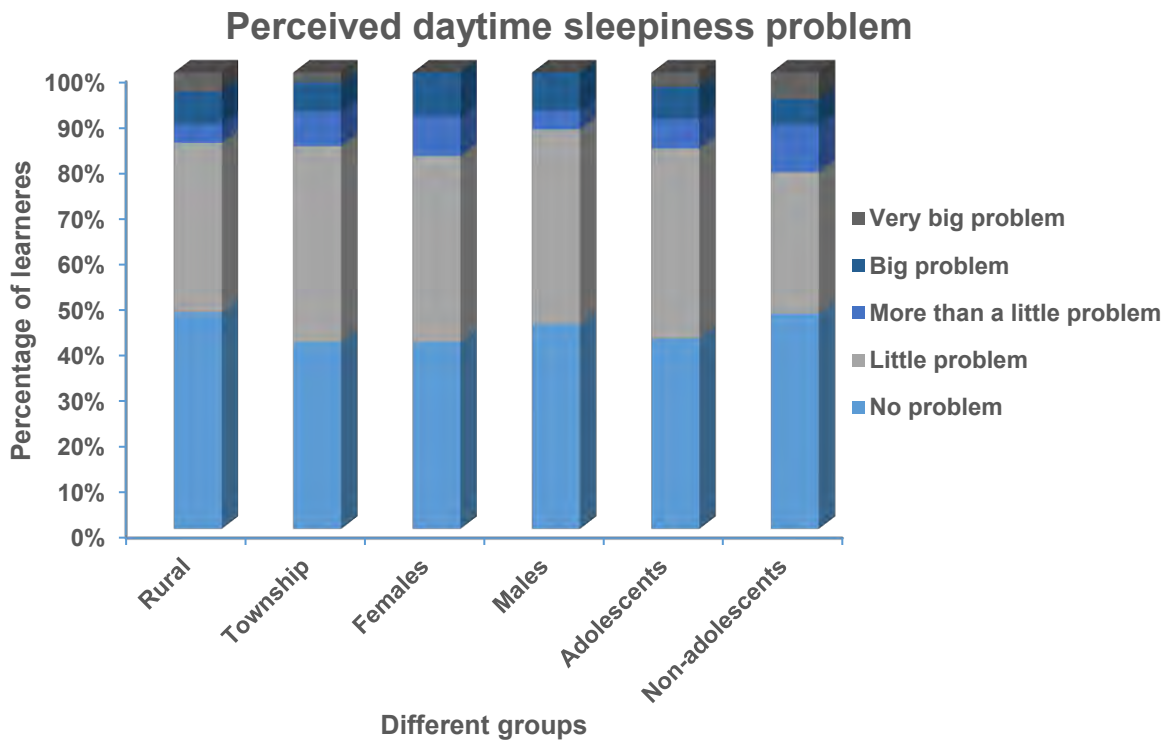
Age group

Statistic	Statistics: Grouping(2) x Perceived sleepiness problem(5) (Copy of Clean data set_JD 1 Oct 2021)		
	Chi-square	df	p
Pearson Chi-square	1,240472	df=4	p=,87139
M-L Chi-square	1,729090	df=4	p=,78543

Gender

Statistic	Statistics: Sex(2) x Perceived sleepiness problem(5) (Copy of Clean data set_JD 1 Oct 2021)		
	Chi-square	df	p
Pearson Chi-square	1,331246	df=4	p=,85605
M-L Chi-square	1,387704	df=4	p=,84633

Perceived daytime sleepiness problem for the different groups



Frequency of nocturnal awakenings

Type of learner

Statistic	Statistics: School(2) x Frequency of nocturnal awakenings(5) (Copy of Clean data set_JD 1 Oct 2021)		
	Chi-square	df	p
Pearson Chi-square	5,576923	df=4	p=,23305
M-L Chi-square	5,296714	df=4	p=,25818

