EXPLORING BEHAVIOURAL ADDICTIONS AND INSOMNIA: A STUDY WITH PORTUGUESE ADOLESCENTS

MARTA BASTOS UVA NUNES

Orientador de Dissertação:

PROF. DOUTORA FILIPA PIMENTA

Coorientador de Dissertação:

MESTRE MARTA PORTO

Professor de Seminário de Dissertação:

PROF. DOUTORA FILIPA PIMENTA

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"We do not ask life what the meaning of life is. Life asks us, what is the meaning of your life. And life demands our answer."

V. Frankl

RESUMO

Introdução: A investigação aponta que 11-30% dos adolescentes experienciam perturbações do sono, particularmente insónia, sendo o sono fundamental para o desenvolvimento saudável. Este estudo propõe-se a compreender 1) que variáveis explicam a insónia, 2) se o autocontrolo medeia a relação entre a Dependência de Comida (DC), Dependência de Internet (DI) e Dependência do Smartphone (DS) e insónia. **Método**: Participaram 1.566 jovens madeirenses com idades compreendidas entre os 12-19 anos (*M*=14,79, *DP*=1,89), que responderam a um questionário sociodemográfico, de acesso à internet e do estado mental, seguido da *Portuguese Yale Food Addiction Scale*, *Internet Addiction Test*, *Smartphone Addiction Scale – Short Version*, *General Functioning dimension of the Family Assessment Device*, *Brief Self-Control Scale*, e *Athens Insomnia Scale*. **Resultados**: Os modelos apresentaram bons ajustamentos. Adolescentes que apresentam maiores níveis de Dependência de Comida (β=,181; *p*<,001), Dependência da Internet (β=,098; *p*=,003), Comportamento Orientado para o Prazer e Impulsividade (β=,334; *p*<,001), Acesso a Ecrãs no Quarto Antes de Dormir (β=,111; *p*<,001), maior Frequência de Uso de Ecrãs Antes de Dormir (β=,096; *p*<,001), menores níveis de Apoio e Confiança (β=-,140; *p*<,001), e que são do sexo feminino (β=,127; *p*<,001), têm níveis de insónia mais elevados. A mediação revelou que existem efeitos positivos diretos das dependências na insónia e efeitos indiretos positivos do autocontrolo disfuncional na insónia. **Discussão**: É sublinhada a pertinência de desenvolver intervenções com adolescentes focadas na promoção da higiene do sono promovendo a adoção de hábitos saudáveis, trabalhando variáveis que tenham impacto em características impulsivas do autocontrolo.

Palavras-chave: Insónia, Preditores, Autocontrolo, Dependências, Adolescentes

ABSTRACT

Background: Research suggests that 11-30% of adolescents experience sleep disturbances, particularly insomnia, since sleep is essential for healthy development. This study aims to understand 1) which variables explain insomnia, 2) if self-control mediates the relationship between Food Addiction (FA), Internet Addiction (IA) and Smartphone Addiction (SA) and insomnia. **Methods:** A total of 1566 young Madeirans aged 12-19 years old (M=14.79, SD=1.89), took part and answered a sociodemographic, internet access, and mental state questionnaire followed by the *Portuguese Yale Food Addiction Scale*, *Internet Addiction Test*, *Smartphone Addiction Scale – Short Version*, *General Functioning dimension of the Family Assessment Device*, *Brief Self-Control Scale*, and the *Athens Insomnia Scale*. **Findings:** The models presented good fits. Adolescents who present higher levels of Food Addiction (β=.181; p<.001), Internet Addiction (β= .098; p=.003), Pleasure Driven Behaviour and Impulsivity (β= .334; p<.001), Access to Screens in the Room at Night (β= .111; p<.001), higher Frequency of Screen Use Before Going to Sleep (β=.096; p<.001), lower levels of Support and Trust (β= -.140; p<.001), and who are female (β=.127; p<.001) have higher levels of insomnia. The mediation revealed that there are direct positive effects of addictions on insomnia and indirect positive effects of pleasure driven behaviour and impulsivity on insomnia. **Discussion:** It is highlighted the pertinence of developing interventions with adolescents focused on promoting sleep hygiene and healthy habits, working on variables that have an impact on impulsive self-control characteristics.

Keywords: Insomnia, Predictors, Self-control, Addictions, Adolescents

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GENERAL INTRODUCTION

Adolescence is a life stage that occurs between childhood and adulthood, lasting from the ages of 10 to 24, according to Sawyer et al. (2018). This is an important stage in human development because it helps lay the foundations for long-term health. Adolescents experience rapid cognitive, psychosocial, and physical development, which influences their thoughts, emotions, interactions, and decisions with their surroundings (WHO, 2020).

Sleep is a natural physiological process that ensured healthy intellectual, physical, and mental development. It serves as a regenerative, energy-conserving, memory-consolidating, and recuperative function, and corresponds to a period when physical and motor activity, consciousness, and metabolism all decline. Therefore, sleep is essential for adolescents' physical, cognitive, and psychological development (Brand & Kirov, 2011). As a result, sleep quality is critical to maintaining a healthy lifestyle because it influences cardiovascular regulation, memory consolidation, endocrine-metabolic regulation, weight (i.e., can predict obesity and overweight) and mood (NHLBI, 2022a). It is strongly recommended that teenagers get approximately 8-10 hours of sleep per day. In order to accomplish this, it is necessary to practice sleep hygiene behaviours (e.g., staying away from electronic devices such as smartphones or tablets, and avoiding alcohol and energy/caffeinated drinks, which disrupt sleep; SNS24, 2023). According to Buysse (2014), good sleep quality, includes sleep satisfaction, a consistent sleeping pattern, adequate sleep duration, alertness during awake time, adequate sleep duration, and no difficulty returning to sleep or falling asleep. In contrast, poor sleep quality is defined as a dissatisfaction with sleep latency and efficiency as well as experiencing nocturnal awakenings (National Sleep Foundation, 2020).

Circadian rhythms are the physical, mental, and behavioural changes that occur over the course of a 24-hour cycle and are mainly influenced by light and darkness (NIGMS, 2023). Circadian rhythms are essential for health since they affect body temperature, hormone release and eating habits (NIGMS, 2023). This way, a delay in the phase of circadian physiology combined with a slower accumulation of sleep need leads to a nocturnal alertness which in turn results in a preference for later wake-up times and bedtimes in adolescents (Carskadon, 2011). Smartphone and social media use, as well as bedtime autonomy, all contribute to delayed sleeping patterns (Scott et al., 2019; Tashjian et al., 2019). Nonetheless,

sleep needs remain constant, and when accompanied by the early start of school, these factors create an adverse sequence of events that affect adolescent's' sleep (Bowers & Moyer, 2017).

In this way, despite the crucial role of sleep in maintaining adolescents' health, investigation has shown that teenagers frequently do not meet their sleep needs (Galland et al., 2018). This is illustrated by the prevalence of adolescents with sleep disturbances found by Blunden et al. (2012) which is around 11-30% and it is believed that it might be increasing (de Zambotti et al., 2018). Therefore, adolescents are reporting poor sleep quality, inadequate sleep duration and irregular sleep patterns (Owens et al., 2014), which have already been linked to mood fluctuations, anxiety and sadness, daytime sleepiness and memory and learning problems (SNS24, 2023). In this way, it is essential to try to understand what is responsible for these sleep disturbances.

Insomnia is one of the most common sleeping disorders and is characterized by a difficulty associated with sleep onset and sleep maintenance that can also express itself through early awakenings (APA, 2022; Cunnington, 2013). The diagnosis of insomnia is based on three criteria: (A) dissatisfaction with sleep quality and quantity, (B) clinically significantly distress or impairment in critical domains of functioning (e.g., social) and (C) sleeping difficulties must occur at least three nights a week (APA, 2022; WHO, 1993). This type of sleep disorder leads the person who experiences it to exhaustion (Cunnington, 2013).

The present work will be guided by the model developed by Claudatos et al. (2019), in which it is postulated that there is a bidirectional relationship between sleep disturbances that can be motivated by both internal and external factors (e.g., alterations in circadian rhythms and increased screen time, respectively) and substance consumption in teenagers. Adolescence is marked by major changes in sleep cycles, including a preference for later bedtimes. However, lack of sleep disrupts inhibitory processes, which affects adolescents' behaviour and self-control, and may lead to dangerous behaviours (Claudatos et al., 2019). The authors defend that this relationship can be promoted by 1) negative coping, 2) emotional dysregulation and 3) poor impulse control/reward seeking (Claudatos et al., 2019).

Negative coping involves consuming substances as a coping mechanism to induce sleep (Goodhines et al., 2017). However, this can motivate an overconsumption which ends up jeopardising sleep itself (Claudatos et al., 2019). Regarding emotion dysregulation, the authors defend that sleep deprivation can impair emotional experience regulation, which

makes them more vulnerable to become impulsive, decreasing their self-regulation capacity and elevating the chances of initiating substance consumption (Murray et al., 2009). Lastly, in terms of poor impulse control/reward seeking, adolescents can experience alterations in reward functioning and impulse control (Clark et al., 2008), which can lead them to initiate substance consumption (Romer et al., 2009).

It remains unclear what is the exact cause of insomnia. Nevertheless, there are a lot of risk factors that motivate its development, such as being a girl since they tend to present higher levels of insomnia than their peers from the opposite sex (APA, 2022; Johnson, 2006), stress, anxiety, and depression (Strine & Chapman, 2005), poor levels of self-control (Dahl & Lewis, 2002), poor diet (Tan et al., 2015), conflicting relationships between family members (Maratia et al., 2023) and inadequate and excessive use of internet/smartphones (Bhatt & Gaur, 2019; Van Deursen et al., 2015).

In what regards stress, anxiety, and depression, it is known that sleep is fundamental to ensure emotion regulation (Baglioni et al., 2010) and mental health (Palagini et al., 2022). Therefore, sleep deprivation can induce a state of allostatic overload which can end up increasing the risk of developing mental disorders (Palagini et al., 2019). Nowadays, insomnia is recognised as a transdiagnostic process that can increase the chances of developing mental disorders (Harvey et al., 2011).

Self-control refers to the ability to exert control over the individual's own physical, psychological, and behavioural processes in order to fulfil a specific long-term goal (Blankstein & Polivy, 1982). According to Lindner et al. (2015), self-control can be either dysfunctional or maladaptive – linked to increased levels of impulsivity, or functional or adaptive – linked to self-discipline. Research has shown that self-control can be jeopardised by poor sleep quality (Telzer et al., 2013). Simultaneously, poor impulse control promote irregular sleep patterns which can end up in poor sleep quality (Dahl & Lewis, 2002). On the other hand, good sleep quality is motivated by positive affect (Bower et al., 2010). At the same time, experiencing better sleep quality increases positive affect and improves emotion regulation and self-control Hamilton et al., 2008; Kalmbach et al., 2014).

Family consists of a dynamic system that is characterised by constant transformations that derive from its structure and issues (Scabini, 2016). Bearing that in mind, family is one of the most important socializing contexts for adolescents as the relationships

they establish with other family members predict their development (Kurock et al., 2022). Also, family relationships significantly influence adolescents' sleep quality (Ailshire & Burgard, 2012; El-Sheikh & Kelly, 2017). Therefore, family contexts that are characterised by insecurity, conflicts, instability, make adolescents more vulnerable to develop sleeping problems (e.g., insomnia; Kelly & El-Sheikh, 2011; Nilsen et al., 2022). These sleeping problems, in turn, may lead to more conflict at home (Roberts et al., 2002; Roberts et al., 2008). Conversely, family contexts that are characterised by close, warm, and responsive relationships between family members, promote a better sleep quality for adolescents (Sasser et al., 2021).

The use/abuse of substances is no longer the only one that comes to mind when discussing addictions. This occurs as a result of the emergence of new addictions, including food addiction, internet addiction and smartphone addiction. According to Chamberlain et al. (2016), all these addictions fall under the category of behavioural addictions. Because they involve a variety of social, psychological, and physical components, behavioural addictions can be challenging to diagnose. Nonetheless, the following traits are shared by all behavioural addictions: 1) continued participation in a behaviour despite its detrimental effects, 2) diminished control over participation in the behaviour, compulsive engagement and 3) craving urges that immediately prompt participation in the behaviour (Chamberlain et al., 2016).

Food Addiction (FA) is a hedonic behaviour of excessively consuming highly palatable foods (i.e., foods that are rich in sugar, salt, and fats) in major quantities than those needed to ensure energetic homeostasis (Kalon et al., 2016; Najem et al., 2019; Hauck et al., 2020). FA can result from dietary, psychological, biological, and behavioural factors Gearhardt et al., 2011). FA is commonly confused with obesity. Though obesity is defined as having a body mass index (BMI) of 30 or higher for adults and more than two standard deviations above the grown referenced valued by the World Health Organization for children and adolescents between the ages of 5 and 19 (WHO, 2024), FA implies an insatiable desire to eat beyond what is believed to be a metabolic or physical need (Hauck et al., 2020; Kalon et al., 2016; Najem et al., 2019). Therefore, a person can suffer from FA without being obese and being obese without suffering with FA, despite the fact that FA can promote overweight and obesity (Falcon et al., 2021; Torres et al., 2017). FA's conceptualisation is grounded in the DSM-IV-TR diagnostic criteria for substance dependence disorder, since the mechanisms behind both of them are believed to be the same (Gearhardt et al., 2011; Najem et al., 2019;

Torres et al., 2017). The prevalence of FA among adolescents is around 2-16% (Rodrigue et al., 2019) and also 2.6-49.9% (Skinner et al., 2021). It is known that some individuals (i.e., suffering with depression/anxiety), might consume high-calorie foods in order to cope with their negative emotions (Luo et al., 2022; Oliveira et al., 2020). Therefore, FA, mood, and impulsivity are associated with each other (Kalon et al., 2016). Additionally, Tan et al. (2015) have found that the quality of an individual's diet can predict insomnia. Thus, diets that are rich in sweets and carbohydrates are associated with poorer sleep quality, while diets that are rich in vitamin D and vegetables are associated with better sleep quality (Tan et al., 2015). FA can also jeopardise the sleep quality (Najem et al., 2019).

The internet has irreversibly changed how people use technology, especially in their social interactions. Global internet users were estimated to be around 4,1 billion in 2019 (International Telecommunication Union, 2019). Nonetheless, research into the construct of Internet Addiction (IA) has grown as a result of the awareness that some users have become addicted to the internet, as a person becomes addicted to substances (e.g., drugs; Young, 1998). Therefore, IA can be defined as a long-term, problematic, and obsessive internet use that hinders a person's functioning (Kapus et al., 2021). Gambling disorder is the one that most closely resembles the characteristics of pathological internet use (Young, 1998). Therefore, it was possible to conceptualise IA as an impulse control disorder that was not caused by a toxic substance (Young et al., 1999). IA can result in anxiety, depression, difficulties with interpersonal relationships and also insomnia (Bhatt & Gaur, 2019); Boonvisudhi & Kuladee, 2017). Thus, higher levels of IA may be associated with higher levels of insomnia (Bhatt & Gaur, 2019).

The number of people using smartphones and the internet has increased exponentially this century, to the point where these devices are now necessary for day-to-day activities (AlBarashdi et al., 2016). Smartphones provide the ability to use social media to interact with others, access the internet and play games (Demirci et al., 2015; Kim et al., 2013). According to Statista's report, approximately 6.4 billion people globally owned a smartphone in 2022. However, it is projected that by 2028, there will be 7.7. billion smartphone users worldwide (Statista, 2023). Furthermore, research has demonstrated that smartphones can also lead to addiction symptoms that are identical to those of internet addiction, such as tolerance, withdrawal, disruption of daily life and a preference for relationships centred around cyberspace (Kim, 2013). This addiction is called Smartphone Addiction (SA). SA is a compulsive condition characterised by an individual's uncontrollably

high use of smartphones to the point where their functioning is impaired (Chóliz, 2010). As they simultaneously work as a computer, mp3 player and DVD (Kwon et al., 2013), the prevalence of SA tends to be higher than that of IA (Kwon et al., 2013). Also, SA can also lead to insomnia (Van Deursen et al., 2015).

According to earlier studies, there is a positive correlation between IA and SA (Ben-Yehuda et al., 2016), and both have detrimental effects on those who experience them. In this sense, IA and SA can endanger the typical development of adolescents by affecting their coping strategies, interpersonal relationships, academic achievement, and physical pain (e.g., neck and shoulder pain; AlBarashdi et al., 2016; Kim, 2013; Samaha & Hawi, 2016). Teenagers go through a crucial developmental stage during which they search for their independence, make new friends, and change the way they behave (Mak et al., 2014). Because of their insatiable curiosity and lack of self-control, they are therefore more likely to develop SA (Kim & Lee, 2022; Munno et al., 2017).

Although the strength of the correlation varies between studies, prior research has demonstrated a negative relationship between self-control and SA (Jeong et al., 2020; Li et al., 2021). However, it has not yet been possible to determine whether a lack of self-control (i.e., higher impulsivity) causes IA, so the results regarding the association between IA and self-control remain uncertain (Li et al., 2021).

Thus, it is highly probable that the aforementioned variables present some kind of relationship with insomnia. However, it remains unclear how these interactions works and also if they are also valid in a Portuguese sample. Additionally, it looks pertinent to explore the influence of both forms of self-control (namely Resisting Temptation and Self-Discipline and Pleasure Driven Behaviour and Impulsivity) on the relationships between the previously mentioned addictions and insomnia in order to understand how adolescents' self-control is affecting teenagers' health and development.

Therefore, this study aims to explore if FA, IA, SA, stress, anxiety, depression, biological sex, access to screens at night, frequency of screen use before going to sleep/until falling asleep, support and trust (from family), difficulty negotiating and sharing (within the family), resisting temptation and self-discipline and pleasure driven behaviour and impulsivity are predictors of insomnia in this sample of Portuguese adolescents, through the development of a predictive structural equations model (study presented in Chapter 1). Additionally, this study also intends to comprehend if there is a unidirectional relationship

between 1) FA and insomnia, 2) IA and insomnia, and 3) SA and insomnia, and if self-control takes part of this relationship and how, through the development of three mediation models (studies shown in Chapter 2 and 3). Finally, the psychometric properties of all instruments used will be presented (Chapter 4).

CHAPTER 1

INSOMNIA IN PORTUGUESE ADOLESCENTS: WHAT DETERMINANTS?

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ABSTRACT

Background: Sleep ensures adolescents' healthy development. Around 11-30% of adolescents experience sleep disturbances, particularly insomnia. As insomnia causes remains uncertain, this study seeks to explore which of the variables under study best predict insomnia. **Methods:** The sample comprised 1,566 adolescents from Madeira schools, with ages between 12-19 years old (*M*=14.79, *SD*=1.89), who answered a sociodemographic, an internet use and also the *Portuguese Yale Food Addiction Scale*, *Internet Addiction Test*, *Smartphone Addiction Scale – Short Version*, *General Functioning dimension of the Family Assessment Device*, *Brief Self-Control Scale*, and the *Athens Insomnia Scale*. **Findings:** The refined structural model presented a good fit (SRMR=.066; GFI=.970; CFI=.973; TLI=.974; RMSEA=.060; p<.001; 90% *CI*=].059, .061[). Teenagers who present higher levels of Food Addiction (β=.181; p<.001), Internet Addiction (β= .098; p=.003), Pleasure Driven Behaviour and Impulsivity (β= .334; p<.001), Access to Screens in the Room at Night (β= .111; p<.001), higher Frequency of Screen Use Before Going to Sleep/Until Falling Asleep (β=.096; p<.001), lower levels of Support and Trust (β= -.140; p<.001) and who are female (β=.127; p<.001) experienced higher levels of insomnia. Conversely, Smartphone Addiction (β= -.095; p=.066), Difficulty Negotiating and Sharing (β= .016; p=.711) and Resisting Temptation and Self-Discipline (β= -.012; p=.817) were not predictors of insomnia. **Discussion:** These findings emphasise the necessity of developing future interventions with adolescents focused on the promotion of sleep hygiene behaviours including the management of behaviours related to internet and food addiction, as well as working with the negotiation ability within the family, which might result in better sleep quality.

Keywords: Insomnia, Predictors, Portuguese Adolescents, Structural Equations Model

INTRODUCTION

Sleep is a natural physiological process that contributes to the healthy development of the body, mind, and intellect. Adolescents need around 8-10 hours of sleep, in order to develop cognitively, physically, and psychologically (SNS24, 2023; Brand & Kirov, 2011). Despite the importance of meeting sleep needs, research has shown that adolescents often report irregular sleeping patterns and poor sleep quality (Owens et al., 2014). These findings are consistent with what was found by Blunden et al. (2012), and then reinforced by de Zambotti et al. (2018), where 11-30% of teenagers experience sleeping disorders and this prevalence might be increasing.

Insomnia involves difficulties in inducing and maintaining sleep and can also be accompanied by early awakenings. As such, it significantly impairs the daily functioning of those who experience it (Cunnington, 2013). Investigation has shown that it is still unclear which is the exact cause of insomnia. Nevertheless, there are a lot of risk factors for the development of insomnia, such as biological sex (i.e., being a women is a risk factor for the development of insomnia; APA, 2022; Johnson, 2006), stress, depression, and anxiety (Strine & Chapman, 2005), unhealthy diet (Tan et al., 2015), problematic family contexts (Maratia et al., 2023), and excessive/inadequate use of internet and/or smartphones (Bhatt & Gaur, 2019; Van Deursen et al., 2015).

When it comes to stress, anxiety and depression research has shown that, sleep disturbances may facilitate a state of allostatic overload, which ends up increasing the chances of developing mental disorders (Palagini et al., 2019). Also, when adolescents suffer with insomnia, they become more likely to experience stress, anxiety, and depression (Dahl & Harvey, 2007; Drake et al., 2014). Hence, this relationship is bidirectional as insomnia can boost stress, anxiety, and depression in adolescents (Dagys et al., 2012; Drake et al., 2014).

Food Addiction (FA) is a behavioural addiction that consist of an excessive and uncontrolled consumption of high-calorie foods (e.g., sweets; Najem et al., 2019). In this way, investigation in this domain has found that FA can jeopardise sleep quality (Najem et al., 2019). This information is consistent with the results obtained by Tan et al. (2015), in which it was found that sleep quality might be affected by the individual's diet, since a diet rich in vitamins can promote better sleep quality and conversely, a diet rich in sugar and carbohydrates can lead to poorer sleep quality (Tan et al., 2015).

The term Internet Addiction (IA) refers to the problematic internet use that affects a person's functioning (Kapus et al., 2021). Smartphone Addiction (SA), according to Chóliz et al. (2010), is characterised by compulsive behaviour that impairs an individual's functions due to uncontrolled smartphone use. IA and SA have been found to be positively associated (Ben-Yehuda et al., 2016). Simultaneously, both addictions seem to have a positive relationship with insomnia (Bhatt & Gaur, 2019; Van Deursen et al., 2015).

Family also plays an important role in adolescent's sleep quality (Ailshire & Burgard, 2012). Research has shown that since increased arousal and alertness inhibit sleep, it is necessary for a person to feel secure and safe in order to get proper sleep quality (Dahl & El-Sheikh, 2007). Simultaneously, family contexts that are marked by chaos can influence adolescents' sleep quality negatively (Kelly & El-Sheikh, 2011).

Self-control is also an important variable to consider as better emotion regulation and higher frequency of positive emotions are linked to higher levels of self-control and consequent better sleep quality (Bower et al., 2010). Conversely, poor self-control is linked to more difficulty controlling emotions (Bower et al., 2010).

The present work is based on the theoretical model developed by Claudatos et al. (2019), which postulates that there is a reciprocal relationship between adolescents' substance use and sleep disturbances that can be cause by both internal and external variables. This association can occur through 1) negative coping, 2) emotional dysregulation and 3) reward seeking/poor impulse control.

As the causes of insomnia remains unclear, this is a pertinent investigation since it allows a deeper understanding of the role of each variable in the development of insomnia. Therefore, the aim of the present study is to comprehend if FA, IA, SA, stress, anxiety, depression, biological sex, access to screens at night, frequency of screen use before going to sleep/until falling asleep support and trust, difficulty negotiating and sharing, resisting temptation and self-discipline and pleasure driven behaviour and impulsivity predict insomnia in this sample of Portuguese adolescents.

METHOD

Participants

This is a descriptive, correlational and cross-sectional study. At first, the sample consisted of 1,672 young individuals from the Autonomous Region of Madeira, out of which 106 participants were excluded due to not providing consent (*n*=56), not referring their biological sex (*n*=10), not meeting the defined age criteria (*n*=20), or not providing enough information (*n*=20). The final sample comprised 1.566 participants, with an average age of 14.79 (*SD*=1.89). The inclusion criteria consisted of being a student in the Autonomous Region of Madeira with an age between 12-19 years. The sample size corresponds to 8,72% of the Madeiran student population in the 3rd cycle of basic education and secondary education in the 2019/2020 public education year (DREM, 2023). Participants' characteristics are shown in table 1 and participants' access and use of the internet data in table 2.

Table 1

Participants' characteristics

Characteristics	**Adolescents** (*n*=1566)
	***n* (%)**
Sex	
Males	742 (47.4)
Females	824 (52.6)
Level of Education	
Basic Education (3rd cycle)	854 (54.5)
Secondary Education	712 (45.5)
Residential Areas	
Urban Areas	1178 (75.2)
Rural Areas	388 (24.8)

Table 2

Participants' access and use of the internet data

Characteristics	**Adolescents** (*n*=1566) ***n* (%)**
Having a smartphone/mobile phone	
Have a smartphone	1336 (85.3)
Have a mobile phone	212 (13.5)
Don´t have any	18 (1.1)
Times per day they use their smartphone/mobile phone	
1-10 times	332 (21.2)
11-20 times	463 (29.6)
21-30 times	309 (19.7)
More than 31 times	462 (29.5)
Time per day during the week they use the Internet for leisure or hobbies	
Up to 30 minutes	71 (4.5)
From 30 to 60 minutes	141 (9.0)
From 1 to 2 hours	258 (16.5)
From 2 to 4 hours	383 (24.5)
From 4 to 6 hours	260 (16.6)
From 6 to 8 hours	163 (10.4)
More than 8 hours	290 (18.5)
Time per day during the weekend they use the Internet for leisure or hobbies	
Up to 30 minutes	75 (4.8)
From 30 to 60 minutes	119 (7.6)
From 1 to 2 hours	223 (14.2)
From 2 to 4 hours	286 (18.3)
From 4 to 6 hours	333 (21.3)
From 6 to 8 hours	227 (14.5)
More than 8 hours	303 (19.3)
Have family meals at the table	
Yes	1438 (91.8)
No	128 (8.2)

Use of electronic devices during meals with their families	
They and their families use it	129 (8.2)
They use it but their families don't	122 (7.8)
They don't use, but their family do	62 (4.0)
Neither them nor their families use	1175 (75.0)
Have access to screens (e.g., smartphone) in their rooms at night	
Yes	1189 (75.9)
No	377 (24.1)
How often do they use screens (e.g., tablets) just before bed or until they fall asleep	
Never	86 (5.5)
Rarely	262 (16.7)
Sometimes	436 (27.8)
Many times	249 (15.9)
Daily	533 (34.0)

Measures

Sociodemographic and Internet Use and Access Data. Sociodemographic measures included biological sex, age, residential area, and level of education. Internet use and access data included, owing a smartphone/mobile phone, times per day they use their smartphone, time per day during the week/weekend participants use the Internet for leisure, use of electronic devices while having meals with their families and smartphone use before sleep.

Portuguese Yale Food Addiction Scale (P-YFAS). This scale was developed by Gearhardt et al. (2009) and validated to a Portuguese sample by Torres et al. (2017). This scale consists of 24 self-report items assessing addictive eating behaviours that have occurred in the previous year (e.g., "*I find myself continuing to consume certain foods even though I am no longer hungry.*"; Gearhardt et al., 2009). The symptoms of substance dependence were adapted from the DSM-IV-TR to eating behaviour, resulting in: 1) consuming more/for longer time than planned (items 1, 2, 3); 2) inability to reduce/quit certain food's consumption (items 4, 22, 24); 3) lots of time and effort dispended on food consumption (items 5, 6, 7); 4) abandoning significant social activities (items 8, 9, 10, 11); 5) persistent behaviour in spite of being aware of its consequences (item 19); 6) tolerance (items 20, 21); and 7) withdrawal

(items 12, 13, 14). There are also two items designed to assess clinically significant impairment, considered symptom 8 (items 15, 16) and three introductory items for other questions (items 17, 18, 23). Higher scores represent a greater manifestation of symptoms in line with an FA pattern. PYFAS offers continuous scores that represent the quantity of addiction symptoms that have been verified. The first 23 items were rated on a 5-point Likert scale, ranging from 0 "*never*" to 4 "*4 or more times per week, or daily*", and the 24th item was also rated on 5-point Likert scale, ranging from 1 "*1 or fewer times*" to 5 "*5 or more times*". Additionally, the scale has also a dichotomous scoring system that indicates symptomatic expression congruent with FA. In this study, it was applied the continuous scoring method. In the validation, the scale demonstrated good internal consistency, with α=.82 (Torres et al., 2017).

Internet Addiction Test (IAT). This scale developed by Young (1998), was validated to a Portuguese sample by Pontes et al. (2014). IAT consists of 20 items that assess how often the individual performs certain online behaviours (e.g., "*How often do you find yourself anticipating when will you go online again?*"; Pontes et al., 2014). Each item was rated on a 6-point Likert Scale, ranging from 0 "*not applicable*" to 5 "*always*". The final score was given by the sum of each item score, where 0-30 points suggests absence of internet addiction, 31-49 points mild internet addiction, 50-79 points moderate internet addiction and 80-100 points severe internet addiction (Young, 2011). In the validation, IAT showed an excellent value of internal consistency, with α=.90 (Pontes et al., 2014).

Smartphone Addiction Scale – Short Version (SAS-SV). This scale was developed by Kwon et al. (2013) and validated to a Portuguese sample by Água et al. (2017). SAS-SV is a short version of the original SAS (33 items), that comprises 10 self-report items assessing the level of smartphone dependence (e.g., "*Feeling impatient and fretful when I am not holding my smartphone*."; Kwon et al., 2013). Each item was rated on a 6-point Likert scale ranging from 1 "*strongly disagree*" to 6 "*strongly agree*". The final score was given by the sum of each item's score, however the cut-off to consider a greater manifestation of symptoms in line with a SA pattern is 31 for males and 33 for females. In the validation, SAS-SV showed a good value of internal consistency, with α=.86 (Água et al., 2017).

General Functioning dimension of the Family Assessment Device (GF-FAD). This scale developed by Epstein et al. (1983), was validated to a Portuguese sample by Patrão et al. (2020). The original version of the FAD is composed of 53 items, divided according to 7 dimensions (e.g., Problem Solving, Communication, and General Functioning). However,

only the dimension General Functioning was validated. FAD's Portuguese version consists of 12 items assessing the family's general health/pathology. Of all items, 6 of them are positives and refer to the Family Functionality dimension (items 2, 4, 6, 8, 10, 12; e.g., "*We trust each other*."; Patrão et al., 2020), while the other 6 are related with Family Dysfunctionality (items 1, 3, 5, 7, 9, 11; "*We can't talk to each other about the sadness we feel.*"; Patrão et al., 2020). After carefully analysing the content of the items, it was decided to change the name of each dimension, where Family Functionality dimension became Support and Trust, and Family Dysfunctionality dimension became Difficulty Negotiating and Sharing. Each item was rated on a 4-point Likert scale, ranging from 1 "*strongly disagree*" to 4 "*strongly agree*". The total score was calculated by the sum of all items. Higher scores in the Support and Trust dimension, suggest greater support and trust between family members and higher scores in the Difficulty Negotiating and Sharing, suggests greater difficulty in negotiating and sharing things (e.g., thoughts, feelings) within the family. In the validation, Difficulty Negotiating and Sharing and Support and Trust demonstrated good internal consistency, with α=.84 and α=.86 respectively (Patrão et al., 2020).

Psychological Well-being and Mental State. Psychological well-being was assessed with only 1 item "*How do you evaluate your psychological well-being*?" that was rated on a 10-point Likert scale, ranging from 1 "*extremely bad*" to 10 "*extremely good*". Mental state was assessed with 3 items evaluating how often the individual experience high levels of depressed mood, anxiety, and stress (e.g., "*How often do you feel high levels of anxiety?*"). These items were rated on a 6-point Likert scale, ranging from 1 "*never*" to 6 "*everyday*".

Brief Self-Control Scale (BSCS). This scale developed by Tangney et al. (2004), was validated to a Portuguese sample by Água et al. (2020). The BSCS assesses self-control and consists of 13 items rated on a 5-point Likert scale ranging from 1 "*not at all like me*" to 5 "*very much like me*". This scale has two dimensions, Maladaptive/Dysfunctional Self-Control (items 2, 3, 4, 5, 9, 10, 12, 13) (e.g., "*Sometimes I can't stop doing something, even if I know it's wrong.*"; Água et al., 2020) and Adaptive/Functional Self-Control (items 1, 6, 7, 8, 11) (e.g., "*I'm good at resisting temptation*."; Água et al., 2020). However, after carefully analysing the content of all items, it was decided to change the name of both dimensions. Therefore, Dysfunctional Self-Control became Pleasure Driven Behaviour and Impulsivity and Functional Self-Control became Resisting Temptation and Self-Discipline. To determine the final score, items related to the first dimension were reversed, so that a global higher score

corresponds to more adaptative self-control. In the validation to the Portuguese sample, both Resisting Temptation and Self-Discipline and Pleasure Driven Behaviour and Impulsivity demonstrated good and acceptable internal consistency, with α=.86 and α=.68 respectively (Água et al., 2020).

Athens Insomnia Scale (AIS). This scale developed by Soldatos et al. (2000), was validated to a Portuguese sample by Lamelas et al. (2023). AIS assesses the level of experienced insomnia and consists of 8 items (e.g., "*Final awakening earlier than desired*."; Soldatos et al., 2000), matching the International Classification of Diseases – 10 (ICD-10) criteria A, B and C for the diagnosis of insomnia. Criterion A assesses difficulty initiating sleep and total sleep quality. Criterion B refers to the frequency of these events. Criterion C corresponds to the consequences of sleep deprivation on an individual's daily functioning (e.g., perceived sleepiness). The items were rated on a 4-point Likert scale, ranging from 0 "*no problem at all*" to 3 "*very serious problem*". The total scores ranged from 0 (absence of insomnia) to 24 (severe insomnia level), however, a symptomatic expression consistent with insomnia is indicated by total scores equal to or greater than 6 (Soldatos et al., 2003). In the validation, the AIS exhibited a good internal consistency with α=.82 (Lamelas, 2023).

Procedure

The research project was approved by the Ethics Committee of ISPA – University Institute and by Regional Secretariat of Education, Science and Technology of the Regional Government of Madeira (RSESTRGM). After that, several public schools of Madeira were contacted to request permission to distribute online surveys to students in the 3rd cycle of basic education and secondary education. Prior to participation, students were asked to give their Informed Consent, and an Informed Consent was sent to the legal guardians of the students under 16 years in collaboration with the RSESTRGM. Right after the informed consents were obtained and the inclusion criteria were met, the students filled out the online survey on the platform Google Forms in the classroom setting. The research complied with the Deontological Code of the Ordem dos Psicólogos Portugueses (2021) and the principles of the American Psychological Association (2017), regarding ethical treatment of participants.

Regarding data analysis, a descriptive analysis (i.e., measures of central tendency and measures of dispersion) of the latent variables will be carried out using using IBM SPSS Statistical software, version 29. After that, it will be carried out the confirmatory factor analysis of all scales, and also the average variance extracted of each sub-construct and comparison of the later with the squared correlation between factors in order to evaluate how

well they discriminated among them using R 4.2.1 statistical system, (R Core Team) via Rstudio. Following that, multicollinearity between variables will be assessed using IBM SPSS Statistical software, version 29. Finally, it will be performed a predictive structural equations model in order to analyse which of the independent variables (i.e., FA, IA, SA, Stress, Anxiety, Depression, Biological Sex, Access to Screens at Night, Frequency of Screen Use Before Going to Sleep/Until Falling Asleep, Support and Trust, Difficulty Negotiating and Sharing, Resisting Temptation and Self-Discipline and Pleasure Driven Behaviour and Impulsivity) significantly explained the dependent variable (insomnia). After that, the refined model will be performed, including only the significant predictors of the dependent variable (i.e., insomnia). Both models will be performed using R 4.2.1 statistical system, (R Core Team) via Rstudio.

RESULTS

Descriptive Analysis

In order to characterise the sample in relation to the latent variables, a descriptive analysis was conducted (table 3).

In what regards the levels of insomnia, in this sample 31,5% of adolescents reported moderate to severe levels of insomnia, while the other 68,5% did not exhibit a symptomatic expression congruent with an insomnia pattern.

Table 3

Descriptive Statistics of Latent Variables

Latent variables	Mean	Standard deviation (SD)	Minimum	Maximum
Food addiction	2.85	2.10	0	8
Internet addiction	36.15	15.03	0	100
Smartphone addiction	25.05	8.77	10	60
(Family) Support and Trust	17.65	4.52	6	24
(Family) Difficulty Negotiating and Sharing	11.25	3.43	6	24
Resisting Temptation and Self-Discipline	11.60	3.61	4	20
Pleasure Driven Behaviour and Impulsivity	18.78	6.52	8	40
Psychological well-being	7.78	2.10	1	10

Depression	2.26	1.22	1	6
Anxiety	2.55	1.34	1	6
Stress	2.81	1.39	1	6
Insomnia	4.45	3.88	0	23

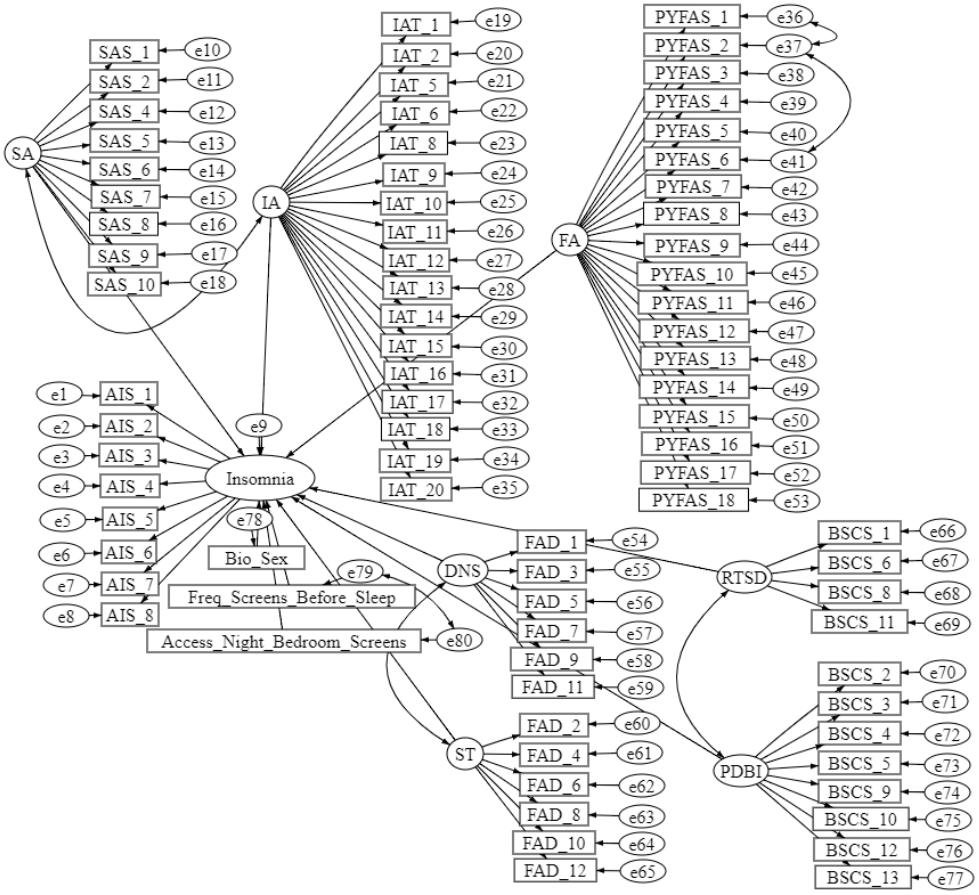
Structural Model

After exploring the quality of the internal structure of all the instruments and checking that all the scales had good psychometric properties and that there was no multicollinearity between any of the variables under study, it was therefore possible to proceed with the construction of a structural model (Figure 1) in order to explore the relationships between all of the independent variables (Food Addiction, Internet Addiction, Smartphone Addiction, Support and Trust, Difficulty Negotiating and Sharing, Resisting Temptation and Self-Discipline and Pleasure Driven Behaviour and Impulsivity, Biological Sex, Access to Screens in the Room at Night and Frequency of Screen Use Before Going to Sleep/Until Falling Asleep) and the dependent variable (Insomnia).

Since the structural equation model had initially an unacceptable fit, the items with a factor weight lower than the reference value (λ=.500) were removed, to obtain a better model fit. This led to the exclusion of the stress, anxiety, and depression, and some items from the scales applied, which will be discussed later in Chapter 4, regarding psychometric analysis of the instruments.

Figure 1

Structural Model of the Predictors of Insomnia in Portuguese Teenagers



Note. SA= Smartphone Addiction; IA= Internet Addiction; FA= Food Addiction; DNS= Difficulty Negotiating and Sharing; ST= Support and Trust; RTSD= Resisting Temptation and Self-Discipline; PDBI= Pleasure Driven Behaviour and Impulsivity; Bio_Sex= Biological Sex; Freq_Screens_Before_Sleep= Frequency of Screen Use Before Going to Sleep/Until Falling Asleep; Access_Night_Bedroom_Screens= Access to Screens in the Room at Night.

Once the items had been excluded, the model showed a good fit (SRMR=.062; GFI=.964; CFI=.968; TLI=.969; RMSEA=.057; p<.001; 90% *CI*=].056, .058[).

The structural model in figure 1 showed that adolescents who present higher levels of Food Addiction (β=.178; p<.001), Internet Addiction (β=.166; p<.001), Pleasure Driven Behaviour and Impulsivity (β=.330; p<.001), Access to Screens in the Room at Night (β= .111; p<.001), Frequency of Screen Use Before Going to Sleep/Until Falling Asleep (β=.097; p=.001), and who are female (β=.127; p<.001), experience higher levels of insomnia. Conversely, adolescents who experience higher levels of Support and Trust (β= -.156; p=.002) within the family present lower levels of insomnia. Additionally, the variables Resisting

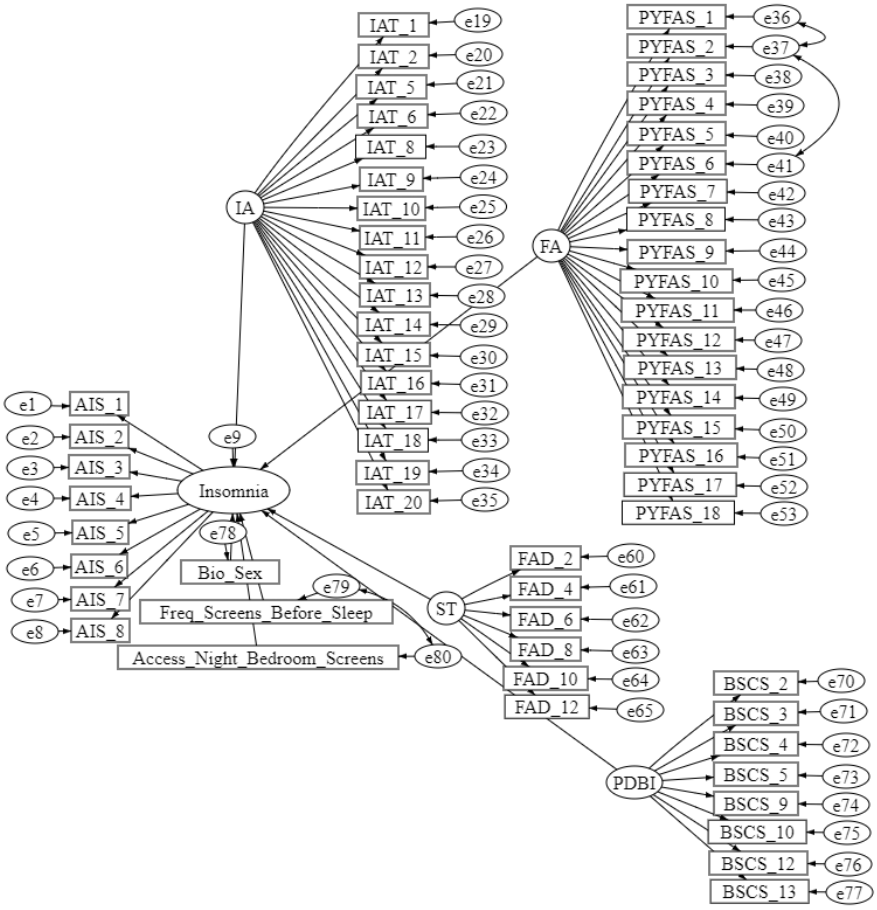
Temptation and Self-Discipline (β= -.012; *p*=.817), Difficulty Negotiating and Sharing (β= .016; *p*=.711) and SA (β= -.095; *p*=.066) are not predictors of insomnia in this sample.