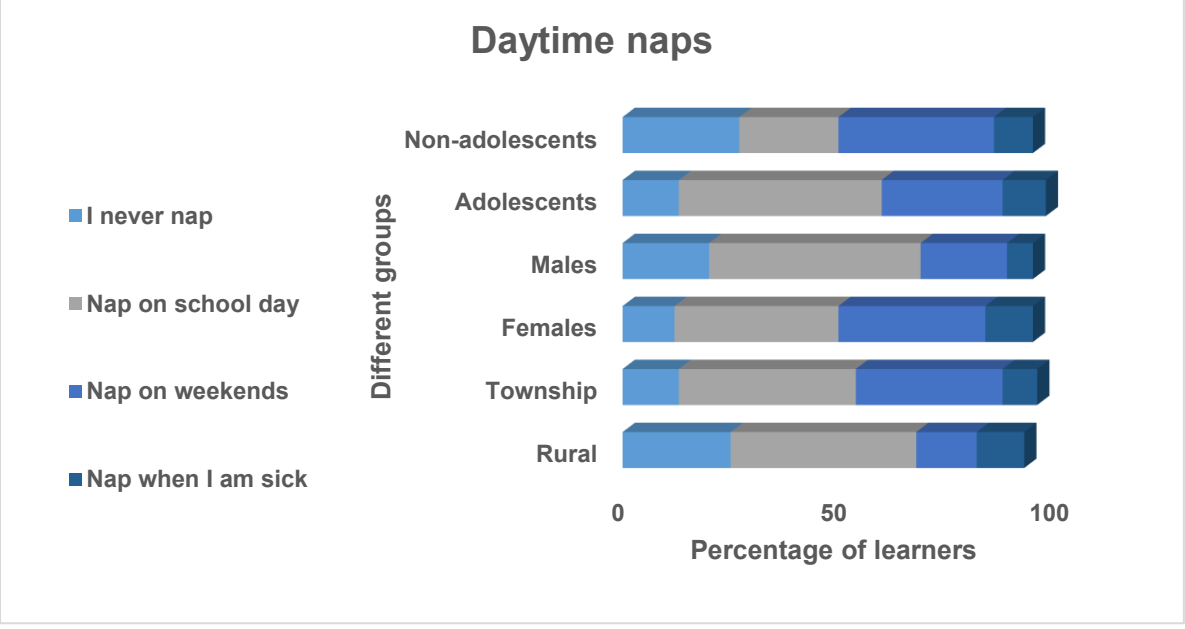
Age group

Statistic	Statistics: Grouping(2) x Frequency of nocturnal awakenings(5) (Copy of Clean data set_JD 1 Oct 2021)		
	Chi-square	df	p
Pearson Chi-square	5,678607	df=4	p=,22447
M-L Chi-square	6,616303	df=4	p=,15761

Gender

Statistic	Statistics: Sex(2) x Frequency of nocturnal awakenings(5) (Copy of Clean data set_JD 1 Oct 2021)		
	Chi-square	df	p
Pearson Chi-square	6,213497	df=4	p=,18376
M-L Chi-square	6,253999	df=4	p=,18097

Frequency of naps for the different groups



Scales: Sleepiness, Sleep-wake behaviour problems, Depressive mood, and Morning Evening-ness

Sleepiness scale

Mann-Whitney U Test (w / continuity correction) (Copy of Clean data set_JD 1 Oct 2021)
By variable Sleepiness scale sum
Marked tests are significant at p <,05000

variable	Rank Sum Group 1	Rank Sum Group 2	U	Z	p-value	Z adjusted	p-value	Valid N Group 1	Valid N Group 2	2*1sided exact p
School	39,00000	39,00000	18,00000	0,000000	1,000000	0,000000	1,000000	6	6	1,000000
Grouping	45,00000	33,00000	12,00000	0,880705	0,378478	1,359636	0,173946	6	6	0,393939
Sex	42,00000	36,00000	15,00000	0,400320	0,688921	0,467177	0,640374	6	6	0,699134

Sleep-wake behaviour problems

Mann-Whitney U Test (w/ continuity correction) (Copy of Clean data set_JD 1 Oct 2021)
By variable Sleep wake problems sum
Marked tests are significant at p <,05000

variable	Rank Sum Group 1	Rank Sum Group 2	U	Z	p-value	Z adjusted	p-value	Valid N Group 1	Valid N Group 2	2*1sided exact p
Sex	18,50000	9,50000	3,500000	0,707107	0,479501	0,816497	0,414217	4	3	0,400000
Grouping	14,00000	14,00000	4,000000	-0,530330	0,595883	-0,866025	0,386477	4	3	0,628571
School	15,00000	13,00000	5,000000	-0,176777	0,859684	-0,204124	0,838257	4	3	0,857143