Refined Structural Model

After the analysis of the initial model, it was developed a new (refined) structural model (figure 2) which only included the predictors of the dependent variable (insomnia).

Figure 2

Refined Structural Model of the Predictors of Insomnia in Portuguese Teenagers



The refined model has shown a good fit (SRMR=.066; GFI=.970; CFI=.973; TLI=.974; RMSEA=.060; *p*<.001; 90% *CI*=].059, .061[). This model (with the accounted variables) explains 31% of the variance in insomnia (R^2= .308).

Table 4

Trajectories between Food Addiction, Internet Addiction, Support and Trust, Pleasure Driven Behaviour and Impulsivity, Biological Sex, Access to Screens in the Room at Night, Frequency of Screen Use Before Going to Sleep/Until Falling Asleep and Insomnia

Trajectories ←	β	*p*
Insomnia ← FA	.181	***
Insomnia ← IA	.098	.003
Insomnia ← ST	-.140	***
Insomnia ← PDBI	.334	***
Insomnia ← BioSex	.127	***
Insomnia ← ASRN	.111	***
Insomnia ← FSUBGS	.096	***

Note: FA= Food Addiction; IA= Internet Addiction; SA= Smartphone Addiction; ST= Support and Trust; DNS= Difficulty Negotiating and Sharing; PDBI= Pleasure Driven Behaviour and Impulsivity, BioSex= Biological Sex, ASRN=Access to Screens in the Room at Night, FSUBS = Frequency of Screen Use Before Going to Sleep/Until Falling Asleep.
***p<.001

DISCUSSION

This study aimed to comprehend which of the studied variables predict insomnia among a large sample of Portuguese adolescents. This is an important research since previous studies have found that the prevalence of teenagers suffering with sleep disturbances is around 11-30% (Blunden et al., 2012), with a tendency to increase (de Zambotti et al., 2018). However, sleep deprivation may threaten adolescent's health on several levels (SNS24, 2023). In this study, 31,5% of adolescents reported moderate to severe insomnia.

As already mentioned, there are several risk factors that can lead to the development of insomnia. In this study it was found that FA, IA, Support and Trust, Pleasure Driven Behaviour and Impulsivity, being female, Access to Screens at Night, and Frequency of Screen Use Before Going to Sleep/Until Falling Asleep are all predictors of insomnia in this sample of Portuguese adolescents. However, Difficulty Negotiating and Sharing, SA, and Resisting Temptation and Self-Discipline are not.

In this way, adolescents who present higher levels of FA, experience higher levels of insomnia. This finding aligns with the results obtained by Najem et al. (2019), in which sleep quality has been proven to be impaired by FA.

When it comes to IA, SA, Access to Screens at Night and Frequency of Screen Use Before Going to Sleep/Until Falling it was observed that adolescents who experience higher levels of IA, have higher access to screens at night and report higher frequency of screen use present higher levels of insomnia. This finding aligns with what was found by Bhatt and Gaur (2019), where higher levels of IA were associated with higher levels of insomnia and screen use led adolescents to stay up late (Hale & Guan, 2015). However, higher levels of SA are not associated with insomnia. This result goes against the findings of Van Deursen et al. (2015) in which SA proved to impair sleep. Thus, it is hypothesised that adolescents might be using other types of screens (e.g., smartwatches, computers, tablets) rather than smartphones, and these screens might be the ones foreseeing their insomnia.

Regarding family context, it was observed that adolescents who experience higher levels of family support and trust, present lower levels of insomnia. However, it was also found that difficulty negotiating and sharing does not predict insomnia in this sample. This way, the role of family in adolescents' adjustment, especially to sleep, is emphasised (as seen in another studies, e.g., Kurock et al., 2022). These findings are supported by El-Sheikh and Kelly (2017), in the sense that family contexts characterised by mutual trust, and positive

communication, allow teenagers to feel secure, reducing the chances of developing insomnia, but they are at the same time contrasted since the authors observed that family contexts marked by chaos and instability make adolescents more vulnerable to developing sleep disorders (El-Sheikh & Kelly, 2017). However, the results of this study are supported by longitudinal studies developed by Roberts et al. (2008), in that they found an inconsistency in the impact that negative family factors have on adolescents' sleep in the long term. These results also raise the hypothesis that this relationship may be bidirectional (such that adolescents' sleep problems may create more problems at home; Roberts et al., 2008).

When it comes to self-control, it was found that adolescents who present higher levels of pleasure driven behaviour and impulsivity, also present higher levels of insomnia. However, higher levels of resisting temptation and self-discipline are not associated with insomnia; hence, the later does not serve as a protective variable. As Bauducco et al. (2019) found, changes in sleep patterns lead to increased difficulties with impulse control which in turn, jeopardise sleep quality and promote sleep disturbances. Additionally, positive affect is linked to better sleep quality and this mutual interaction promotes self-control and improves emotion regulation (Kalmbach et al., 2014).

Finally, in this study it was observed that female adolescents present higher levels of insomnia than male adolescents. These differences can be explained by the fact that girls might be less adaptative in managing negative emotions, since they may resort to maladaptive coping mechanisms (e.g., rumination; Nolen-Hoeksema & Girgus, 1994) to deal with a negative mood, which can result in insomnia (Hiller et al., 2015).

The refined model that was obtained explains 31% of the variability of insomnia, which means that 69% of its variability remains unexplained. Nevertheless, there are other variables such as school-related stress, peer-related conflict, school appreciation/valorisation, perceived safety in their homes, that might help explaining insomnia (Hsieh et al., 2019; Li et al., 2019; Roberts et al., 2008; Zhang et al., 2021). It would therefore be very interesting for future studies to address these variables and explore their associations with insomnia.

This study presents some limitations, such as the fact that the BSCS has 8 items assessing Pleasure Driven Behaviour and Impulsivity and only 4 items assessing Resisting Temptation and Self-Discipline. Therefore, this instrument presents more variability in the Pleasure Driven Behaviour and Impulsivity spectrum than in the Resisting Temptation and Self-Discipline spectrum. This way, Resisting Temptation and Self-Discipline may not have

been properly assessed. Additionally, the fact that the questionnaire was completed by the students without the presence of the investigator was also a limitation, as it was not possible to clarify any doubts. In the future, it would be pertinent to include adolescents from both Portuguese islands (i.e., Azores and Madeira) and the mainland, and to conduct a thorough evaluation of both self-control dimensions, using two independent instruments to better assess Pleasure Driven Behaviour and Impulsivity and Resisting Temptation and Self-Discipline.

However, this study also has its strengths, namely the fact that it is conducted with a large and balanced sample in terms of biological sex, and this is a unique study developed with a Portuguese sample from an insular reality, that seeks to understand what individual and familial experiences contribute to insomnia in these adolescents.

In conclusion, both individual characteristics (Biological Sex, addiction patterns (FA, IA), positive family-related experiences (Support and Trust), psychological (Pleasure Driven Behaviour and Impulsivity) and behavioural (Access to Screens at Night, Frequency of Screen Use Before Going to Sleep/Until Falling Asleep) predict insomnia in this sample of Portuguese adolescents. Therefore, future interventions in this area should focus on the promotion of sleep hygiene behaviours and the importance of making pro-health choices such as having a healthy diet, reduce screen time, better impulse control, better family communication, trust and negotiation so that adolescents remain physically, emotionally, socially, and psychologically healthy.

CHAPTER 2

SELF-CONTROL: A MEDIATOR BETWEEN FOOD ADDICTION AND INSOMNIA?

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ABSTRACT

Eating habits and circadian rhythms are influenced by behaviours that impact adolescent health. Food addiction (FA) is linked to weak emotional regulation and impulsivity. However, evidence on its impact on sleep remains limited. Thus, this study aims to explore whether FA predicts insomnia in adolescents and whether self-control (both Resisting Temptation and Self-Discipline and Pleasure Driven Behaviour and Impulsivity) mediates this relationship. The sample consisted of 1566 young individuals attending schools in Madeira, aged between 12 and 19 years (M =14.79, SD = 1.89), who completed an online questionnaire including sociodemographic data, the Portuguese version of the Yale Food Addiction Scale (P-YFAS), Athens Insomnia Scale (AIS), and Brief Self-Control Scale (EBAC). A parallel mediation model was conducted, with gender and age as covariates. There is a significant positive direct effect of FA on insomnia (β =.068, $p<.001$) and a positive indirect effect of FA on insomnia, mediated by the Pleasure Driven Behaviour and Impulsivity dimension (β = .224). The results highlight the relevance of developing interventions focused on youth impulsivity, providing strategies aimed at promoting impulse control, sleep hygiene (also addressing compulsive eating behaviour), and making pro-health decisions.

Keywords: Food addiction, Insomnia, Resisting Temptation and Self-Discipline, Pleasure Driven Behaviour and Impulsivity

INTRODUCTION

Dietary habits and sleep patterns are predictors of adolescent health. Research indicates that approximately 11-30% of young people suffer from some form of sleep disorder (Blunden et al., 2012). Insomnia, in particular, is characterized by difficulty falling asleep and/or maintaining sleep, along with possible early awakenings, and significantly impacts the lives of those experiencing it, potentially leading to exhaustion and overindulgence (e.g., in eating) (Cunnington, 2013). The specific cause of insomnia is complex and challenging to identify. One risk factor for insomnia is being female, as young, and adult women are more likely to develop insomnia than their male counterparts (Johnson, 2006). Additionally, factors like increasing age, tobacco, drug, and alcohol consumption (NHLBI, 2022b), anxiety, depression (Strine & Chapman, 2005), and even smartphones excessive use/misuse (Van Deursen et al., 2015) could be risk factors for insomnia development. Research reveals that diet is a significant predictor of sleep quality and, therefore, can also be a cause of insomnia (Tan et al., 2015). Moreover, a high intake of sweets, sodas, and carbohydrates is associated with poor sleep quality, while a diet rich in fish, vegetables, and vitamin D is linked to better sleep quality (Tan et al., 2015).

Food addiction (FA) involves the consumption of highly palatable foods (i.e., foods high in sugar, salt, and fats) in quantities exceeding those necessary for maintaining homeostasis (Kalon et al., 2016). Therefore, this behaviour poses a risk for overweight and even obesity development (Falcon et al., 2021). FA is a clinical condition conceptualized in the context of substance dependence, involving a strong craving for the substance (i.e., food), loss of control over consumption, significant effort and time spent to obtain it, and inability to reduce or stop consumption (Torres et al., 2017).

Self-control is a skill that allows individuals to regulate and control their own behavioural, psychological, and physical processes in order to achieve a defined long-term goal (Blankstein & Polivy, 1982).

The model proposed by Claudatos et al. (2019) aims to explain the bidirectional relationship between sleep disturbances—caused by external factors (e.g., increased screen time) and internal factors (e.g., changes in circadian rhythms)—and substance consumption in adolescents. This relationship can occur through three different pathways: 1) negative coping, 2) emotional dysregulation, and 3) reward seeking/weak impulse control.

The authors of the model argue that adolescence is marked by significant changes in sleep cycles, such as a preference for later bedtime (Claudatos et al., 2019). These changes occur due to shifts in young people's circadian rhythms influenced by environmental factors (e.g., early school start times), developmental factors (e.g., increased autonomy in managing their routines compared to childhood), and behavioural factors (e.g., reduced sleep time during the week compensated by longer sleep on weekends) (Wolfson & Carskadon, 1998). Moreover, sleep deprivation impairs inhibitory processes, affecting teenagers' behaviour and self-control, potentially leading to risky behaviours, such as consuming highly caloric foods (Claudatos et al., 2019). This relationship can create a vicious circle since addictive consumption of high-calorie foods may impact sleep, particularly its quality and interruptions (Claudatos et al., 2019).

Negative coping is a mechanism that catalyses this relationship, as adolescents may consume substances as a coping mechanism to promote sleep (Goodhines et al., 2017), which might induce excessive consumption and have the opposite effect, disrupting sleep itself (Claudatos et al., 2019).

Regarding emotional dysregulation, it is known that sleep uniquely contributes to emotional recalibration and functioning (Walker et al., 2009). Therefore, sleep deprivation could impair emotional experience regulation. Adolescents in this situation might be more vulnerable to neurobiological changes in emotional regulation and reward response, diverging from those occurring in normal development of adolescents who have no sleep disorder/insomnia (Volkow et al., 2012). Thus, young people with varying circadian rhythms throughout the week may be more susceptible to reduced behavioural and emotional self-regulation, making them more prone to substance consumption (Claudatos et al., 2019).

Additionally, concerning reward seeking/weak impulse control, adolescents undergo a crucial phase in the development of structures essential for the reward cycle's functioning, also involved in mood and behaviour, which can lead to alterations in reward functioning and impulse control (Clark et al., 2008). These changes can make them more vulnerable to initiating substance consumption (Romer et al., 2009).

To date, it is known that FA is related to weak emotional regulation (Kozak et al., 2017) and impulsivity (Kalon et al., 2016). However, there is still limited information on how it affects young people's sleep. FA conceptualization is based on the substance dependence model (Torres et al., 2017). Therefore, this research builds upon the conceptual model

developed by Claudatos et al. (2019) with the aim of exploring the unidirectional relationship between FA and insomnia. Specifically, it seeks to understand how FA predicts insomnia and how self-control (both Resisting Temptation and Self-Discipline and Pleasure Driven Behaviour and Impulsivity) mediates this relationship.

METHOD

Participants

Initially, the sample comprised 1672 young individuals from Madeira, out of which 106 participants were excluded due to not providing consent (*n*=56), not indicating their biological sex (*n*=10), not meeting the specified age criteria (*n*=20), or not providing reliable information for weight percentile calculation (*n*=20). The final sample consisted of 1566 participants eligible for this study, with an average age of 14.79 (*SD*=1.89). Inclusion criteria involved being a student in the Autonomous Region of Madeira and aged between 12 and 19 years. Thus, out of a total of 17,989 students attending the 3rd cycle of basic education and secondary education in Madeira during the academic year 2019/2020, 1566 students were eligible for this study. Consequently, the sample represents 8.72% of the Madeiran student population in the 3rd cycle of basic education and secondary education in the 2019/2020 public education year (DREM, 2023). The characteristics of the participants are shown in Table 5.

Table 5.

Participants' characteristics.

Characteristics	**Adolescents** (*n*=1566)
	***n* (%)**
Sex	
Males	742 (47.4)
Females	824 (52.6)
Level of Education	
Basic Education (3rd cycle)	854 (54.5)
Secondary Education	712 (45.5)
Residential Areas	
Urban Areas	1178 (75.2)

Rural Areas	388 (24.8)
Academic Performance	
Students with very good grades	194 (12.4)
Students with good grades	680 (43.4)
Students with sufficient grades	635 (40.5)
Students with negative grades	57 (3.6)
Academic Retention	
Students who had never been retained	1155 (73.8)
Students who had been retained in one or more years	411 (26.2)

Measures

***Sociodemographic Data*:** Sociodemographic measures included biological sex, age, residential area, academic performance, academic retention, height, and weight.

***Yale Food Addiction Scale (P-YFAS)*:** This scale consists of 24 self-report items assessing addictive eating behaviours occurring over the past year (e.g., "*I felt sluggish or tired from overeating.*"; Torres et al., 2017). The YFAS was developed according to the criteria for substance dependence disorder described in the DSM-IV-TR , which were adapted to food behaviour, resulting in seven criteria: 1) consuming larger amounts or for longer periods than intended (items 1, 2, 3); 2) inability to reduce or stop certain foods' consumption (items 4, 22, 24); 3) spending significant time and effort on food consumption (items 5, 6, 7); 4) giving up important social activities (items 8, 9, 10, 11); 5) persistent behaviour despite knowledge of its physical and psychological consequences (item 19); 6) tolerance (items 20, 21); and 7) withdrawal (items 12, 13, 14). Higher scores indicate more symptomatic expression consistent with a FA pattern. The scale provides continuous scores indicating the number of checked addiction symptoms. The first 23 items are rated on a 5-point Likert scale ranging from 0 “never” to 4 “4 or more times per week, or daily”, and the last item on a 5-point Likert scale ranging from 1 “1 or fewer times” to 5 “5 or more times”. The scale also has a dichotomous scoring system indicating whether a person exhibits symptomatic expression similar to a situation of FA (yes/no) if they have at least 3 symptoms and report clinically significant impairment. In this study, the continuous scoring method was used. The

scale demonstrated good internal consistency for the Portuguese population, with α=.82, indicating its reliability (Torres et al., 2017).

***Brief Self-Control Scale (BSCS)*:** This scale assesses self-control and consists of 12 items rated on a 5-point Likert scale ranging from 1 "Not at all like me" to 5 "Very much like me". It has two dimensions: Maladaptive/Dysfunctional Self-Control (items 2, 3, 4, 5, 9, 10, 12, 13) (e.g., "*I say inappropriate things.*"; Água et al., 2020) and Adaptive/Functional Self-Control (items 1, 6, 8, 11) (e.g., "*People would say I have strong self-discipline*."; Água et al., 2020). After analysing the content of all items, it was decided to change the name of both dimensions, where Dysfunctional Self-Control became Pleasure Driven Behaviour and Impulsivity and Functional Self-Control became Resisting Temptation and Self-Discipline. To calculate the total score, items related to the first dimension were reversed, so that a higher score corresponds to a greater ability to resist temptation and higher levels of self-discipline. Both Pleasure Driven Behaviour and Impulsivity and Resisting Temptation and Self-Discipline dimensions demonstrated good and acceptable internal consistency, with α=.86 and α=.68 respectively, indicating the instrument's reliability (Água et al., 2020).

Athens Insomnia Scale (AIS): This scale assesses the level of experienced insomnia and consists of 8 items (e.g., "*Difficulty in initiating sleep*."; Soldatos et al., 2000), corresponding to criteria A, B, and C of the International Classification of Diseases - 10 (ICD-10) insomnia diagnosis. Criterion A assesses difficulty initiating sleep, nocturnal awakenings, early morning awakenings, overall sleep quality, and sleep duration. Criterion B refers to the frequency of these events, with a minimum of at least 3 times per week over the last month. Finally, criterion C corresponds to the daily repercussions experienced due to lack of sleep (e.g., well-being, physical and mental functionality, and perceived sleepiness). Each item is rated on a 4-point Likert scale, ranging from 0 "No Problem at All" to 3 "Very Serious Problem". Total scores range from 0 (absence of insomnia) to 24 (severe insomnia level), with total scores equal to or higher than 6 indicating a symptomatic expression consistent with insomnia (Soldatos et al., 2003). Regarding internal consistency, the AIS-8 exhibited a value of α=.82 in validation for the Portuguese population, indicating good internal consistency and the scale's reliability (Lamelas et al., 2023).

Procedure

The research project was approved by the Ethics Committee of ISPA – University Institute and by the Regional Secretariat of Education, Science, and Technology of the Regional Government of Madeira. Subsequently, various public schools in Madeira were

contacted to request permission to distribute online questionnaires to students in basic and secondary education. Prior to participation, informed consent was obtained from the young individuals, and an Informed Consent form was sent to the legal guardians of students under 16 years old, in collaboration with the Regional Secretariat of Education, Science, and Technology of the Regional Government of Madeira. After obtaining informed consents and ensuring compliance with inclusion criteria, students completed the questionnaire in the classroom setting. The research adhered to the Deontological Code of the Ordem dos Psicólogos Portugueses (2021) and the principles of the American Psychological Association (2017) regarding ethical treatment of participants.

Regarding data analysis, it will be performed one parallel mediation model (i.e., mediation model number 4) between FA (independent variable) and insomnia (dependent variable) through IBM SPSS PROCESS macro version 4.2. This mediation model will be created with a 95% confidence interval, based on 10.000 bootstrap samples, using sex and age as covariates. Direct and indirect effects will be analysed according to Hayes' criteria, which states that the significance is considered by excluding 0 from the confidence interval (Hayes, 2018).

RESULTS

Initially, the sample was analysed to provide a general characterization of the percentiles, insomnia levels, and FA among the students. Regarding percentile evaluation, generally, the students predominantly had normal weight, with a total of 1116 (71.3%) students, followed by 215 (13.7%) students classified as overweight, 181 (11.6%) with obesity, and 54 (3.4%) underweight. Concerning insomnia levels, the sample had a mean of 4.45 (*SD*=3.88), with a minimum of 0 and a maximum of 23, indicating that the majority of the young individuals in this sample, specifically 1072 (68.5%) young people, did not show symptomatic expression consistent with insomnia. However, 494 (31.5%) young people exhibited insomnia levels equal to or greater than 6, indicating symptomatic expression consistent with insomnia, revealing that a significant portion of students still experiences mild, moderate, or severe insomnia. Regarding FA (Food Addiction) levels, the mean was 2.85 (*SD*=2.10), with a minimum of 0 and a maximum of 8 symptoms identified consistent with those presented in cases of FA. In general, young individuals exhibited only 2 symptoms consistent with those experienced in FA, with a total of 776 (49.6%) young people in this situation. However, the remaining 790 (50.4%) young people exhibited 3 or more symptoms consistent with those experienced in FA, indicating a high number of adolescents in this situation.

Subsequently, a simple linear regression model was conducted, with insomnia as the dependent variable and FA as the independent variable. The linear regression model revealed that FA is positively and significantly associated with insomnia (r=.227, p<.001). Furthermore, another complementary linear regression model was performed, adding the variables gender and age, as shown in Table 6. In this model, it was observed that in addition to the previously identified relationship between FA and insomnia, there is also a positive and significant relationship between sex and insomnia (r=.114, p<.001). This indicates that females are more prone to insomnia compared to their male counterparts. Conversely, there is no significant relationship between age and insomnia (r=.046, p=.049).

Table 6

Regression Coefficients of FA on Insomnia. Simple linear regression model of the correlation between FA (independent variable) and insomnia (dependent variable) with age and gender as covariates (total sample with male and female youth).

Variable	*B*	*β*	*SE*	*Sig*
Constant	5.055***		.792	<.001
FA	.068***	.227	.008	<.001
Sex[a]	.882***	.114	.178	<.001
Age	.094	.046	.047	.049
Pleasure Driven Behaviour and Impulsivity	.158***	.265	.016	<.001
Resisting Temptation and Self-Discipline	-.048	-.045	.026	.061
R^2	.188			

Note: *n*=1566. The impact of FA on insomnia was examined, with the covariates being gender and age, as well as the variables pleasure driven behaviour and impulsivity and resisting temptation and self-discipline.

[a]Men/boys = 1, Women/girls = 2. FA=Food Addiction

****p*<.001

The mediation analysis was conducted using the SPSS PROCESS macro v4.2. Each model was generated with a 95% confidence interval, based on 10,000 bootstrap samples. The parallel mediation model presented in Table 7 reveals a significant positive direct effect of FA on insomnia (*c*'=.0679, *p*<.001). Additionally, there is a positive indirect effect of FA on insomnia, mediated by the dimension of Pleasure Driven Behaviour and Impulsivity (a_1=.224). Conversely, a non-significant indirect effect of FA on insomnia was observed when mediated by the dimension of Resisting Temptation and Self-Discipline (a_2=-.021), indicating that this is a mediator to be disregarded. The significance of the mentioned effects is determined by the exclusion of 0 from the confidence interval. The model is schematically represented in Figure 3.

Table 7

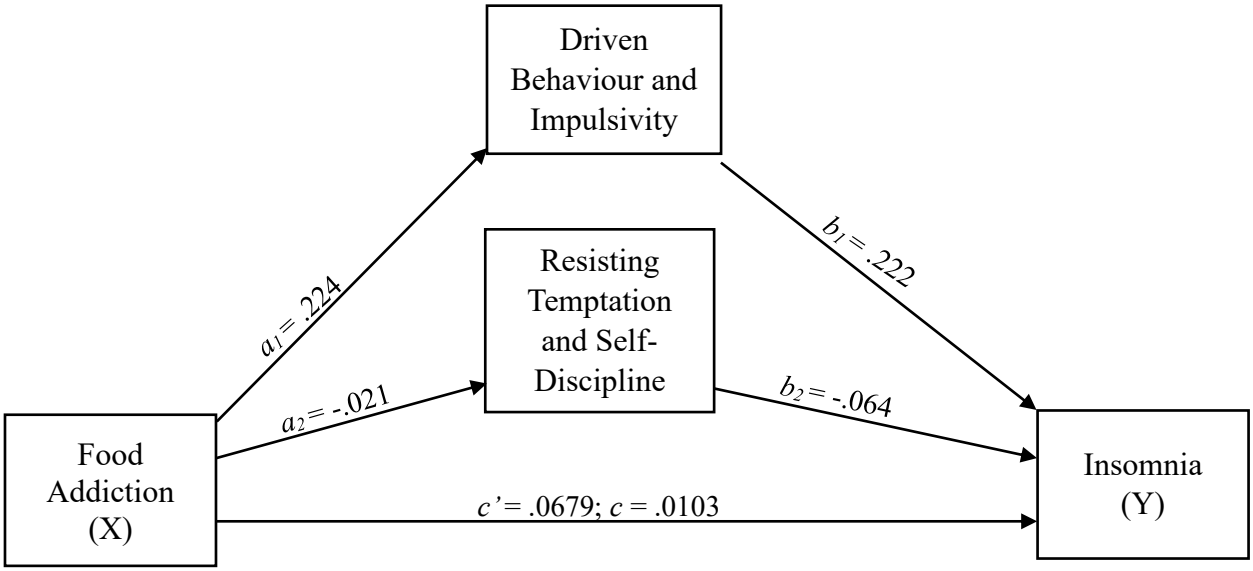
Parallel mediation of the correlation between food addiction (independent variable) and insomnia (dependent variable) with age and sex as covariates (total sample of male and female youth).

	Direct effect of FA on insomnia	*SE*	*LLCI*	*ULCI*
	.0679***	.0077	.0528	.0829
Mediators	*Indirect effects of FA on insomnia*	*BootSE*	*BootLLCI*	*BootULCI*
Pleasure Driven Behaviour and Impulsivity	.0361***	.0042	.0282	.0448
Resisting Temptation and Self-Discipline	-.0007 (NS)	.0005	-.0019	.0001

Note: *n*=1566. SE = standard error; LLCI = lower limit of the confidence interval; ULCI = upper limit of the confidence interval; BootLLCI = lower bootstrap limit of the confidence interval; BootULCI = upper bootstrap limit of the confidence interval.
***p <.001; NS = nonsignificant

Figure 3

Schematic representation of the parallel mediation model of the correlation between food addiction (independent variable) and insomnia (dependent variable) with age and sex as covariates.



DISCUSSION

This study aimed to understand how FA can help explain insomnia in young people from Madeira, mediated by the variable of self-control. This research is particularly relevant as sleep-wake cycles and eating habits are regulated by circadian rhythms (Najem et al., 2019). Disruptions in circadian rhythms can be a risk factor for physical conditions like obesity (Kandeger et al., 2018) and psychological conditions like depression (Armitage, 2007). Circadian rhythms are also related to the reward system (Murray et al., 2009). Therefore, disturbances in circadian rhythms could affect inhibitory control, enhance impulsivity, and increase the seeking of rewards, reinforcing substance (e.g., food) consumption (Tashjian et al., 2017).

This study found that FA helps explain insomnia in young adolescents when their self-control tendencies lean towards dysfunctionality, indicating higher impulsivity and a pleasure driven behaviour (Lindner et al., 2015). Conversely, resisting temptation and self-discipline does not mediate the relationship between FA and insomnia. This suggests that Pleasure Driven Behaviour and Impulsivity is a risk factor for both FA development and subsequent insomnia.

The results of this study align with previous research in this area and support the theoretical model proposed by Claudatos et al. (2019), demonstrating a unidirectional relationship between FA and insomnia. This relationship was also found in a study by Najem et al. (2019), where FA was associated with poorer sleep quality. Given that FA involves impulsive consumption of certain foods, it is naturally related to an individual's self-control (Luo et al., 2022). Higher levels of self-control are associated with increased self-efficacy and can reduce impulsivity, preventing excessive consumption (Wang et al., 2015). Conversely, lower self-control levels are linked to higher impulsivity, increasing the risk of developing FA (Minhas et al., 2021).

Moreover, uncontrolled consumption of certain foods can serve as a regulatory mechanism, allowing individuals to manage negative emotions (Lou et al., 2022). Individuals experiencing anxiety and depression tend to consume highly palatable foods as a way to alleviate their negative or depressed mood (Oliveira et al., 2020), highlighting the association of FA with impulsivity and mood (Kalon et al., 2016). Furthermore, chronic stress can exacerbate the dysregulation of the reward system, increasing the risk of developing FA (Wei et al., 2019).

Additionally, research has shown that the prevalence of FA among adolescents ranges from 2-16% (Rodrigue et al., 2019). These prevalence rates are influenced by cultural factors and can vary across populations (Luo et al., 2022). In a country like Portugal, with a rich culinary tradition, people might perceive consuming large quantities of food as acceptable, whereas in other countries, it might be considered excessive and characteristic of FA (Torres et al., 2017). In this sample, approximately half, specifically 776 (49.6%) young individuals, exhibited only 2 symptoms consistent with FA. However, the concern lies with the other half; the remaining 790 (50.4%) young individuals showed 3 or more symptoms consistent with those experienced in FA, a significantly high figure.

Regarding insomnia, 1072 (68.5%) young individuals did not exhibit symptoms typical of insomnia. However, 494 (31.5%) young individuals showed symptoms consistent with insomnia, indicating a substantial portion of students experiencing mild, moderate, or severe levels of insomnia. Thus, despite half the sample displaying mild levels of FA and the other half showing moderate to high levels, with the majority not exhibiting symptoms indicative of insomnia, the partial mediation of Pleasure Driven Behaviour and Impulsivity in the relationship between FA and insomnia is pronounced. This suggests that in cases of very high FA prevalence, this relationship could be even more pronounced, leading to significantly higher insomnia levels.

As previously mentioned, it was also observed that females experience higher levels of insomnia, in line with Johnson's (2006) findings that the female biological sex (being a women) could be a risk factor for insomnia development. This may be explained by the pubertal development that young females experience during this phase (Zhang et al., 2016).

Despite providing valuable insights, this study has limitations. The inclusion of participants solely from the Autonomous Region of Madeira may have made the sample peculiar and distinct, with the region's cultural traits potentially influencing the variables under study. Future studies should aim to include Portuguese youth from across the country, including both mainland and other islands. Additionally, the online nature of the questionnaire, without the presence of a researcher, might have hindered clarification of participant doubts. Furthermore, the option to skip certain questions could have led participants to omit answers in specific parts of the questionnaire.

Nonetheless, this study has notable strengths. It is among the first to consider self-control as a mediator in the relationship between FA and insomnia. Moreover, the study was conducted with a sample that represents 8.72% of the student population in the Autonomous

Region of Madeira in the 3rd cycle of basic education and secondary education in the 2019/2020 school year, which, despite appearing small, adds value to the study due to the substantial sample size (i.e., 1566 participants) and represents nearly 10% of the population under study.

The main conclusion of this study emphasizes the role of pleasure driven behaviour and impulsivity as a driver in the relationship between FA and insomnia, partially amplifying FA's influence on insomnia. Simultaneously, resisting temptation and self-discipline does not impact this relationship, meaning it does not shield individuals from initiating these addictive behaviours.

Thus, the results of this study highlight the importance of developing interventions for this age group, focused on pleasure driven behaviour, particularly addressing juvenile impulsivity. Providing strategies aimed at promoting impulse control and pro-health decision-making is essential. Equally important is empowering young individuals and informing them about the importance of maintaining good sleep hygiene, explaining how circadian rhythms need to be aligned with individual needs to ensure optimal physical, emotional, cognitive, and mental functioning.

CHAPTER 3

CAN SELF-CONTROL MEDIATE THE RELATIONSHIPS BETWEEN INTERNET/SMARTPHONE ADDICTION AND INSOMNIA?

Paper submitted for publication

ABSTRACT

Background: Adolescence is associated with multiple factors that can dysregulate teenagers' sleep. Internet addiction (IA) and smartphone addiction (SA) are becoming a major health concern since they can harm teenagers' sleep quality. Evidence regarding its impact on Portuguese adolescents' sleep, as well as how can self-control influence these relationships is still limited. Therefore, this study aims to explore if IA and SA predict insomnia in adolescents and whether self-control (Pleasure Driven Behaviour and Impulsivity and Resisting Temptation and Self-Discipline) mediates these relationships. **Method:** This cross-sectional online study included 1,566 adolescents from Madeira, Portugal (12-19 years old; M=14.79, SD=1.89). Data were collected using the Internet Addiction Test, Smartphone Addiction Scale – Short Version, Brief Self-Control Scale, and the Athens Insomnia Scale. A mediation analysis was conducted using SPSS PROCESS macro v4.2. **Findings:** Two parallel mediation models were performed with age and biological sex as covariates, one for each addiction. A significant direct effect of IA and SA on insomnia was found (B=.0375 and B=.0425, respectively; p<.001), along with significant indirect effects of IA and SA on insomnia, when mediated by pleasure driven behaviour and impulsivity (B=.2333, 95% CI = [.0322, .0496] and B=.3136, 95% CI =[.0496, .0751]). **Discussion:** Resisting Temptation and Self-Discipline did not work as a protective variable. This study highlights the pertinence of developing future interventions focusing on youth impulsivity, specifically promoting impulse control, the adoption of sleep hygiene behaviours and providing strategies on how to better regulate a healthy use of smartphones/internet.

Keywords: Internet addiction, Smartphone addiction, Insomnia, Resisting Temptation and Self-Discipline, Pleasure Driven Behaviour and Impulsivity

INTRODUCTION

Sleep patterns and quality are predictive of teenage health (Blunden et al., 2012; Maratia et al., 2023). The use of social media/smartphones, as well as independent bedtime scheduling, postpones sleep onset (Scott et al., 2019; Tashjian et al., 2019). Adolescents need to sleep in order to develop cognitively, psychologically, and physically (Brand & Kirov, 2011). However, according to previous studies, 11-30% of adolescents suffer from sleep disturbances (Blunden et al., 2012), and this prevalence is rising (de Zambotti et al., 2018).

Insomnia involves a difficulty related with sleep initiation and/or maintenance, as well as early awakenings (Cunnington, 2013). It is difficult to pinpoint the exact cause of insomnia but there are some risk factors that can influence the development of insomnia, such as using tobacco (NHLBI, 2022b), and also overusing smartphones/internet (Bhatt & Gaur, 2019; Van Deursen et al., 2015).

The way people use technology, particularly in their interactions with one another, has been permanently altered by the internet. In 2019, there were about 4.1 billion internet users worldwide (International Telecommunication Union, 2019). However, the realization that some internet users have developed an addiction to the internet, has prompted the development of research into the concept of Internet Addiction (IA). IA can be defined as prolonged, problematic, and compulsive internet use that impairs an individual's functioning (Kapus et al., 2021). Additionally, the widespread adoption of smartphones as the primary means of accessing the internet has forever changed the way people live their daily lives. As a result, individuals have unintentionally become addicted to their smartphones – Smartphone Addiction (SA), as they have become inseparable from them (Chotpitayasunondh & Douglas, 2016). SA can be defined as a compulsive condition in which the individual's functions are compromised duet to their uncontrolled use of smartphones (Chóliz, 2010).

Previous research has found that IA and SA are positively associated (Ben-Yehuda et al., 2016), and both have negative effects on the people who experience them. This way, IA and SA can jeopardise adolescent's normal development as they influence their coping mechanisms, interpersonal relationships, academic performances as well as leading teenagers to experience physical pain (e.g., neck and shoulder pain; AlBarashdi et al., 2016; Kim, 2013; Samaha & Hawi, 2016). Adolescence comprises a critical period of development in which teenagers are searching for their autonomy, forming new peer relationships, and modifying their behaviour (Mak et al, 2014). As such, they are more vulnerable to develop SA due to their curiosity and lack of self-control (Kim & Lee, 2022; Munno et al., 2017).

Self-control is the ability of an individual to withstand both internal and external temptations in order to accomplish long-term goals (Tangney et al., 2004). Previous studies have shown that self-control is negatively associated with SA, although the strength of the correlation varies between studies (Jeong et al., 2020; Li et al., 2021). However, when it comes to the relationship between IA and self-control the results regarding their association are still unclear, as it has not yet been possible to see whether a lack of self-control (i.e. increased impulsivity) leads to IA (Li et al., 2021).

The model put forth by Claudatos et al. (2019), seeks to explain the reciprocal relationship that exists between adolescent substance use (in this case, internet/smartphones use) and sleep disturbances brought on by both internal and external factors. The authors defend that three distinct processes may influence this relationship: 1) emotional dysregulation, 2) reward seeking/weak impulse control, and 3) negative coping.

Previous studies have shown that poor self-control is related with SA, and might be related with IA (Jeong et al., 2020; Li et al., 2021). However, it remains unclear how these relationships affect adolescents' sleep. Thus, the present study is based on Claudatos et al. (2019) theoretical model, with the aim of exploring the unidirectional relationship between 1) IA and insomnia and 2) SA and insomnia and if self-control (i.e., Resisting Temptation and Self-Discipline, and Pleasure Driven Behaviour and Impulsivity) mediates these two relationships.

METHOD

Participants

This study is descriptive (observational), correlational and cross-sectional. Initially, the sample consisted of 1672 young individuals from the Autonomous Region of Madeira, of which 106 participants were excluded for failing to provide consent (*n*=10), to meet the specific age requirements (*n*=20) or failing to provide reliable or enough information regarding variables under study (*n*=20). As a result, the final sample included 1566 participants qualified for this study, with an average age of 14.79 (*SD*=1.89). The inclusion criteria consisted of being a student in the Autonomous Region of Madeira between the ages of 12 and 19 and having their parents (age < 18 years old) and own (18-19 years old) informed consent. In this way, 1566 students qualified for this study out of a total of 17,989 students attending the 3rd cycle of basic education and secondary education in Madeira during the academic year 2019/2020. Thus, the sample size corresponds to 8,72% of the Madeiran student population in the 3rd cycle of basic education and secondary education during the 2019/2020 public school year (DREM, 2023). Participants' characteristics are presented in table 8 and internet access and use in table 9.

Table 8

Participants' characteristics

Characteristics	**Adolescents** (*n*=1566) ***n* (%)**
Sex	
Males	742 (47.4)
Females	824 (52.6)
Level of Education	
Basic Education (3rd cycle)	854 (54.5)
Secondary Education	712 (45.5)
Residential Areas	
Urban Areas	1178 (75.2)
Rural Areas	388 (24.8)
Academic Performance	
Students with very good grades	194 (12.4)
Students with good grades	680 (43.4)
Students with sufficient grades	635 (40.5)
Students with negative grades	57 (3.6)
Academic Retention	
Students who had never been retained	1155 (73.8)
Students who had been retained in one or more years	411 (26.2)

Table 9

Participants' access and use of the internet data

Characteristics	**Adolescents** (*n*=1566) ***n* (%)**
Having a smartphone/mobile phone	
Have a smartphone	1336 (85.3)
Have a mobile phone	212 (13.5)
Don´t have any	18 (1.1)
Times per day they use their smartphone/mobile phone	
1-10 times	332 (21.2)
11-20 times	463 (29.6)
21-30 times	309 (19.7)
More than 31 times	462 (29.5)
Time per day during the week they use the Internet for leisure or hobbies	
Up to 30 minutes	71 (4.5)
From 30 to 60 minutes	141 (9.0)
From 1 to 2 hours	258 (16.5)
From 2 to 4 hours	383 (24.5)
From 4 to 6 hours	260 (16.6)
From 6 to 8 hours	163 (10.4)
More than 8 hours	290 (18.5)
Time per day during the weekend they use the Internet for leisure or hobbies	
Up to 30 minutes	75 (4.8)
From 30 to 60 minutes	119 (7.6)
From 1 to 2 hours	223 (14.2)
From 2 to 4 hours	286 (18.3)
From 4 to 6 hours	333 (21.3)
From 6 to 8 hours	227 (14.5)
More than 8 hours	303 (19.3)
Have family meals at the table	
Yes	1438 (91.8)
No	128 (8.2)

Use of electronic devices during meals with their families	
They and their families use it	129 (8.2)
They use it but their families don't	122 (7.8)
They don't use, but their family do	62 (4.0)
Neither them nor their families use	1175 (75.0)
Have access to screens (e.g., smartphone) in their rooms at night	
Yes	1189 (75.9)
No	377 (24.1)
How often do they use screens (e.g., tablets) just before bed or until they fall asleep	
Never	86 (5.5)
Rarely	262 (16.7)
Sometimes	436 (27.8)
Many times	249 (15.9)
Daily	533 (34.0)

Measures

Sociodemographic and Internet Access and Use Data: Biological sex, age, residential area, level of education, academic performance and retention were all sociodemographic measures. Internet use and access data included having or not a smartphone/mobile phone, times per day they use their smartphone, time per day during the week/weekend they use the Internet for leisure, use of electronic devices while having meals with their families and smartphone use before sleep.

***Internet Addiction Test (IAT)*:** Young (1998) developed this scale, which Pontes et al. (2014) validated on a Portuguese sample. The IAT consists of 20 items that assess how frequently the individual engages in specific online behaviours (e.g., "*How often do you stay online longer that you intended?*"; Pontes et al., 2014). This scale evaluates the severity of internet addiction, categorising it according to the harm it causes the individual. Each item was rated on a 6-point Likert scale, with 0 indicating "not applicable" and 5 indicating "always". The sum of each item score yields the final score, with 0-30 suggesting absence of internet addiction, 31-49 mild internet addiction, 50-79 moderate internet addiction and 80-100 severe internet addiction (Young, 2011). IAT demonstrated an excellent value of internal consistency, α=.90, in the validation to the Portuguese sample (Pontes et al., 2014).

Smartphone Addiction Scale – Short Version (SAS-SV): Kwon et al. (2013) developed this scale, which was validated on a Portuguese sample by Água et al. (2017). SAS-SV is a condensed version of the original SAS (33 items), consisting of 10 self-report items that assess the level of smartphone dependence (e.g., *"Missing planned work due to smartphone use."*; Kwon et al., 2013). Each item was rated on a 6-point Likert scale, with 1 being "strongly disagree" and 6 being "strongly agree". The final score was calculated by adding the scores of each item yet, the cut-off that indicates a greater manifestation of symptoms consistent with a smartphone addiction pattern is 31 for males and 33 for females. SAS-SV showed a good value of internal consistency α=.86 in the validation to a Portuguese sample, indicating the instrument's reliability (Água et al., 2017).

Brief Self-Control Scale (BSCS)**:** Tangney et al. (2004) developed this scale, which Água et al. (2020) validated on a Portuguese sample. The BCSC measures self-control and is composed of 12-items rated on a Likert scale ranging from 1 to 5, with 1 being "not at all like me" and 5 being "very much like me". This scale has 2 dimensions: Maladaptative/Dysfunctional Self-control (items 2, 3, 4, 5, 9, 10, 12, 13) (e.g., *"I have trouble breaking bad habits"*; Água et al., 2020) and Adaptive/Functional Self-Control (items 1, 6, 8, 11) (e.g., "*I refuse to do things that are harmful to me*."; Água et al., 2020). After carefully analysing the content of all items, the name of both dimensions was changed, were Dysfunctional Self-Control became Pleasure Driven Behaviour and Impulsivity and Functional Self-control became Resisting Temptation and Self-Discipline. Items related to the first dimension were reversed to determine the final score, with a higher score corresponding to a greater ability to resist temptation and higher self-discipline. The Resisting Temptation and Self-Discipline and Pleasure Driven Behaviour and Impulsivity demonstrated good and acceptable internal consistency in the validation to the Portuguese sample, with α=.86 and α=.68 respectively (Água et al., 2020).

Athens Insomnia Scale (AIS): Soldatos et al. (2000) developed this scale, which was validated on a Portuguese sample by Lamelas et al. (2023). The AIS assesses the level of experienced insomnia and is composed of 8 items (e.g., *"Sense of well-being during the day*."; Soldatos et al., 2000), which correspond to the International Classification of Diseases – 10 (ICD-10) criteria A, B and C for the diagnosis of insomnia. Criterion A evaluates sleep difficulties, sleep duration, nocturnal awakenings, early morning awakenings, and total sleep quality. Criterion B refers to the frequency of these events, which must occur at least three times per week for the previous month. Finally, criterion C is concerned with the effects of

sleep deprivation on an individual's daily functioning (e.g., physical, and mental functionality, well-being, perceived sleepiness). The items were rated on a 4-point Likert scale, with 0 indicating "no problem at all" and 3 indicating "very serious problem". Total scores ranges from 0 (absence of insomnia) to 24 (severe insomnia level). Still, total scores equal to or greater than 6 suggest symptomatic expression associated with insomnia (Soldatos et al., 2003). The AIS demonstrated good internal consistency with α=.82, when validated against the Portuguese sample (Lamelas, 2023).

Procedure

The Ethics Committee of ISPA – University Institute and the Regional Secretariat of Education, Science and Technology of the Regional Government of Madeira both approved the research project. Following that, Madeira public schools were contacted to request permission to distribute online surveys to students in the third cycle of basic and secondary education. Students were asked to provide Informed Consent prior to participation, and an Informed Consent was distributed to the legal guardians of the students under the age of 16 in collaboration with the Madeira Regional Secretariat of Education, Science and Technology.

After obtaining the Informed Consents and meeting the inclusion criteria, students completed an online survey on the Google Forms platform in the classroom setting. In terms of ethical treatment of participants, the research followed the Deontological Code of the Ordem dos Psicológos Portugueses (2021) and the guidelines of American Psychological Association (2017).