Depressive mood

Mann-Whitney U Test (w/ continuity correction) (Copy of Clean data set_JD 1 Oct 2021)
By variable Depressed Mood Scale
Marked tests are significant at p <,05000

variable	Rank Sum Group 1	Rank Sum Group 2	U	Z	p-value	Z adjusted	p-value	Valid N Group 1	Valid N Group 2	2*1sided exact p
School	16,50000	61,50000	10,50000	-0,462250	0,643902	-0,713624	0,475460	3	9	0,600000
Grouping	19,50000	58,50000	13,50000	0,092450	0,926341	0,112834	0,910162	3	9	1,000000
Sex	16,50000	61,50000	10,50000	-0,462250	0,643902	-0,531904	0,594793	3	9	0,600000

Morning Evening-ness

Mann-Whitney U Test (w/ continuity correction) (Copy of Clean data set_JD 1 Oct 2021)
By variable M/E scale sum
Marked tests are significant at p <,05000

variable	Rank Sum Group 1	Rank Sum Group 2	U	Z	p-value	Z adjusted	p-value	Valid N Group 1	Valid N Group 2	2*1sided exact p
School	282,0000	279,0000	129,0000	-0,23414	0,814875	-0,37685	0,706284	17	16	0,817345
Grouping	246,0000	315,0000	93,0000	-1,53093	0,125787	-2,16109	0,030689	17	16	0,126978
Sex	300,5000	260,5000	124,5000	0,39624	0,691928	0,46798	0,639800	17	16	0,682660

Prevalence of physical activity or sport

Mann-Whitney U Test (w/ continuity correction) (Copy of Clean data set_JD 1 Oct 2021)
By variable During the last week, did you engage in organized sports or a regularly scheduled physical activity, including competitions
Marked tests are significant at p <,05000

variable	Rank Sum Group 1	Rank Sum Group 2	U	Z	p-value	Z adjusted	p-value	Valid N Group 1	Valid N Group 2	2*1sided exact p
School	4717,500	2663,500	1582,500	0,758210	0,448326	1,037956	0,299291	75	46	0,448216
Grouping	4657,500	2723,500	1642,500	0,437840	0,661503	0,655384	0,512221	75	46	0,660775
Sex	5067,000	2314,000	1233,000	2,624366	0,008681	3,108636	0,001880	75	46	0,008325

Frequency of caffeine consumption with consuming soda with caffeine

variable	Mann-Whitney U Test (w/ continuity correction) (Clean data set) By variable Frequency of consumption soda with caffeine (E.g. Coke; Pepsi; not like Orange soda and Spite) Marked tests are significant at p <,05000									
	Rank Sum Group 1	Rank Sum Group 2	U	Z	p-value	Z adjusted	p-value	Valid N Group 1	Valid N Group 2	2*1sided exact p
School	791,0000	290,0000	125,0000	-1,45140	0,146670	-1,96404	0,049526	36	10	0,148704
Sex	787,0000	294,0000	121,0000	-1,55792	0,119252	-1,80535	0,071021	36	10	0,120454
Grouping	835,0000	246,0000	169,0000	-0,27963	0,779764	-0,44936	0,653173	36	10	0,783128

Frequency of caffeine consumption with tea or coffee

variable	Mann-Whitney U Test (w/ continuity correction) (Clean data set) By variable Frequency of consumption coffee or tea with caffeine Marked tests are significant at p <,05000									
	Rank Sum Group 1	Rank Sum Group 2	U	Z	p-value	Z adjusted	p-value	Valid N Group 1	Valid N Group 2	2*1sided exact p
School	782,5000	207,5000	152,5000	-0,13093	0,895830	-0,22022	0,825701	35	9	0,886357
Grouping	784,0000	206,0000	154,0000	-0,08729	0,930443	-0,12490	0,900600	35	9	0,931671
Sex	733,0000	257,0000	103,0000	-1,57117	0,116144	-1,86250	0,062534	35	9	0,117371