In terms of data analysis, it will be performed two parallel mediation models (mediation model number 4 – i.e., one for each addiction) between IA and SA (independent variables) and insomnia (dependent variable) using IBM SPSS PROCESS macro version 4.2. The two mediation models will be developed with a 95% confidence interval, based on 10.000 bootstrap samples, using age and sex as covariates. Direct and indirect effects will be analysed based on Hayes' criteria, which postulates that the significance is determined by the exclusion of 0 from the confidence interval (Hayes, 2018).

RESULTS

Descriptive analysis

In this sample, 68,5% of adolescents did not present symptoms congruent with insomnia, while 31,5% of them exhibited mild, moderate or severe levels of insomnia.

Regarding IA, 35,5% of adolescents did not present symptoms consistent with a pattern of IA, while 47,7%, 16,3% and 0,5% of them presented mild, moderate and severe levels of IA, respectively.

Finally, when it comes to SA levels, 21,5% of teenage girls present symptoms consistent with SA, while the other 78,5% did not. Regarding teenage boys and SA, 20,9% of them exhibit symptoms typical of SA while the other 79,1% of them did not.

Internet addiction and insomnia

The parallel mediation model presented in table 10, reveals the correlation between IA and insomnia mediated by Resisting Temptation and Self-Discipline and Pleasure Driven Behaviour and Impulsivity dimensions. In this model, it was possible to observe that there was a significant positive direct effect of IA on insomnia (c'=.0375, p<.001). Additionally, there was a significant positive indirect effect of IA on insomnia mediated by the Pleasure Driven Behaviour and Impulsivity dimension (B=.2333, SE= .0322, 95% CI= [.0322, .0496]). Additionally, there was also a weak negative significant indirect effect of IA on insomnia mediated by the Resisting Temptation and Self-Discipline dimension (B=.0266, SE= .0008, 95% CI= [-.0033, -.0003]). Therefore, it is possible to observe that Resisting Temptation and Self-Discipline were a weak protective factor for the development of IA and insomnia, when Pleasure Driven Behaviour and Impulsivity was controlled. Figure 4 shows the schematic representation of this mediation model.

Table 10

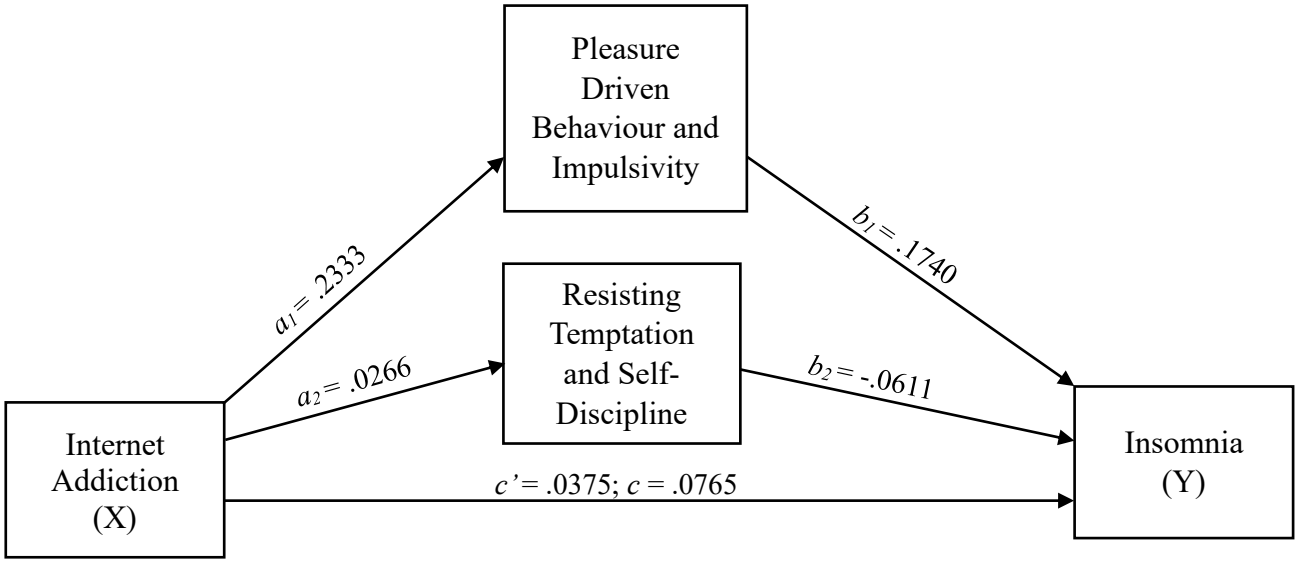
Parallel mediation of the correlation between internet addiction (independent variable) and insomnia (dependent variable) with age and sex as covariates (total sample of male and female youth)

	Direct effect of IA on insomnia	*SE*	*LLCI*	*ULCI*
	.0375***	.0071	.0236	.0514
Mediators	*Indirect effects of IA on insomnia*	*BootSE*	*BootLLCI*	*BootULCI*
Pleasure Driven Behaviour and Impulsivity	.0406***	.0045	.0322	.0496
Resisting Temptation and Self-Discipline	-.0016***	.0008	-.0033	-.0003

Note: *n*=1566. SE = standard error; LLCI = lower limit of the confidence interval; ULCI = upper limit of the confidence interval; BootLLCI = lower bootstrap limit of the confidence interval; BootULCI = upper bootstrap limit of the confidence interval.
***p <.001; NS = nonsignificant

Figure 4

Schematic representation of the parallel mediation model of the correlation between internet addiction (independent variable) and insomnia (dependent variable) with age and sex as covariates.



IA and Pleasure Driven Behaviour and Impulsivity together explain 14% (R_{adj}^2 = .14) of the total explained variance of insomnia.

Smartphone addiction and insomnia

Table 11 represents the parallel mediation model of the relationship between SA and insomnia, mediated by Pleasure Driven Behaviour and Impulsivity and Resisting Temptation and Self-Discipline dimensions. This model reveals that there was a significant positive direct effect of SA on insomnia (*c*'=.0425, *p*<.001). In addition, as with the previous models, there was a significant positive indirect effect of SA on insomnia when mediated by the Pleasure Driven Behaviour and Impulsivity dimension (*B*=.3136, *SE*=.0065, 95% *CI*= [.0496, .0751]), and there was a non-significant indirect effect of SA on insomnia mediated by the Resisting Temptation and Self-Discipline dimension (*B*=-.0224, *SE*=.0008, 95% *CI*= [-.0002, .0030]). Resisting Temptation and Self-Discipline was a neglected mediator in this relationship. Figure 5 represents the schematic representation of this parallel mediation model.

Table 11

Parallel mediation of the correlation between smartphone addiction (independent variable) and insomnia (dependent variable) with age and sex as covariates (total sample of male and female youth).

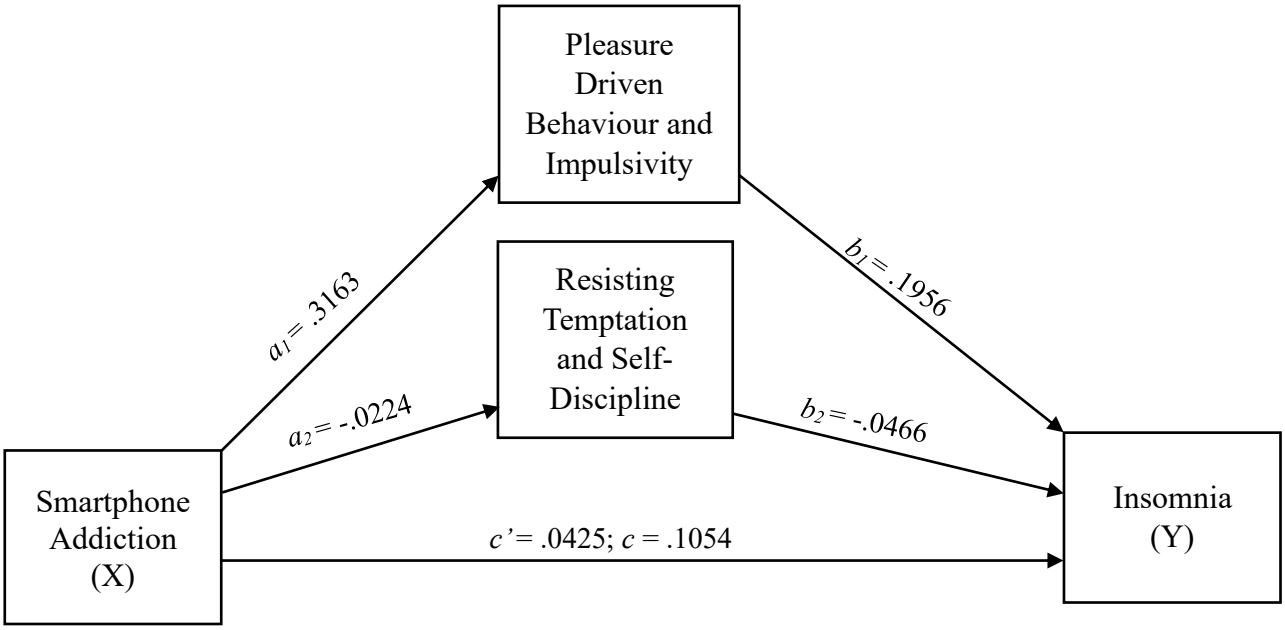
	Direct effect of SA on insomnia	*SE*	*LLCI*	*ULCI*
	.0425***	.0117	.0196	.0653
Mediators	*Indirect effects of SA on insomnia*	*BootSE*	*BootLLCI*	*BootULCI*
Pleasure Driven Behaviour and Impulsivity	.0618***	.0065	.0496	.0751
Resisting Temptation and Self-Discipline	.0010 (NS)	.0008	-.0002	.0030

Note: *n*=1566. SE = standard error; LLCI = lower limit of the confidence interval; ULCI = upper limit of the confidence interval; BootLLCI = lower bootstrap limit of the confidence interval; BootULCI = upper bootstrap limit of the confidence interval.

***p <.001; NS = nonsignificant

Figure 5

Schematic representation of the parallel mediation model of the correlation between smartphone addiction (independent variable) and insomnia (dependent variable) with age and sex as covariates.



SA and Pleasure Driven Behaviour and Impulsivity account for 14% (R_{adj}^2 = .14) of the total explained variance of insomnia.

DISCUSSION

The purpose of this study was to determine how IA and SA through the mediation of self-control, may contribute to the explanation of insomnia in this sample of Portuguese adolescents. This is an especially pertinent investigation as adolescents who use smartphones/computers, report having shorter sleep duration and delayed sleep onset (Hale & Guan, 2015). Moreover, teenagers who have trouble sleeping, also have difficulties regulating their impulses, and at the same time, difficulties on impulse regulation were also linked with more sleeping problems (Bauducco et al., 2019).

In this study it was found that IA helps explain insomnia in teenagers when their self-control tends to be more oriented towards impulsiveness and pleasure driven behaviour. Additionally, it was also possible to observe that IA is weak and negatively associated with insomnia, when this relationship is mediated by resisting temptation and self-discipline. So, in this mediation model, pleasure driven behaviour and impulsivity is a catalyst in the relationship between IA and insomnia, but resisting temptation and self-discipline can be a slightly protective factor when pleasure driven behaviour and impulsivity is controlled, weakly preventing that these Portuguese adolescents who have higher levels of IA have the latter associated with insomnia.

Additionally, when it comes to the relationship between SA and insomnia, it was found that SA contributed to the explanation of insomnia in this sample of Portuguese adolescents whose self-control tended to be more related to a pleasure driven behaviour and impulsivity. On the other hand, it was observed that resisting temptation and self-discipline does not interfere with the relationship between SA and insomnia. This reveals that in this study, pleasure driven behaviour and impulsivity is considered a risk factor for the influence of SA on insomnia. Conversely, resisting temptation and impulsivity does not participate in this relationship, and therefore does not constitute a protective factor within this relationship between SA and insomnia.

These results are in line with the theoretical model proposed by Claudatos et al. (2019), in that it was possible to see that there is a unidirectional relationship between IA and insomnia and also SA and insomnia. Additionally, these results also align with what was found by Bhatt & Gaur (2019) and Van Deursen et al. (2015) in which both IA and SA were associated with insomnia. In addition, it is important to remember that these addictions are somewhat similar and have an association with each other (Ben-Yehuda et al., 2016), and both

involve negative harm for those who experience them (e.g., harms interpersonal relationships; AlBarashdi et al., 2016; Kim, 2013; Samaha & Hawi, 2016).

In what regards IA and self-control, the literature stated that it is inconclusive how and if these two variables are associated with each other if high levels of impulsivity promote the development of IA (Li et al., 2021). However, in this study it was found that there is a negative association between these two variables, meaning that when self-control is more impulsive and oriented to a pleasure driven behaviour, the levels of IA are higher. Nevertheless, it was also found that resisting temptation and impulsivity has a slight protective effect on the relationship between IA and insomnia, when pleasure driven behaviour and impulsivity is controlled. This way when teenagers present high levels of resisting temptation and self-discipline, they can be protected from having IA impacting insomnia by around 0,2%. However, this effect is very small and cannot be taken into account in clinical practice. Even so, this suggests that when teenagers control their impulsiveness and try to act with self-discipline, they manage, albeit very weakly, to maintain some control and not engage in behaviours that are characteristic of IA, which in turn might be associated with lower insomnia severity. This hypothesis is consistent with the fact that high levels of self-control are associated with better emotion regulation and a higher frequency of positive emotions (Paschke et al., 2016), which in turn contribute to better sleep quality (Bower et al., 2010). Simultaneously, better sleep quality promotes functional self-control and emotion regulation (Hamilton et al., 2008; Kalmbach et al., 2014).

Self-control has been found to be negatively associated with SA, which means that lower levels of self-control, (i.e., increased impulsivity) elevate the levels of SA (Jeong et al., 2020; Li et al., 2021). This is consistent with the findings of the present study, since Pleasure Driven Behaviour and Impulsivity has been shown to promote the relationship between SA and insomnia in the sense that the presence of higher levels of impulsivity increases the adolescent's vulnerability of presenting a more severe addiction to the smartphone, which will associate with worsened insomnia. Additionally, it is also known that poorer impulse control can jeopardise sleep quality since the absence of self-discipline can make adolescents more prone to have irregular/inconsistent sleep patterns (Dahl & Lewis, 2002). Simultaneously, poor sleep quality can negatively impact self-control. Therefore, these two variables are mutually influenced, and as already been mentioned, teenagers are more likely to develop SA because of their lack of self-control and vulnerability to engage in addictive behaviours (Kim & Lee, 2022; Munno et al., 2017). This highlights the importance of supporting teenagers, as

respective families, in order to mitigate this vicious cycle that promotes and facilitates the development of addictive-like patterns and sleep deterioration (Claudatos et al., 2019; Telzer et al., 2013).

The present study has some limitations. Firstly, this study only includes participants from the Autonomous Region of Madeira, and their culture may have influenced the variables under study. In the future, it would be interesting to include in the sample Portuguese teenagers from the mainland and diverse islands (from both Azores and Madeira). Therefore, it would be interesting to consider the impact of the context of the participants on the way they interact with their smartphones or the internet. Finally, this study used the Brief Self-Control Scale which has 4 items evaluating resisting temptation and self-discipline and 8 items evaluating pleasure driven behaviour and impulsivity. As such, there is more variability in the dysfunctionality spectrum than in the functionality spectrum, and as such resisting temptation and self-discipline may have not been assessed with the desired precision. Therefore, it would be pertinent to use two different instruments, one for each dimension of self-control in order to properly assess and better analyse them.

On the other hand, this study also has its strengths. First of all, this study comprises a large number of participants, representing 8,72% of all students in the Autonomous Region of Madeira who were attending the 3rd cycle of basic education and secondary education in the 2019/2020 school year. Additionally, this sample is also well balanced in terms of biological sex and age (apart from the 18-19 years old).

In conclusion, it was possible to observe the impact of pleasure driven behaviour and Impulsivity on the relationship between IA and insomnia and SA and insomnia, partially potentiating the influence of these two addictions on insomnia. At the same time, resisting temptation and self-discipline does not play a significant role in these two relationships and was not a significant protective factor that prevented adolescents from engaging in these addictive behaviours and, in turn, from experiencing insomnia.

Therefore, the results of the present study highlight the pertinence of developing interventions with adolescents orientated towards youthful impulsiveness, in order to promote impulse control and health-promoting decision making. At the same time, it is also important to inform them about the importance of maintaining good sleep routines and proper use of smartphones and internet, providing strategies in this regard, and alerting them and their

families to the importance of adopting healthy behaviours in order to maintain good health and well-being.

CHAPTER 4

PSYCHOMETRIC PROPERTIES OF ALL INSTRUMENTS

Statistical Analysis

Descriptive analysis (i.e., measures of central tendency and measures of dispersion) of the latent variables was performed using IBM SPSS Statistical software, version 29.

Confirmatory Factor Analysis (CFA) were conducted on the P-YFAS, IAT, SAS-SV, GF-FAD (General Functioning dimension of the Family Assessment Device), BSCS, and AIS in order to evaluate the quality of fit of the measurement models as well as the psychometric qualities of each scale in the sample being studied, through R 4.2.1 statistical system, (R Core Team) via RStudio. It was used the Diagonally Weighted Least Squares (DWLS) estimation method which was specifically conceived for ordinal data through the Lavaan library for the software R. This way, in order to analyse the quality of the model fit, three quality of fit indices were considered. In the Absolute Indices, the Goodness of Fit Index (GFI) was used, which must not be less than 0.8 (Marôco, 2014), and the Standardized Root Mean Square Residual (SRMR) – since this is a large sample, which cannot be greater than 0.08 (Hu & Bentler, 1999). In the Relative Indices, the Comparative Fit Index (CFI) and the Tucker-Lewis Index (TLI) were used, which also must not be less than 0.8. In the Population Discrepancy Indices, the Root Mean Square Error of Approximation (RMSEA) was used, which must not be greater than 0.10 (Marôco, 2014). Additionally, it was also used RMSEA's 90% confidence interval and RMSEA's p value, which must be equal to or greater than .05 (Marôco, 2014).

Regarding the psychometric qualities of the scales, the sensitivity of the items, validity evidence based on internal structure, convergent and discriminant validity evidence, and reliability were analysed. Item sensitivity was assessed through shape measurements (i.e., asymmetry and kurtosis), in the R statistical software using the Multivariate Normality (MVN) library. In order for the items to have good psychometric sensitivity, the asymmetry and kurtosis should not be higher than 3 and 7 respectively (Marôco, 2007; Kline, 2011). Validity evidence based on internal structure was assessed by examining the standardized factor weights of all the items which are considered adequate when $\lambda \geq .500$, and also the internal reliability of all the items, which are adequate if $r^2 \geq .25$. To analyse evidence of convergent validity, the Average Variance Extracted (AVE) was assessed. The scale has convergent evidence when the AVE≥.500, according to Forell-Larcker criterion (Forell & Larcker, 1981). In order for the scale to have discriminant validity evidence, the individual

AVE of each factor is considered, and its values must be greater than the square of the correlation between factors (Forell & Larcker, 1981). Lastly, the reliability assesses the scale's internal consistency through the analysis of the Cronbach's α and the McDonald's ω (measure of composite reliability), which are both considered adequate if α and ω≥0.7 (Marôco, 2014; Padilla & Divers, 2016). The scales' reliability was assessed through the SemTools package for R statistical system.

After checking if all the previously mentioned measurement models had at least an acceptable fit, the existence of multicollinearity between the variables under study was also checked, and for multicollinearity to exist the Variance Inflation Factor (VIF) > 5 (Marôco, 2007). Once there was no multicollinearity between the variables under study, in order to fulfil the first objective of this research, a structural equations model was developed, and later, the refined structural equations model using the lavaan package for R. In this way, it was performed a structural equations analysis also using through R 4.2.1 statistical system, (R Core Team) via RStudio. After carefully analysing the quality of the model's fit and observed that it present at least an acceptable fit, it was analysed which of the independent variables (i.e., FA, IA, SA, Stress, Anxiety, Depression, Biological Sex, Access to Screens at Night, Frequency of Screen Use Before Going to Sleep/Until Falling Asleep, Support and Trust, Difficulty Negotiating and Sharing, Resisting Temptation and Self-Discipline and Pleasure Driven Behaviour and Impulsivity) significantly predicted the dependent variable (insomnia). After that, the refined model was performed, including only the significant predictors of the dependent variable under study.

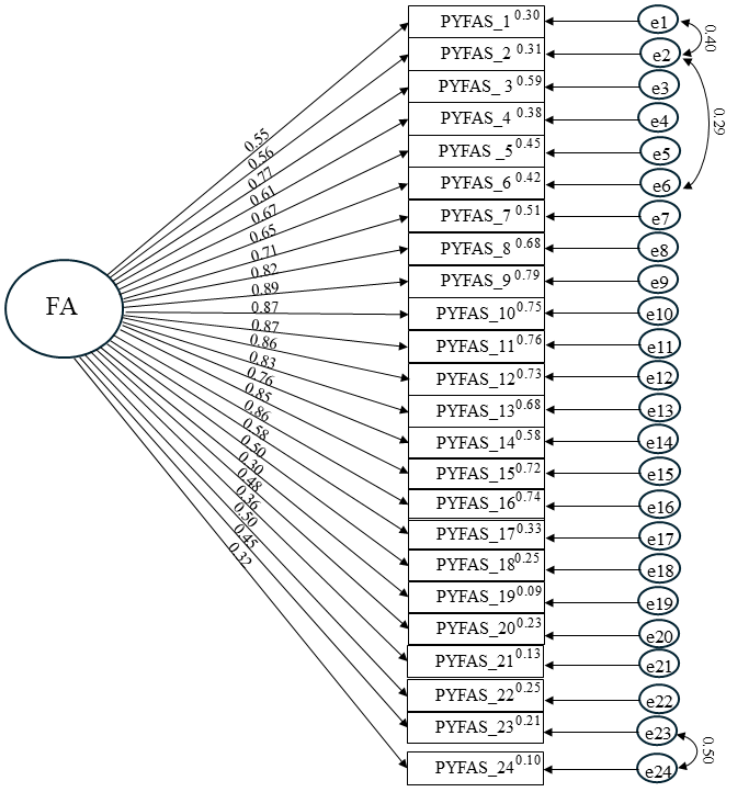
Finally, in order to achieve the second goal of this investigation, that is to explore the influence of self-control on the relationship between the three addictions studied (independent variables – FA, IA, SA) and insomnia (dependent variable), three mediation analysis were conducted using IBM SPSS PROCESS macro version 4.2. Therefore, three parallel mediation models (i.e., one for each addiction) were performed (model 4), with age and sex as covariances. Each model was developed with a 95% confidence interval, based on 10.000 bootstrap samples. After that, it was analysed the significance of both direct and indirect effects based on the criteria that the significance is concluded by the exclusion of 0 from the confidence interval (Hayes, 2018).