Correlation between caffeine consumption and sleep variables

Variable	Kendall Tau Correlations (Copy of Clean data set_JD 1 Oct 2021) MD pairwise deleted Marked correlations are significant at p <,05000 Weekday bed-time decimals equiv	Weekday wake-time decimals equiv	Weekday time spent in bed	Weekend bed time	Weekend wake time	weekend time spent in bed	Sleepiness scale sum	Sleep wake problems sum	Depressed Mood Scale	M/E scale sum	Frequency of consumption soda with caffeine (E.g. Coke; Pepsi; not like Orange soda and Spite)	Frequency of consumption coffee or tea with caffeine
Weekday bed-time decimals equiv	1,000000	0,084969	-0,032237	-0,026327	0,046837	-0,048120	0,033412	-0,043238	-0,054469	-0,137974	0,063109	-0,096129
Weekday wake-time decimals equiv	0,084969	1,000000	0,329050	-0,129459	0,138215	0,026958	0,059809	-0,051262	-0,025592	-0,104574	-0,019713	-0,010039
Weekday time spent in bed	-0,032237	0,329050	1,000000	-0,085888	0,019683	0,086903	0,012907	-0,003675	0,038969	-0,104537	0,062414	-0,071687
Weekend bed time	-0,026327	-0,129459	-0,085888	1,000000	0,030916	-0,008258	-0,039319	-0,063455	-0,015562	-0,026893	0,147553	0,125629
Weekend wake time	0,046837	0,138215	0,019683	0,030916	1,000000	0,358509	0,040450	0,041669	0,012476	-0,078913	0,145981	0,056861
weekend time spent in bed	-0,048120	0,026958	0,086903	-0,008258	0,358509	1,000000	-0,051653	-0,087274	-0,101259	0,014315	0,099793	-0,024095
Sleepiness scale sum	0,033412	0,059809	0,012907	-0,039319	0,040450	-0,051653	1,000000	0,513851	0,454123	0,177347	-0,126270	-0,110627
Sleep wake problems sum	-0,043238	-0,051262	-0,003675	-0,063455	0,041669	-0,087274	0,513851	1,000000	0,523092	0,159621	-0,067008	-0,085648
Depressed Mood Scale	-0,054469	-0,025592	0,038969	-0,015562	0,012476	-0,101259	0,454123	0,523092	1,000000	0,181452	0,139608	0,032850
M/E scale sum	-0,137974	-0,104574	-0,104537	-0,026893	-0,078913	0,014315	0,177347	0,159621	0,181452	1,000000	-0,013472	-0,054936
Frequency of consumption soda with caffeine (E.g.	0,063109	-0,019713	0,062414	0,147553	0,145981	0,099793	-0,126270	-0,067008	0,139608	-0,013472	1,000000	0,459586
Frequency of consumption coffee or tea with caffein	-0,096129	-0,010039	-0,071687	0,125629	0,056861	-0,024095	-0,110627	-0,085648	0,032850	-0,054936	0,459586	1,000000

Correlation between reported grades and sleep variables

Variable	Kendall Tau Correlations (Clean data set) MD pairwise deleted Marked correlations are significant at p <,05000 Weekday bed-time decimals equiv	Weekday wake-time decimals equiv	Weekday time spent in bed	Weekend bed time	Weekend wake time	weekend time spent in bed	Sleepiness scale sum	Sleep wake problems sum	Depressed Mood Scale	M/E scale sum	Reported grades
Weekday bed-time decimals equiv	1,000000	0,065846	0,110197	0,053590	0,006984	0,010946	-0,041039	-0,056459	-0,048791	-0,141090	0,084864
Weekday wake-time decimals equiv	0,065846	1,000000	0,452808	0,073464	0,038393	0,041832	0,058666	-0,046451	-0,005118	0,071417	0,224174
Weekday time spent in bed	0,110197	0,452808	1,000000	0,089932	0,044453	0,023037	0,121099	-0,027197	0,074533	0,072063	-0,009715
Weekend bed time	0,053590	0,073464	0,089932	1,000000	0,039139	-0,195522	0,044749	0,071320	0,076583	-0,025485	0,097554
Weekend wake time	0,006984	0,038393	0,044453	0,039139	1,000000	0,400205	-0,009922	0,027028	-0,019924	0,027155	0,018336
weekend time spent in bed	0,010946	0,041832	0,023037	-0,195522	0,400205	1,000000	-0,045827	-0,060920	-0,061743	0,055216	-0,040841
Sleepiness scale sum	-0,041039	0,058666	0,121099	0,044749	-0,009922	-0,045827	1,000000	0,513851	0,454123	0,177347	-0,054287
Sleep wake problems sum	-0,056459	-0,046451	-0,027197	0,071320	0,027028	-0,060920	0,513851	1,000000	0,523092	0,159621	-0,016365
Depressed Mood Scale	-0,048791	-0,005118	0,074533	0,076583	-0,019924	-0,061743	0,454123	0,523092	1,000000	0,181452	-0,108796
M/E scale sum	-0,141090	0,071417	0,072063	-0,025485	0,027155	0,055216	0,177347	0,159621	0,181452	1,000000	-0,025964
Reported grades	0,084864	0,224174	-0,009715	0,097554	0,018336	-0,040841	-0,054287	-0,016365	-0,108796	-0,025964	1,000000