Portuguese Yale Food Addiction Scale (P-YFAS)

Figure 6 shows the Confirmatory Factor Analysis of the P-YFAS with a single-factor structure (as validated in a sample of Portuguese young people), used to assess the latent variable "food addiction (FA)" in this study's sample.

Figure 6

Confirmatory Factor Analysis of the Portuguese Yale Food Addiction Scale (P-YFAS)



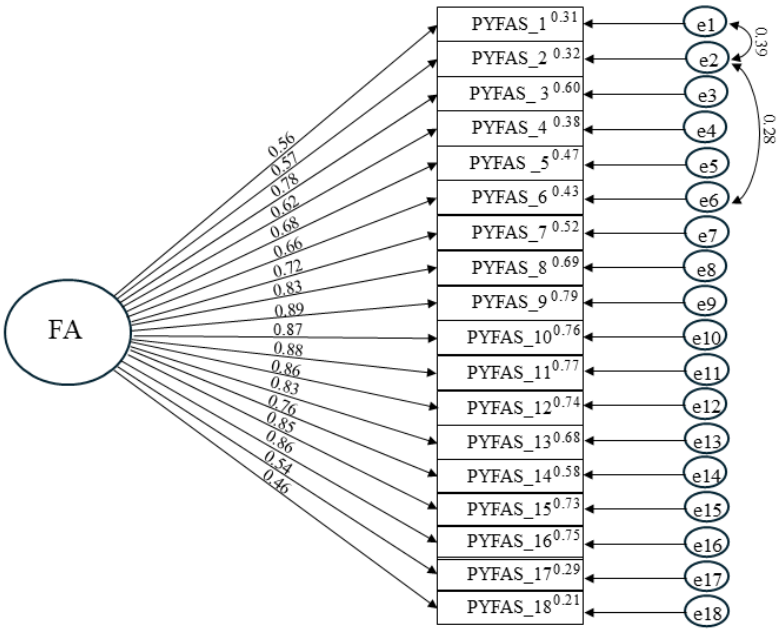
Validity Evidence Based on Internal Structure

Regarding validity evidence based on internal structure of the P-YFAS, the items have an adequate standardized factor weight ($\lambda \geq .569$), with the exception of item 19 ($\lambda_{19}=.298$), item 20 ($\lambda_{20}=.482$), item 21 ($\lambda_{21}=.352$), item 22 ($\lambda_{22}=.266$), item 23 ($\lambda_{23}=.245$) and item 24 ($\lambda_{24}=.330$), which have a standardized factor weight below the reference value. In terms of internal reliability, all the items show appropriate individual reliability ($r^2 \geq .32$), except for item 19 ($r^2=.09$), item 20 ($r^2=.23$), item 21 ($r^2=.12$), item 22 ($r^2=.07$), item 23 ($r^2=.06$) and item 24 ($r^2=.11$). As for the quality of the model's fit, the modification indices suggest that there is a correlation between items 1-2, 2-6 and 22-23. After the respective corrections, the model showed a good fit (SRMR=.107; GFI=.979; CFI=.974; TLI=.971; RMSEA=.095, $p<.001$; 90% *CI*=].092, .097[).

Since items 19, 20, 21, 22, 23 and 24 presented standardized factor weights and individual reliabilities below the reference values, it was hypothesized that these items might not adequately translate scale's construct. As such, their exclusion was considered. Therefore, after refining the model (excluding the previously mentioned items), and correlating the measurement errors, most of the indices of quality of the model's fit showed significant improvements (SRMR=.084; GFI=.990; CFI=.988; TLI=.986; RMSEA=.081; p<.001; 90% *CI*=].078, .085[), and the model presented a good fit, as can be observed in figure 7. Also, the scale's internal consistency increased from α=.94 to α=.95 when items 19, 20, 21, 22, 23 and 24 were eliminated.

Figure 7

Refined Confirmatory Factor Analysis of the Portuguese Yale Food Addiction Scale (P-YFAS)



Item sensitivity. To assess any issues with the distribution of the P-YFAS, the 5-point Likert scale (ranging from 0 to 4, and from 1 to 5) was examined, and it was discovered that all of the items were answered in all of the possible minimum and maximum values. This way, all of the items had adequate values for asymmetry (-,284<*Sk*<2.056) and kurtosis (-1.958<*Ku*<3.372). Therefore, the scale items exhibited good psychometric sensitivity.

Convergent validity evidence. With regard to the convergent validity evidence of the P-YFAS, this scale has an inadequate value (AVE=.556). Therefore, the P-YFAS does not have convergent validity evidence.

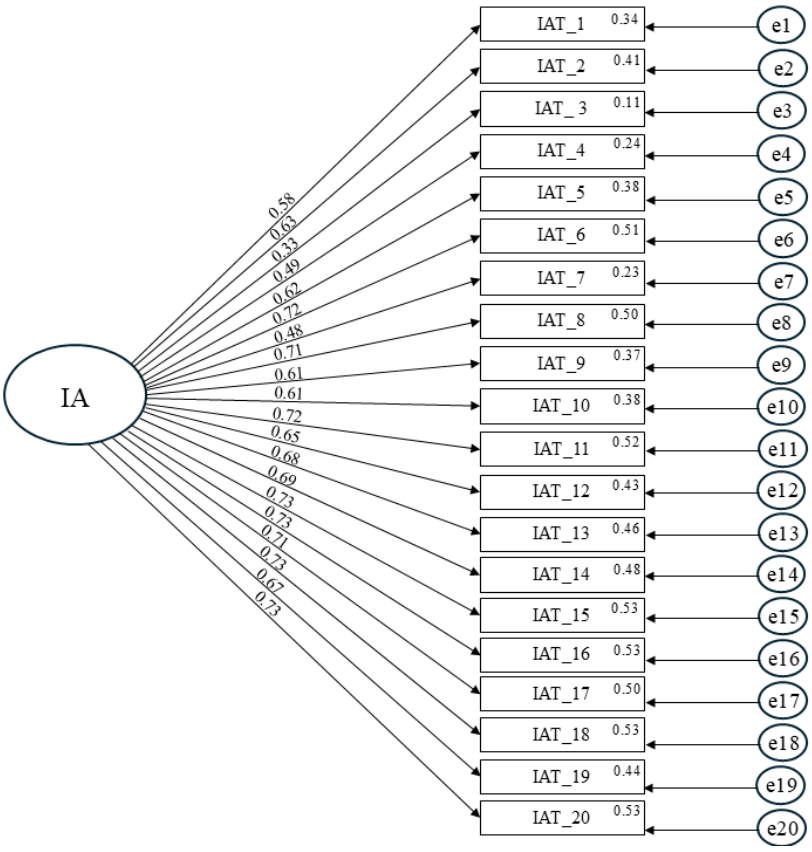
Reliability. With regard to the P-YFAS' internal consistency, this proved to be excellent (α=.95; ω=.92).

Internet Addiction Test (IAT)

Figure 8 shows the Confirmatory Factor Analysis of the IAT with a single-factor structure (as validated in a sample of Portuguese young people), used to assess the latent variable "internet addiction (IA)" in this study's sample.

Figure 8

Confirmatory Factor Analysis of the Internet Addiction Test (IAT)



Validity Evidence Based on Internal Structure

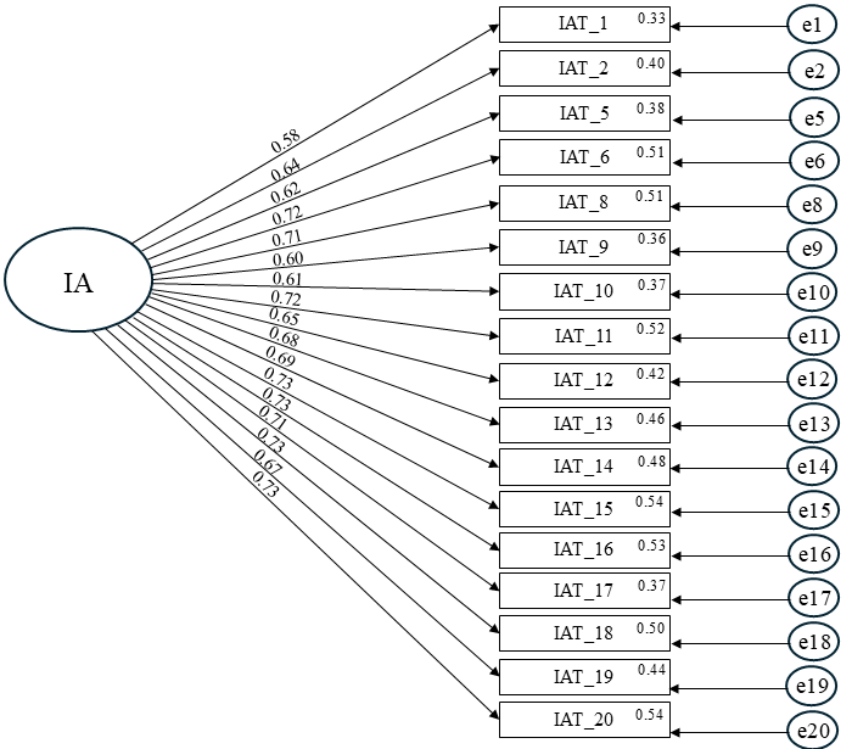
Regarding validity evidence based on internal structure of the IAT, the items have an adequate standardized factor weight (λ≥.581), with the exception of item 3 (λ_3=.327), item 4 (λ_4=.487) and item 7 (λ_7=.479), which have a standardized factor weight below the reference value. As far as internal reliability is concerned, all the items show appropriate individual reliability (r^2≥.34), except for item 3 (r^2=.11), item 4 (r^2=.24) and item 7 (r^2=.23). As for the

quality of the model's fit, the model showed a good fit (SRMR=.062; GFI=.985; CFI=.978; TLI=.975; RMSEA=.092; *p*<.001; 90% *CI*=].089, .095[).

However, because items 3, 4 and 7 showed standardized factor weights and individual reliabilities below the reference values, it was hypothesized that these items might not adequately translate scale's construct. Therefore, their exclusion was considered. This way, after refining the model (excluding these three items), most of the indices of quality of the model's fit presented some slight improvements (SRMR=.061; GFI=.986; CFI=.980; TLI=.977; RMSEA=.100; *p*<.001; 90% *CI*=].097, .104[), as can be observed in figure 9.

Figure 9

Refined Confirmatory Factor Analysis of the Internet Addiction Test (IAT)



Item sensitivity. In order to assess any issues with the distribution of the IAT, the 6-point Likert scale (0-5) was examined, and it was found that all of the items were answered in all of the possible minimum and maximum values. This way, all the items had adequate values for asymmetry (-,350<*Sk*<2.241) and kurtosis (-,833<*Ku*<5.807). Therefore, the scale items exhibited good psychometric sensitivity.

Convergent validity evidence. With regard to the convergent validity evidence of the IAT, this scale has an adequate value (AVE=.500). As such, the IAT has convergent validity evidence.

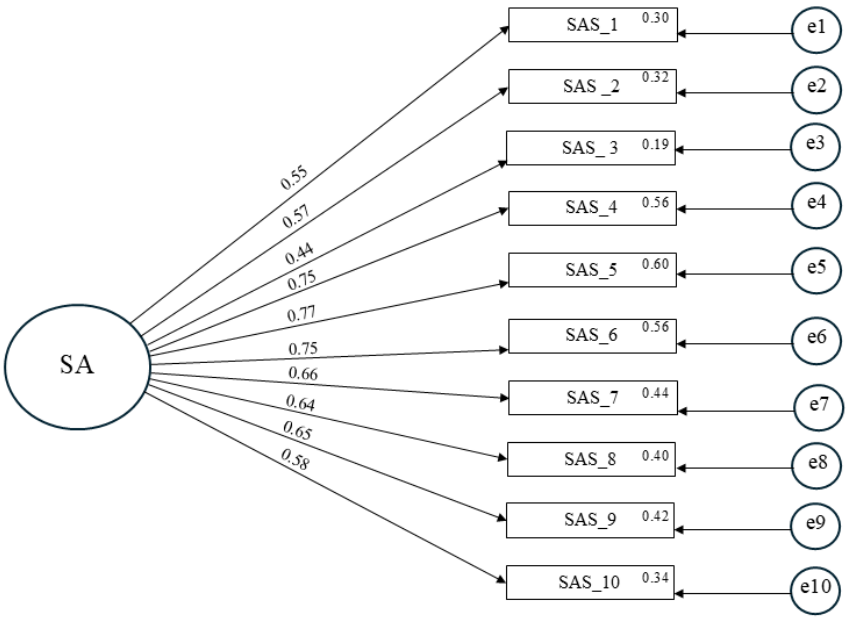
Reliability. With regard to the IAT's internal consistency, this proved to be excellent (α=.93; ω=.92)

Smartphone Addiction Scale – Short Version (SAS-SV)

Figure 10 shows the Confirmatory Factor Analysis of the SAS-SV with a single-factor structure (as validated in a sample of Portuguese young people), used to assess the latent variable "smartphone addiction (SA)" in this study's sample.

Figure 10

Confirmatory Factor Analysis of the Smartphone Addiction Scale - Short Version (SAS-SV)



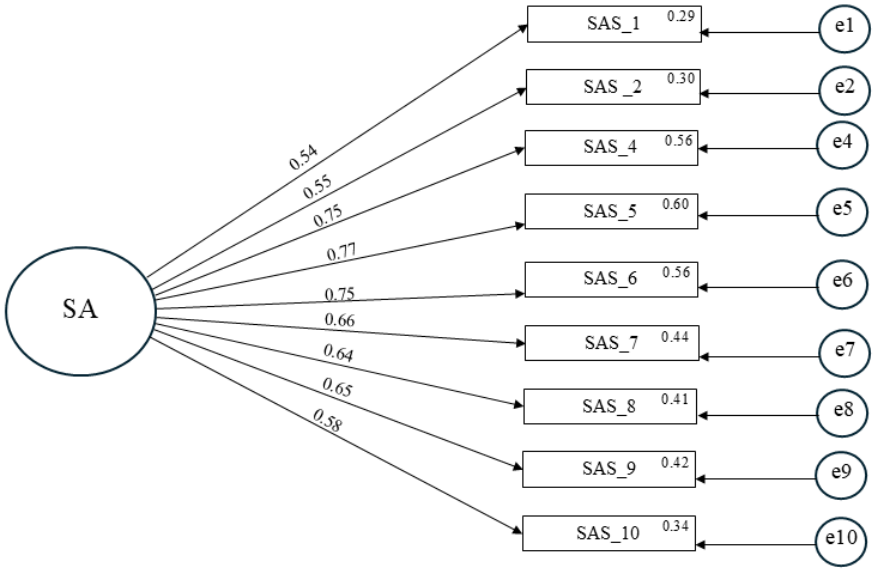
Validity Evidence Based on Internal Structure

Regarding validity evidence based on internal structure of the SAS-SV, the items have an adequate standardized factor weight (λ≥.547), with the exception of item 3 (λ_3=.441) which has a standardized factor weight below the reference value. As far as internal reliability is concerned, all the items show appropriate individual reliability (r^2≥.299), except for item 3 (r^2=.194). As for the quality of the model's fit, the model showed a good fit (SRMR=.066; GFI=.987; CFI=.971; TLI=.963; RMSEA=.098; p<.001; 90% *CI*=].091, .106[).

As already mentioned, item 3 presented a standardized factor weight and an individual reliability below the reference values. This way, it was thought that this item might not adequately translate the scale's construct. Therefore, its exclusion was considered. After refining the model (excluding item 3), some of the indices of quality of the model's fit presented some slight improvements (SRMR=.068; GFI=.987; CFI=.972; TLI=.962; RMSEA=.106; *p*<.001; 90% *CI*=].098, .115[), as can be observed in figure 11.

Figure 11

Refined Confirmatory Factor Analysis of the Smartphone Addiction Scale - Short Version (SAS-SV)



Item sensitivity. To assess any problems with the distribution of the SAS-SV, the 6-point Likert scale (ranging from 1 to 6) was examined, and it was discovered that all of the items were answered in all of the possible minimum and maximum values. This way, all of the items had adequate values for asymmetry (-,095<*Sk*<1.528) and kurtosis (-1.099<*Ku*<1.802). Thus, the scale items exhibited good psychometric sensitivity.

Convergent validity evidence. With regard to the convergent validity evidence of the SAS-SV, this scale has an AVE slightly below the reference value (AVE=.436). As such, the SAS-SV does not have convergent validity evidence.

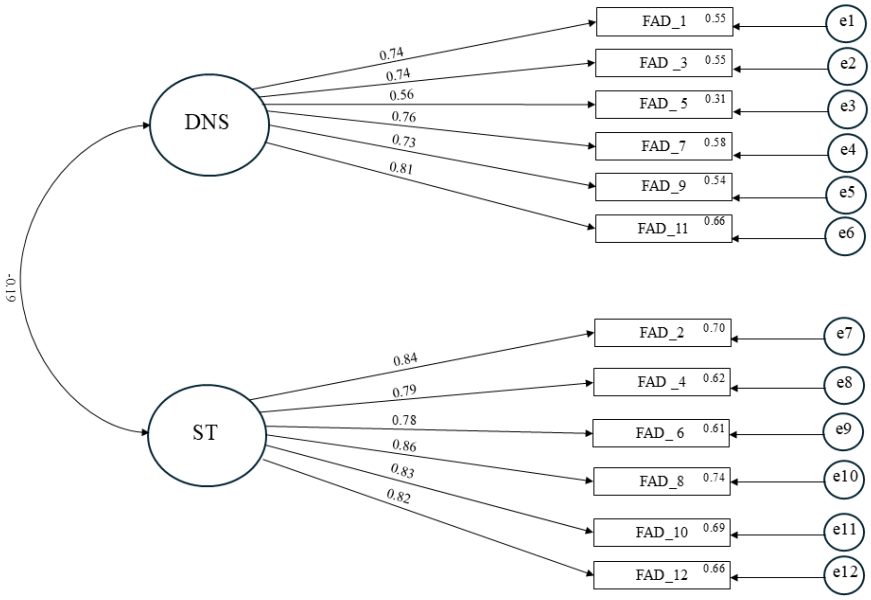
Reliability. With regard to the SAS-SV internal consistency, this proved to be good (α=.87; ω=.85).

General Functioning Dimension of the Family Assessment Device (GF-FAD)

Figure 12 shows the Confirmatory Factor Analysis of the GF-FAD, used to assess the latent variable "family functioning" in this study's sample. Therefore, the bifactor structure was tested according to the validation in a sample of young people. However, the name of the dimensions was changed in this study ("Support and trust" and "Difficulty negotiating and sharing").

Figure 12

Confirmatory Factor Analysis of the General Functioning Dimension of the Family Assessment Device (GF-FAD)



Validity Evidence Based on Internal Structure

Regarding validity evidence based on internal structure of the GF-FAD, all the items have an adequate standardized factor weight (λ≥.577). As far as internal reliability is concerned, all the items show appropriate individual reliability (r^2≥.33). As for the quality of the model's fit, the model showed a good fit (SRMR=.070; GFI=.988; CFI=.984; TLI=.980; RMSEA=.096; p<.001; 90% *CI*=].091, .102[).

Item sensitivity. To assess any problems with the distribution of the GF-FAD, the 4-point Likert scale (between 1 and 4) was examined, and it was discovered that all of the items were answered in all of the possible minimum and maximum values. This way, all of the items had adequate values for asymmetry (-,771<*Sk*<,926) and kurtosis (-,692<*Ku*<,228). Therefore, the scale items exhibited good psychometric sensitivity.

Convergent validity evidence. With regard to the convergent validity evidence of the GF-FAD, this scale has an adequate value in the Support and trust dimension (AVE=.670). and in the Difficulty negotiating and sharing dimension (AVE=.532). This way, the GF-FAD has convergent validity evidence on both Support and trust and Difficulty negotiating and sharing dimensions.

Discriminant validity evidence. The GF-FAD has discriminant validity evidence since the square of the correlations between the two dimensions (r^2=.036) is lower than the individual AVE of each dimension.

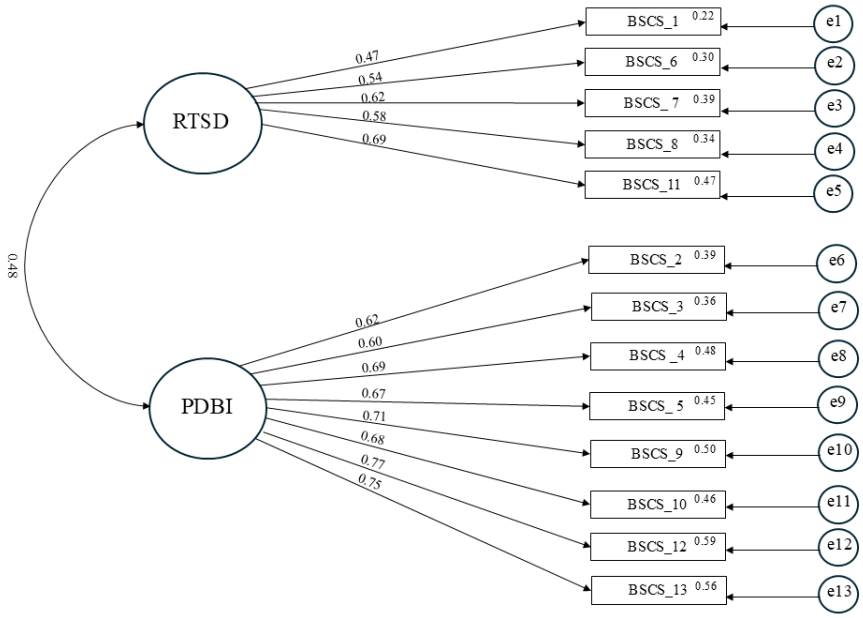
Reliability. With regard to the GF-FAD internal consistency, this proved to be good and excellent in the Support and trust dimension (α=.92; ω=.89), and good in the Difficulty negotiating and sharing dimension (α=.87; ω=.82).

Brief Self-Control Scale (BSCS)

Figure 13 shows the Confirmatory Factor Analysis of the BSCS used to assess the latent variable "self-control" in this study's sample. Therefore, the bifactor structure was tested according to the validation in a sample of young people.

Figure 13

Confirmatory Factor Analysis of the Brief Self-Control Scale (BSCS)



Validity Evidence Based on Internal Structure

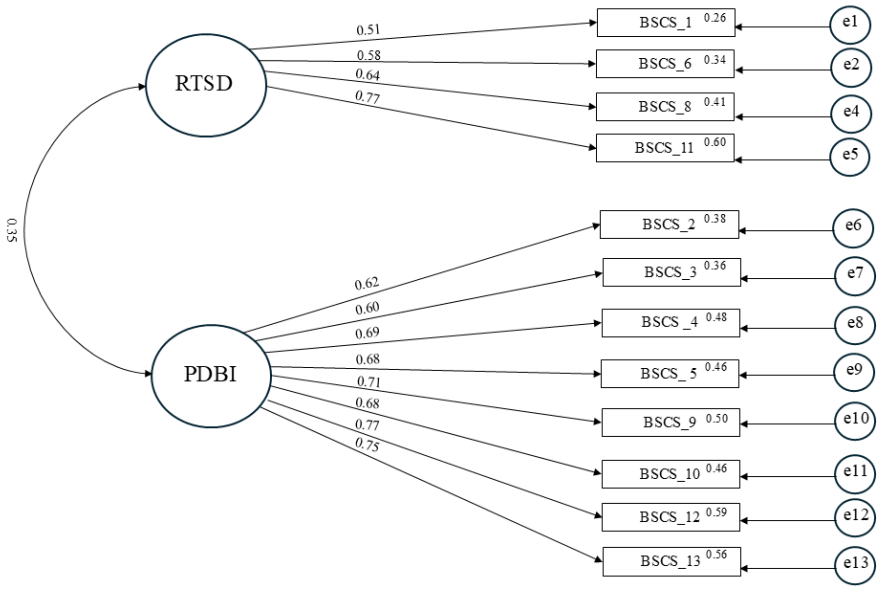
Regarding validity evidence based on internal structure of the BSCS, all the items have an adequate standardized factor weight ($\lambda \geq .514$), with the exception of item 7 ($\lambda_7 = .387$) which has a standardized factor weight below the reference value. As far as internal reliability is concerned, all the items show appropriate individual reliability ($r^2 \geq .26$), apart from item 7 ($r^2 = .15$). As for the quality of the model's fit, the model showed a good fit (SRMR=.072; GFI=.981; CFI=.964; TLI=.955; RMSEA=.096; $p < .001$; 90% *CI*=].090, .102[).

Item 7 (*I'd like to have more self-discipline*) raised some problems as it is an ambiguous item that leaves doubts as to which dimension it belongs and the item does not seem to adequately translate the construct of the scale. Therefore, its exclusion was considered.

After refining the model (excluding item 7), all the indices of quality of the model's fit showed a slight increase (SRMR=.052; GFI=.990; CFI=.982; TLI=.978; RMSEA=.065; $p < .001$; 90% *CI*=].059, .071[), as can be observed in figure 14. Moreover, the scale's internal consistency in the Resisting Temptation and Self-Discipline dimension, increased from α=.69 to α=.73 when item 7 was eliminated.

Figure 14

Refined Confirmatory Factor Analysis of the Brief Self-Control Scale (BSCS)



Item sensitivity. To assess any problems with the distribution of the BSCS, the 5-point Likert scale (ranging from 1 to 5) was examined, and it was discovered that all of the

items were answered in all of the possible minimum and maximum values. Therefore, all of the items had adequate values for asymmetry (-,133<*Sk*<,870) and kurtosis (-1.195<*Ku*<-,205). Thus, the scale items exhibited good psychometric sensitivity.

Convergent validity evidence. With regard to the convergent validity evidence of the BSCS, this scale has inadequate values in the Resisting Temptation and Self-Discipline dimension (AVE=.405) and an adequate value in the Pleasure Driven Behaviour and Impulsivity dimension (AVE=.500). Therefore, the BSCS has convergent validity evidence in the Pleasure Driven Behaviour and Impulsivity dimension but does not have convergent validity evidence in the Resisting Temptation and Self-Discipline dimension.

Discriminant validity evidence. The BSCS has discriminant validity evidence since the square of the correlations between the two dimensions (r^2=.012) is lower than the individual AVE of each dimension.

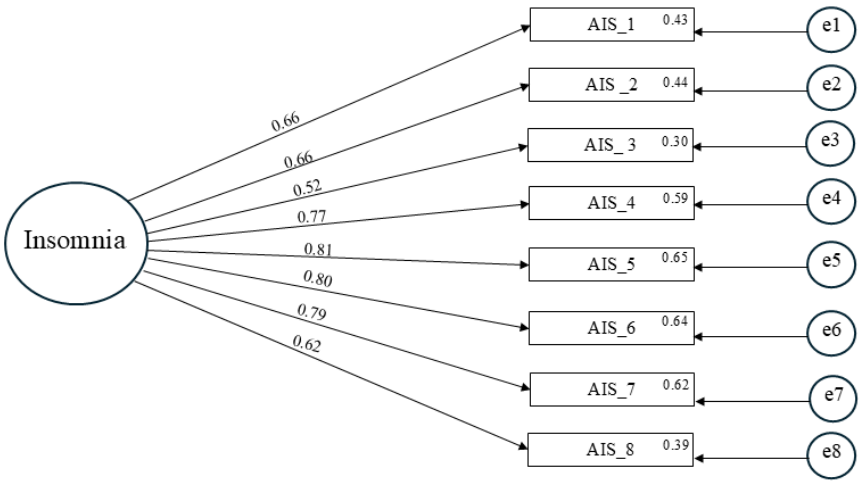
Reliability. With regard to the BSCS internal consistency, this proved to be acceptable in the Resisting Temptation and Self-Discipline dimension (α=.73; ω=.69), and good in the Pleasure Driven Behaviour and Impulsivity dimension (α=.87; ω=.85).

Athens Insomnia Scale (AIS)

Figure 15 shows the Confirmatory Factor Analysis of the AIS with a single-factor structure (as validated in a sample of Portuguese young people), used to assess the latent variable “insomnia” in this study's sample.

Figure 15

Confirmatory Factor Analysis of the Athens Insomnia Scale (AIS)



Validity Evidence Based on Internal Structure

Regarding validity evidence based on internal structure of the AIS, all the items have an adequate standardized factor weight ($\lambda \geq .522$). As far as internal reliability is concerned, all the items show appropriate individual reliability ($r^2 \geq .27$). As for the quality of the model's fit, the model showed a very good fit (SRMR=.057; GFI=.993; CFI=.985; TLI=.980; RMSEA=.075; $p<.001$; 90% *CI*=].066, .085[).

Item sensitivity. To assess any problems with the distribution of the AIS, the 4-point Likert scale (between 1 and 4) was examined, and it was discovered that all of the items were answered in all of the possible minimum and maximum values. This way, all of the items had adequate values for asymmetry (,569<*Sk*<2.090) and kurtosis (-,035<*Ku*<4.369). Thus, the scale items exhibited good psychometric sensitivity.

Convergent validity evidence. With regard to the convergent validity evidence of the AIS, this scale has an adequate value (AVE=.500). As such, the SAS-SV has convergent validity evidence.

Reliability. With regard to the AIS internal consistency, this proved to be good (α=.88; ω=.83).

GENERAL DISCUSSION

The aims of the present study was to which of the variables under study (i.e., Food Addiction – FA, Internet Addiction – IA, Smartphone Addiction – SA, Stress, Anxiety, Depression, Biological Sex, Access to Screens at Night, Frequency of Screen Use Before Going to Sleep/Until Falling Asleep, Support and Trust, Difficulty Negotiating and Sharing, Resisting Temptation and Self-Discipline and Pleasure Driven Behaviour and Impulsivity) predict insomnia in this sample of Portuguese adolescents and also, the impact of self-control (i.e., Resisting Temptation and Self-Discipline and Pleasure Driven Behaviour and Impulsivity) on the relationships between 1) FA and insomnia, 2) IA and insomnia and 3) SA and insomnia in these adolescents. This is a particularly relevant study insofar as research has shown that teenagers do not obtain the recommended 8-10 hours of sleep per night (Galland et al., 2018) and 11-30% of them are suffering with sleep disturbances, and this prevalence will probably keep on growing (Blunden et al., 2012; de Zambotti et al., 2018). The present study found that 31,5% of this sample of Portuguese adolescents report moderate to severe insomnia. It is, therefore, crucial to understand the best way to help adolescents improve their sleep habits, in order to improve their quality of life and also their health.

As mentioned above, the exact cause of insomnia is not yet known for sure, but it is known that there are a number of risk factors for its development. These include biological sex, stress, anxiety and depression, poor diet, an excessive use of internet and/or smartphones and poor relationships between family members (APA, 2022; Bhatt & Gaur, 2019; Johnson, 2006; Maratia et al., 2023; Strine & Chapman, 2005; Tan et al., 2015; Van Deursen et al., 2015). The structural models carried out showed that higher FA, higher IA, lower Support and Trust, higher Difficulty Negotiating and Sharing, higher Pleasure Driven Behaviour and Impulsivity, being a girl and higher Frequency of Screen Use Before Going to Sleep/Until Falling Asleep are all predictors of higher insomnia severity in this sample of Portuguese adolescents. Conversely, SA, Access to Screens at Night, and Resisting Temptation and Self-Discipline are not. Therefore, it is pertinent to analyse each variable in order to understand why it predicts (or not) insomnia in this sample of Portuguese adolescents.

FA proved to be a predictor of the dependent variable under study, which means that in this sample, Portuguese adolescents who present higher levels of FA, will also present higher levels of insomnia. This is consistent with the results obtained by Najem et al. (2019), in which it was found that sleep quality is negatively affected by FA. Moreover, it is known that the quality of an individual's diet may jeopardise the quality of his sleep since a diet low

in nutrients has a negative impact on the quality of sleep they experience, while a high intake of nutritious and healthy foods allows them to experience a better quality of sleep (Tan et al., 2015).

IA was also a predictor of insomnia in this sample, showing that teenagers who experience high levels of IA, will also experience more insomnia symptoms. These results align with those obtained in a study carried out by Bhatt and Gaur (2019), in which was found that higher levels of IA were associated with higher levels of insomnia, and this is understandable given that internet allows access to diverse activities (e.g., gaming, social networks) which might prompt addictive patterns, typical of substance use disorders (Young, 1998). Additionally, this may also be related to the fact that adolescence is marked by an emerging interest in interpersonal relationships (i.e., friends), a gain in independence with regard to their sleep schedules and an appreciation of the use of internet and smartphones leading them to stay up later, which in turn impairs the sleep period (i.e., both sleep onset and sleep maintenance) if they keep notifications on and gadgets switched on during the night (Hale & Guan, 2015; Maume, 2013; Short et al., 2011).

Regarding family factors, Support and Trust also proved to be an important predictor of insomnia in this study. Therefore, Support and Trust shows an inverse relationship with insomnia, in the sense that adolescents who perceive high levels of support and trust in their family, are also the ones who experience lower levels of insomnia. Bearing in mind that, for adolescents, the family is a crucial source of socialisation and establishment of rules and limits, since the relationship they establish with its members enhances their development and adjustment, this relationship fits in with the perspective of the importance of family context in healthy adjustment of adolescents (Brofenbrenner & Morris, 2007; Kurock et al., 2022). In this regard, as it was already found in a study developed by El-Sheikh and Kelly (2017), the quality of the relationships between family members and family context impacts the way teenagers sleep. Therefore, when the adolescent is surrounded by a warm, supportive, and encouraging family in which feelings and thoughts (including concerns and negative affect) can be communicated and mutual trust is instilled, this will allow them to feel good and secure with themselves and their family context, allowing them to achieve a good quality of sleep on a daily basis, reducing the chances of developing or suffering from sleep disturbances (El-Sheikh & Kelly, 2017; Sasser et al., 2021). On the other hand, Difficulty Negotiating and Sharing is not a predictor of insomnia in this sample. This finding goes against the results obtained by Amato et al. (2010) and Khor et al. (2021), since they observe

that adolescents who are involved in a family context characterised by arguments, conflicts, instability (e.g., of rules) and chaos, might become disorganised and can culminate in the development of sleep disorders. However, this result is supported by the inconsistency that exists regarding the long-term negative impact that these negative family contexts have (or not) on adolescents' sleep (Roberts et al., 2008). It is therefore pertinent to continue to investigate the existence of a negative influence on the sleep of adolescents who are involved in problematic family contexts.

When it comes to Pleasure Driven Behaviour and Impulsivity, this has also shown to be a predictor of insomnia. This means that adolescents with higher levels of pleasure driven behaviour and impulsivity, will also present higher levels of insomnia. This association between these variables suggests that there may be a bidirectional relationship between impulsivity/pleasure driven behaviour and insomnia. This relationship is also hypothesised by Bauducco et al. (2019), who observed that adolescents who experience altered sleep patterns have difficulties with impulse control and these difficulties in turn, were associated with a reduction in the quality of sleep and with sleeping problems. A future study should seek to test this bidirectional relationship.

Finally, being female is also a significant predictor of insomnia in this sample. Specifically, it was found that girls tended to have higher levels of insomnia than their peers of the opposite sex. These discrepancies between the levels of insomnia experienced by adolescents from both sexes have already been reported in previous research and it has been pointed out as a possible explanation that girls may be more impulsive when managing negative emotions and therefore, use maladaptive strategies (e.g., rumination; Nolen-Hoeksema & Girgus, 1994) as a way of coping with their negative mood, which in turn can result in insomnia (Hiller et al., 2015).

SA was not a predictor of insomnia in this sample, in the multivariate model. This means that SA is not associated with insomnia in this sample of Portuguese adolescents. This result goes against the findings of several studies, such as Van Deursen et al. (2015), in which SA, due to its addictive nature, proved to delay in sleep induction and impair sleep maintenance, since the notifications that teenagers receive during the night leave them in a permanent state of alertness, even while they sleep (Cain & Gradisar, 2010). This can be explained by the fact that they are using other kinds of screens to access the internet. Therefore, it would be pertinent to understand what kind of screens young people are using since they present symptomatic expression congruent with an IA pattern and not with a SA

pattern. However, as noted above, IA is a predictor of insomnia in this sample, and the smartphone is a way of accessing the Internet (Demirci et al., 2015; Kim, 2013). This can be explained by the fact that adolescents might be using other types of screens instead of smartphones and these could predict their insomnia.

Frequency of Screen Use Before Going to Sleep/Until Falling Asleep and Access to Screens at Night were predictors of insomnia in this sample. This shows that both having access to screens in their bedroom and the frequence with which they access these screens immediately before going to sleep or even until they fall asleep predict the level of insomnia they experience. In this sense, the studies developed by Cain and Gradisar (2010), and Carter et al. (2016), support this hypothesis since it was found that the use of electronic screens right before bed resulted in interrupted sleep, postponed sleep onset, changes in sleep schedules and poorer sleep quality. Additionally, it is known that the light emitted by electronic screens, can jeopardise sleep induction as it impairs the process of melatonin release (Cain & Gradisar, 2010; Higuchi et al., 2003).

Resisting Temptation and Self-Discipline was not a predictor of insomnia. This means that Resisting Temptation and Self-Discipline could not predict lower levels of insomnia in Portuguese students or even protect them from this type of sleep disorder. This is alarming given the mutual positive influence between positive affect and good sleep quality, and also the importance of this bidirectional relationship on the promotion of self-control and emotion regulation (Bower et al., 2010; Hamilton et al., 2008; Kalmbach et al., 2014). However, this absence of protection of self-control might be related with the low average total score of resisting temptation and self-discipline in this sample, and as such, the resisting temptation and self-discipline that these Portuguese teenagers show may be too weak to protect them in this regard. Also, there are some factors such as emotion regulation, positive family interactions, and healthier relationships with both teachers and peers that could minimise the impact of impulsivity in adolescents (Carvalho et al., 2023).

The refined model explains 31% of the variability in insomnia. As such, the other 69% remains unexplained. It is therefore important to understand which other variables could explain insomnia in this sample. According to previous research, there are some physical health problems that can explain insomnia, such as the abuse of alcohol, suicidal ideation, school valorisation/appreciation, stress related to school, the quality of the peer relationships (e.g., popularity vs. fear of missing out), perceived safety in their homes and neighbourhoods, and the presence of some kind of mental disorder (e.g., ADHD) (Hsieh et al., 2019; Li et al.,

2019; Roberts et al., 2008; Zhang et al., 2021). Thus, it would be very pertinent to include these variables in future research, in order to better understand what else can explain insomnia in this sample.

Regarding the second objective of this research, all the three mediation analysis, go along with the theoretical model developed by Claudatos et al. (2019), since it was found that not only FA, but also IA and SA have a unidirectional relationship with insomnia. Additionally, it was observed that all three types of addiction studied (FA, IA, SA) contribute to understanding insomnia in Portuguese teenagers when their self-control is characterised by higher impulsivity and a pleasure driven behaviour. In addition, when it comes to FA and SA, resisting temptation and self-discipline is not a protective factor in avoiding the development of these addictions, and the consequent experience of insomnia and on the other hand, pleasure driven behaviour and impulsivity is a catalyst for these two relationships. When it comes to the case of IA, it was noticed that resisting temptation and self-discipline exerts a slight protective effect on the relationship between IA and insomnia protecting adolescents from engaging in internet addictive behaviours and as a result, experiencing insomnia in 0,2%. Therefore, since that effect is so weak, it cannot be considered in practice. In this case, pleasure driven behaviour and impulsivity is also a catalyst.

As for the relationship between FA and insomnia through the mediation of the two forms of self-control, the previously mentioned results go along with the results found by Najem et al. (2019) in which it was observed that FA led adolescents to experience poorer sleep quality. Also, given the addictive character of FA, it can be understood that this is a type of behaviour that is naturally related to the individual's self-control (Luo et al., 2022). This way, for lower levels of self-control (i.e., increased impulsivity) there is a higher risk of developing FA (Minhas et al., 2021) and for higher levels of self-control (i.e., increased self-efficacy) are associated with a greater ability to control impulses and, as such, avoiding excessive food consumption (Wang et al., 2015). These results can also be explained by the fact that the excessive and uncontrolled consumption of highly palatable foods can be a regulatory mechanism that individuals adopt in order to overcome their negative emotions (Lou et al., 2022). As such, depressed and negative moods can be relieved by eating high-calorie foods, which points to the hazardous association between impulsivity, mood, and FA (Kalon et al., 2016). Experiencing higher levels of stress can also promote a dysregulation of the reward system, increasing the likelihood of developing FA (Wei et al., 2019). Lastly, it is also important to consider that FA is a construct that can be affected by cultural and

gastronomical characteristics. Therefore, large food consumption may be viewed as normal in a nation like Portugal with a strong culinary heritage, but it may be viewed as excessive and indicative of FA in other nations (Torres et al., 2017; Uva et al., 2024).

Regarding IA and insomnia, the aforementioned results add to what is known about the relationship between IA and self-control, given that it is still quite uncertain whether there is a relationship between them, and it was also not possible to certainly confirm the existence of a positive association between poor impulse control and IA (Li et al., 2021). However, it is known that presenting higher levels of self-control is associated with better emotion regulation and a greater prevalence of positive emotions (Paschke et al., 2016), leading the individual to experience better sleep quality (Bower et al., 2010). Better sleep quality in turn, boots emotion regulation and higher self-control (Hamilton et al., 2008; Kalmbach et al., 2014). This way, it becomes possible to understand the role of resisting temptation and self-discipline in this relationship between IA and insomnia. As it was mentioned before, resisting temptation and self-discipline is a weak and inconsistent protective factor in this relationship, which suggests that having higher levels of self-control could protected these Portuguese adolescents from engaging in addictive behaviours related to internet use and consequently suffering from insomnia, when pleasure driven behaviour and impulsivity is controlled. Nevertheless, this effect is very weak, as it is around 0,2% and therefore, it cannot be considered in practice. Moreover, it also makes it possible to see that teenagers can avoid engaging in behaviours that are typical of IA and developing insomnia if they manage their dysfunctional intentions and attempt to act with thoughtfulness. In other words, the effects of resisting temptation and self-discipline are more noticeable when pleasure driven behaviour and impulsivity tendencies are suppressed.

Finally, when it comes to the relationship between SA and insomnia, the previously mentioned results align with what has been found in the studies developed by Jeong et al. (2020), Li et al. (2016), and Li et al. (2021), in which higher levels of impulsivity were associated with higher levels of SA. Therefore, the fact that pleasure driven behaviour and impulsivity promotes the relationship between SA and insomnia is supported by the literature and can be explained by the fact that teenagers' impulsivity makes them more vulnerable to the development and adoption of addictive behaviours, which in turn increases their chance of experiencing insomnia. In addition, previous investigation has found that adolescents with poor impulse control are more prone to experience a deterioration in their quality of sleep since their impulsive tendencies can make them more prone to adopt unregulated and

inconsistent sleep patterns (Dahl & Lewis, 2002). Moreover, the results found in this study in the context of SA and insomnia also fit in with the perspective that higher levels of impulsivity make adolescents more vulnerable to developing SA (Kim & Lee, 2022; Munno et al., 2017).

Therefore, the results obtained in these three mediation models highlight the power of pleasure driven behaviour and impulsivity and consequent poor impulse control in making harmful decisions that influence the adoption of addictive behaviours, deregulating sleep patterns and making these Portuguese adolescents more prone to experience insomnia. At the same time, the inability of resisting temptation and self-discipline to protect these young people, in order to break this cycle of dangerous decisions and the consequent involvement in addictive behaviours, stands out. In addition, the role of sleep in maintain a healthy lifestyle and its contribution to ensuring healthy psychological, physical and cognitive development in adolescents in also very clear (Brand & Kirov, 2011).

Despite the contributions of this study, it does have some limitations. First of all, this is a non-probabilistic sample by convenience that only comprises participants from the Autonomous Region of Madeira and, as such, the specific culture of this region may have influenced the variables under study. Therefore, it would be interesting to include adolescents from the mainland and both islands in future studies. Additionally, the questionnaire was answered by the students without the presence of the investigator which may have prevented the clarification of doubts. Lastly, the fact that Resisting Temptation and Self-Discipline was measured using only 4 items, might have impose a limitation on the construct measurement. This can be explained by the fact that the Brief Self Control Scale only has 4 items for Resisting Temptation and Self-Discipline and 8 items that assess Pleasure Driven Behaviour and Impulsivity, so there is a great variability in the pleasure driven behaviour and impulsivity spectrum and high restriction in the resisting temptation and self-discipline spectrum. Therefore, in the future it would be pertinent to use two independent instruments to assess both forms of self-control in order to carry out a rigorous assessment of both dimensions.

However, the research also has its strengths. This is a study with a large sample size, fairly balanced between female and male participants and also in terms of age, with the exception of the 18-19 age group. As such, this sample represents 8,72% of the population of students from the Autonomous Region of Madeira in the 2019/2020 school year attending the 3rd cycle of basic education and secondary education (Uva et al., 2024). Furthermore, this seems to be the first study to consider so many variables as possible predictors of insomnia

and such recent data in literature and contributing to the explanation of relationships with still inconsistent data, exploring them in a Portuguese sample which is not very common, especially in a sample from the islands, which tend to be even less studied populations. Finally, the refined structural model explains 31% of the variability of insomnia in this sample, which is a really great value in social sciences.

In conclusion, this study has allowed to understand that FA, IA, Support and Trust, Pleasure Driven Behaviour and Impulsivity, Biological Sex, Access to Screens at Night and Frequency of Screen Use Before Going to Sleep/Until Falling Asleep predicted insomnia in this sample of Portuguese adolescents. Additionally, SA, Difficulty Negotiating and Sharing, and Resisting Temptation and Self-Discipline were not predictors of insomnia in this sample. Additionally, it was possible to observe that there is a unidirectional between FA and insomnia, IA and insomnia and SA and insomnia. Also, pleasure driven behaviour and impulsivity proved to be a catalyst for these three relationships, meaning that impulsiveness can make adolescents more vulnerable to the involvement in addictive behaviours and consequent development of this sleep disorder. Finally, resisting temptation and self-discipline has not been shown to considerably interfere in these relationships, not even protecting teenagers from these processes that are harmful to their health and well-being.

Therefore, these findings demonstrate the importance of developing future interventions for Portuguese adolescents that are focused on the promotion of healthy behaviours such as a balanced and nutritious diet, appropriate and regulated online behaviours, in order to enable the development of a consistent sleep routine suited to a teenager's sleep needs. It also seems pertinent to intervene at the family level, seeking to promote a more adequate involvement of the family in the adolescents' well-being marked by feelings of mutual support, trust, and safety in the various relationships between family members. This study also highlights the pertinence of developing interventions with adolescents that are focused on their impulsivity, seeking to offer strategies that encourages impulse control and health-conscious decision-making. Finally, it seems very pertinent to promote and inform about the benefits of adjusting circadian rhythms to meet personal needs in order to ensure the best possible emotional, cognitive, physical, and psychological functioning.

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APPENDICES

Appendix A – Extended Literature Review

Defining adolescence, the importance of sleep patterns, the consequences of sleep deprivation and insomnia

Adolescence corresponds to the period of life that happens in the middle of childhood and adulthood and lasts from 10 to 24 years old (Sawyer et al., 2018). This is a crucial time in human development since it helps building the foundations for long-term health. Teenagers grow extremely quick in cognitive, psychosocial, and physical terms, which in turn influences their thoughts, emotions, decision-making and their interactions with the world they are surrounded by (WHO, 2020).

Teenage health can be predicted by dietary choices, sleep patterns and sleep quality (Blunden et al., 2012; Maratia et al., 2023). The changes that occur on a behavioural, mental, and physical level within a 24-hour cycle are known as circadian rhythms. This process affects the majority of living things (e.g., animals, plants) and is mainly stimulated by light and darkness. Circadian rhythms are crucial to health as they have an influence on the body temperature, eating habits and also, on hormone release (NIGMS, 2023). A delay in the phase of circadian physiology combined with a slower accumulation of sleep need maintains nocturnal alertness and leads to a preference for later bedtimes and wake-up times in adolescence (Carskadon, 2011). Sleep time is further delayed by smartphone and social media utilization and bedtime autonomy (Scott et al., 2019; Tashjian et al., 2019). Nevertheless, sleep needs remain constant and when combined with the early school beginning, these factors lead to an adverse sequence of events that influence teenagers' sleep (Bowers & Moyer, 2017).

Sleep can be defined as a natural physiological process that reassures normal (i.e., healthy) intellectual, mental, and physical development. It operates as a regenerative, energy-conserving, memory-consolidating and recuperative purpose and corresponds to a time when consciousness, physical and motor activity and also metabolism, are all declined. Sleep is essential to ensure teenager's cognitive, psychological, and physical growth (Brand & Kirov, 2011). Therefore, sleep quality is crucial to maintain a healthy lifestyle, since sleep determines mood, cardiovascular regulation, the consolidation of memories and knowledge, endocrine-metabolic regulation, and weight (e.g., can predict obesity; NHLBI, 2022a). It is highly recommended that teenagers get about 8-10 years hours of sleep per day. In order for this to happen, it is necessary to adopt sleep hygiene behaviours, such as avoiding alcohol and

energy/caffeinated drinks and also keeping away electronic devices (e.g., smartphones), as they disrupt sleep (SNS24, 2023). This way, good sleep quality includes sleep satisfaction, regular sleeping pattern, alertness during awake time, adequate sleep duration, and having no trouble going back to sleep and falling asleep (Buysse, 2014). In contrast, poor sleep quality consists of a dissatisfaction with sleep efficiency and sleep latency and experiencing nocturnal awakenings (National Sleep Foundation, 2020).

Despite the importance of sleep mentioned above, previous studies showed that teenagers do not get the 8-10 hours of sleep that are recommended (Galland et al., 2018), and that they frequently report inadequate sleep duration, inconsistent sleeping patterns, and also poor sleep quality (Owens et al., 2014). This is alarming given the importance of sleep in adolescents, and the consequences of poor sleep quality such as daytime sleepiness, memory and learning problems, mood fluctuations, anxiety and sadness, oppositional and defiant behaviour, and others (SNS24, 2023). Additionally, research has shown that between 11-30% of young people experience some sort of sleep disturbance (Blunden et al., 2012) and that this prevalence may be increasing (de Zambotti et al., 2018). Given that, it is essential to realize which factors are influencing teenagers' sleep and harming it.

Insomnia, the most common type of sleep disorder, is characterized by a difficulty falling asleep, and/or maintaining sleep, and also by early awakenings. According to the DSM-V-TR and the ICD-10 (APA, 2022; WHO, 1993), the criteria for diagnosing insomnia are dissatisfaction with the quantity and quality of sleep (criterion A) which can be associated with 1) having trouble falling asleep, 2) inability to maintain sleep caused by recurrent awakenings or trouble falling back asleep after the awakenings and 3) waking up early and finding it hard to fall back asleep. The criterion B refers to the clinically significant distress or impairment in crucial domains of functioning (e.g., social, academic, behavioural) caused by sleep disturbance. In order for criterion C to be verified, it is necessary that these inability to sleep occurs at least 3 nights per week (APA, 2022; WHO, 1993). Insomnia can be episodic if the symptoms lasts between 1 to almost 3 months, severe if the symptoms endure for more than 3 months and recurrent if it occurs twice (or more) throughout a year. Persistent insomnia is associated with an increased risk for the development of anxiety disorders, depression, and alcohol use disorder (APA, 2022). Insomnia has a substantial negative influence on the lives of those who suffer from it, potentially resulting in excessive consumption (e.g., of food) or exhaustion (Cunnington, 2013). The Athens Insomnia Scale (AIS) was developed on the basis of the above-mentioned insomnia disorder criteria by Soldatos et al. (2000).

Theoretical model and possible explanations for the development of teenager's insomnia

Claudatos et al. (2019) proposed a model that seeks to explain the bidirectional relationship between sleep disturbances, that can be caused by internal factors (e.g., changes in circadian rhythms) and external factors (e.g., increased screen time), and substance consumption in adolescents. This relationship can manifest itself in 3 ways: 1) negative coping, 2) emotional dysregulation and 3) reward seeking/weak impulse control.

According to Claudatos et al. (2019), adolescence is characterised by significant changes in sleep cycles, which include a preference for later bedtime. Changes in adolescents' circadian rhythms can be caused by developmental factors (e.g., more independence in managing their routines compared to childhood), behavioural factors (e.g., reduced sleeping hours throughout the week compensated by additional sleeping time during the weekends) and environmental factors (e.g., early onset of school times) (Wolfson & Carskadon, 1998). In addition, sleep deprivation interferes with inhibitory processes, influencing adolescent's behaviour and self-control, potentially triggering risky behaviours (e.g., eating high-calorie foods; Claudatos et al., 2019). Given that, addictive eating of high-calorie foods, may affect sleep, specifically its quality and interruptions. This relationship may result in a vicious circle, in which sleep deprivation interferes with inhibitory control, boosting overeating, which in turn, can also affect sleep quality and cause sleep interruptions (Claudatos et al., 2019).

This relationship can be facilitated by negative coping, since adolescents might consume substances as a coping mechanism to promote sleep (Goodhines et al., 2017), which can lead to overconsumption and ultimately have a reverse effect by interfering with sleep itself (Claudatos et al., 2019). Furthermore, because they experience lower sleep quality, they might consume more stimulants (e.g., caffeine, tobacco, sugar; Wittman et al., 2006) to stay awake during the day, making them more vulnerable to develop a sleep disorder (e.g., lighter, and shorter sleep; Drake et al., 2013).

In terms of emotion dysregulation, it is well known that sleep plays a unique role in emotional functioning and recalibration (Walker et al., 2009). Thus, sleep deprivation may interfere with emotional experience regulation. Therefore, adolescents suffering from sleep deprivation, might become more prone to suffer neurobiological changes in terms of emotional regulation and reward response that differ from those seen in adolescents who do not have a sleep disorder/insomnia (Volkow et al., 2012). Furthermore, a preference for a late bedtime interferes with positive affect and increases impulsivity and sensation-seeking, while decreasing self-regulation capacity (Murray et al., 2009). It is known that the neuronal

systems that regulate sleep and emotions are internally related and influence cognitive and behavioural control (Pieters et al., 2010). As a result, teenagers who have different circadian rhythms throughout the week may be more vulnerable to experience a decrease of emotional and behavioural self-regulation, leading them to be more susceptible to initiate substance consumption (Claudatos et al., 2019).

Regarding reward seeking/weak impulse control, adolescents go through a critical period in the development of structures that is crucial to the reward cycle's functioning, which is also involved in mood and behaviour and can lead to changes in reward functioning and impulse control (Clark et al., 2008). These changes might cause them to be more susceptible to start substance consumption (Romer et al., 2009). Additionally, studies have demonstrated that circadian cycles are related to reward cycle's functioning (Muray et al., 2009). As a result, a dysregulation of the circadian rhythms can influence inhibitory control and may potentiate impulsivity as well as reward-seeking, which could consequently lead them to start using substances (Tashjian et al., 2017).

It is still difficult to identity the exact cause of insomnia. However, a variety of factors may interact to elevate adolescent susceptibility of developing insomnia.

1) Adolescence has been linked with a progressive decrease in the accumulation of homeostatic sleep pressure during awake time, leading to a decrease desire to sleep (Feinberg, Higgins, Khaw, & Campbell, 2006). The homeostatic sleep-wake system regulates the necessity of sleep, with pressure rising as the adolescent stays awake and falling when sleep occurs. Therefore, sleep desire accumulated prior to bedtime aids in controlling the quality and quantity of sleep.
2) Adolescence has been associated with a delay in sleeping time onset, since there is a prolongation of the intrinsic period of the endogenous circadian oscillator (Carskadon et al., 2004). The endogenous circadian oscillator is a biological clock system that regulates the daily, 24-hour rhythmic cycle in conjunction with natural (i.e., environmental) time indicators (e.g., the dark-light cycle). The process of melatonin secretion is linked to the human circadian rhythms (Cajochen, Kräuchi, & Wirz-Justice, 2003). In adolescence, melatonin is released later in the evening when compared to children, which in turns delays their onset of night sleepiness and leads them to naturally prefer later bedtimes (Carskadon, Vieira, & Acebo, 1993).

3) Adolescent acquire social interests and responsibilities (e.g., friendships, homework) which motivate them to stay awake later in the evening (Maume, 2013).
4) At this point of their lives, parents are no longer in control of their teenagers' sleep schedules (Short et al., 2011).
5) Smartphones and computers have a negative effect on adolescents' sleep, such as delayed sleep onset and a reduction in sleeping hours (Hale & Guan, 2015).
6) Caffeine consumption grows during adolescence, which can motivate sleep disturbances (i.e., issues with sleep initiation and maintenance; Owens, Mindell, & Baylor, 2014; Claudatos et al., 2019).
7) Lastly, teenagers are susceptible to the same psychological and physiological vulnerabilities that contribute to adult insomnia (Keller & El-Sheikh, 2011), including a predisposition for cognitive-emotional hyperarousal (FernandezMendoza et al., 2014). In adolescence, these physiological maturational processes and psychological/social factors can interact in such a way that the tendency towards less sleep at night encourages the continuation of activities carried out during wakefulness, delaying bedtime (Carskadon, 2011). Because sleep usually happens at an inappropriate circadian phase, this can lead to two sleep-related consequences: 1) poor sleep efficiency and increased sleep onset latency and 2) limited sleep time since school starts early (Carskadon et al., 2004).

There are also other factors that may be a risk factor for developing insomnia, such as being a women since they tend to present higher rates of insomnia when compared to their male counterparts (APA, 2022; Johnson, 2006). Furthermore, ageing, using tobacco, drugs, and alcohol (NHLBI, 2022b), stress, anxiety and depression (Strine & Chapman, 2005), unhealthy diet (Tan et al., 2015), unstructured families and poor relationships between family members (Maratia et al., 2023) as well as excessive use of smartphones or internet (Bhatt & Gaur, 2019; Van Deursen et al., 2015) may be risk factors for insomnia onset.

Stress, anxiety and depression and its relationship with sleep disturbances

With regard of anxiety and depression, previous studies have shown that sleep plays a crucial role in emotion regulation (Baglioni et al., 2010) and in the regulation of the stress response and system (Lo Martire et al., 2020), since a restful night of sleep is essential to ensure mental health (Palagini et al., 2022). Indeed, while sleep is necessary for brain

plasticity, homeostasis, and mental health (Palagini et al., 2022), sleep issues, particularly insomnia, may promote a state of allostatic overload, which in turn may impair emotional, endocrine, and immune pathways, brain plasticity and elevate the chances of developing mental disorders (Palagini et al., 2019). Teenage insomnia has a negative impact on future functioning and health (Roberts et al., 2009), and it may contribute to and maintain a variety of behavioural and emotional issues, especially anxiety and depression (Dahl & Harvey, 2007).

Insomnia is frequently associated with an extensive number of mental disorders and is regarded as a distinct risk factor as well as an early indicator of multiple psychological conditions and it plays a significant role in their relapses and/or recurrences. This kind of sleep disturbance is very common in patients with mental disorders, with around 70-80% of these suffering from insomnia in the most severe phase of their mental illness (Palagini et al., 2022). Sleep disturbances and insomnia symptoms were thought to be secondary psychopathology symptoms of major disorders (e.g., anxiety and depressive disorders). Nowadays, these disturbances are recognised as a transdiagnostic process that may result in a wide range of mental disorders (Harvey et al., 2011). The relationship between these processes may explain the multifaceted and frequently bidirectional links between sleep and mental health and positive well-being.

Sleep, arousal, and affect are overlapping regulatory systems in which a dysregulation in one affects all the others. Thus, disrupting sleep during critical periods of maturational development (e.g., adolescence) can offer a pathway towards subsequently affective dysregulation and the other way around (Dahl, 1996). Dagys et al. (2012) reported that sleep disturbances in healthy teenagers with ages between 10 and 16, lead to a reduction in positive affect and higher levels of anxiety experienced. McGlinchey et al. (2011) observed that sleep deprived adolescents with ages between 11 to 15 years old, demonstrated significantly fewer positive emotions than sleep deprived adults with ages between 30 to 60 years old, implying that adolescents may be especially susceptible to emotional dysregulation resulting from inadequate sleep.

Research suggests that there may be bidirectional relationships between life stress, sleep, and mental health, and these relationships can be mediated between each other (Drake et al., 2014). Experiencing high levels of life stress during adolescence can lead teenagers to develop mental health disorders (Drake et al., 2014; Nook et al., 2021). Also, individuals respond differently to life stress due to various psychosocial, genetic, and neurobiological

factors (Drake et al., 2014; Nook et al., 2021). This way, understanding the psychosocial and biological mechanisms that link life stress to mental health in adolescents is crucial for developing successful interventions. Life stress can disrupt sleep, leading to mental health issues, making it a potential mediator of this relationship (Yang et al., 2023).

Self-control, impulsivity, and sleep quality

Self-control is an ability that allows individuals to regulate and exert control over their own behavioural, psychological, and physical processes in order to achieve a defined long-term goal (Blankstein & Polivy, 1982). Self-control can also be defined from an impulse control perspective in that it can be considered the ability to alter or restrict a person's impulses or desires (Bandura, 1991). These ability is a crucial and beneficial factor in a person's life since it is associated with happiness and health (Tangney et al., 2004). Self-control is linked to higher levels of self-esteem and interpersonal skills (Tangney et al., 2004), and it can also be a protective factor in the development of an addiction (e.g. smartphone addiction; Água et al., 2020). Self-control can be functional/adaptative when is associated with self-discipline, thoughtfulness, and resilience, or dysfunctional/maladaptive which is related to higher levels of spontaneity and impulsivity (Lindner et al., 2015).

Paschke et al. (2016), found that higher levels of self-control are associated with better emotion regulation and, as a result, a greater prevalence of positive emotions. In this way, positive affect is associated with better sleep quality (Bower et al., 2010) and simultaneously, better sleep quality predicts increased positive affect boosts self-control and emotion regulation (Hamilton et al., 2008; Kalmbach et al., 2014). Conversely, low levels of self-control are associated with greater difficulty regulating emotions, especially the negatives ones.

Investigation in this topic suggests that self-control may be negatively influenced by poor sleep quality (Telzer et al., 2013). In contrast, studies have shown that poor impulse control can result in inconsistent sleep patterns, which in turn may result in poor sleep quality (Dahl & Lewis, 2002). Therefore, it is crucial to understand the underlying mechanisms between sleep and impulse control as these can inform and guide interventions aimed at preventing adolescents from engaging in risky behaviours and simultaneously, promoting their health (Bauducco et al., 2019).

In a study carried out by Bauducco et al. (2019), it was found that over a three-year period, teenagers with sleep disturbances also experienced impulse control issues, and

simultaneously, difficulties on impulse regulation were also related with more sleep problems. Therefore, this relationship proved to be bidirectional. Furthermore, there appear to be some gender differences since girls tend to experience more insomnia than boys due to impact of impulsive behaviour (Bauducco et al., 2019).

The family context as an explanatory factor for insomnia

Adolescence is a critical developmental period to investigate the interactions between family structure and sleep because it is marked by biologically determined changes in sleep, along with greater independence from parents and strong influences from their friends and other social relationships (Troxel et al., 2014). Family is a dynamic system marked by constant transformations resulting from the increasing variety of its structure and issues (Scabini, 2016). The family remains one of the most important socializing contexts, for teenagers (Brofenbrenner & Morris, 2007) since the relationships they establish with their family elements are essential for their proper adjustment and development (Kurock et al., 2022).

However, divorces have been increasing exponentially over the years in western families (Pearce et al., 2018). This phenomenon has led to an increase in family rearrangements with a growing number of stepparent families in European countries and the US (Smock & Schwartz, 2020). Many countries have witnessed an accelerated rise in joint physical custody (JPC) arrangements over the last two decades. JPC is a new type of family structure in which the child lives roughly equally with his parents, after a divorce, switching from one house to another (Steinbach & Augustjin, 2021).

As these family changes occur, studies have shown that an increasing number of adolescents are experiencing sleep deprivation (Keyes et al., 2015), with up to 85% sleeping below the recommended hours (Saxvig et al., 2020). When teenagers experience poor sleep quality and quantity, they become more likely to have worse academic performance (Hysing et al., 2016), and simultaneously, more likely to develop a mental disorder later in adolescence or even in early adulthood (Scott et al., 2021). Therefore, sleeping less time and experiencing insomnia during adolescence have been identified as a major public health concern (Barnes & Drake, 2015).

This way, there has been a growing awareness of how crucial it is to get proper sleep for adolescents' everyday functioning, as well as their physical and mental health. Simultaneously, the context in which teenagers find themselves determine their sleeping

habits and ultimately their sleep quality/issues (Dahl & El-Sheikh, 2007). Recently studies have attempted to explore the relationship between adolescents' sleep and their families' context (El-Sheikh & Kelly, 2017). This arises from the idea that sleep demands that the person feels safe and secure, since increased arousal and alertness inhibit sleep (Dahl & El-Sheikh, 2007).

In this regard, family relationships are considered to be the most important social relationships that they establish and as such, they significantly affect adolescents' sleep quality (Ailshire & Burgard, 2012). This way, family environments marked by stress and lack of safety, can promote sleeping problems (Nilsen et al., 2022). Therefore, conflicts (Kelly & El-Sheikh, 2011), financial difficulties (El-Sheikh et al., 2020), poor family functioning and parent-teenager relationships (Schmeer et al., 2019) are all associated with teenagers' sleep disturbances. With that being said, in order to understand adolescents' sleep, is it crucial to consider family factors such as demographic factors (e.g., family income) and also positive (e.g., positive relationships with relatives) and negative (e.g., high levels of family conflict) relational factors.

Sociodemographic factors have been proved to have a major influence on adolescents' sleep quality (Sosso et al., 2022), specifically family socio-economic status (e.g., family income, parental level of education), and structure (e.g., single parent families, with or without siblings) (Kim et al., 2020). Cross-sectional studies have shown that shorter sleep duration and inconsistent bedtimes are associated with a lack of economic resources, parents with low levels of education or who are both employed (Jarrin et al., 2014). Nonetheless, longitudinal studies have shown that these specific socioeconomic factors do not necessarily influence adolescent sleep quality throughout time (Kim et al., 2020).

When considering the impact of family demographic characteristics on the well-being of adolescents, it is critical to take into account the evolving complexity of the structure (e.g., living with both or one parent, having any sibling) that characterises modern families (Nilsen et al., 2022). Cross-sectional studies conducted on the impact of family structure in teenagers' sleep, have suggested that adolescents in single-parent or stepparent families may have later bedtimes, shorter sleep duration and more sleep disturbances than those in nuclear families (Delaruelle et al., 2021; Troxel et al., 2014). This could be explained, as mentioned, by economic factors since single-parent families are more likely to face financial difficulties (e.g., lower incomes) and as such, to have poorer quality homes in which they have absolutely no control over the outside environment, which in turn can influence sleep as there may be

noise inside or outside the house and a lack of stable family routines (Philbrook et al., 2020). These difficulties also affects adolescents' parents as they can experience higher levels of stress and more mental health challenges due to job insecurity or demanding schedules which reduces their ability for sleep-positive parenting practices (e.g., defining bedtimes; Short et al., 2011). In addition, having siblings can also influence the quality of sleep, making it poorer (Delaruelle et al., 2021), and sharing the bedroom with other relatives may result in less sleep time (Blair et al., 2012). However, longitudinal studies do not support that adolescents with single-parent families or sharing the bedroom with siblings has a negative long-term effect on adolescents' sleep (Kim et al., 2020).

Additionally, the quality of the relationships that adolescents maintain with other family members, has been theorized to affect teenagers' sleep quality. Therefore, family relational factors such as family support and even family conflict might predict adolescents' sleep quality (El-Sheikh & Kelly, 2017). However, longitudinal studies have suggested that these family relational factors can influence adolescent's sleep to such an extent that it can lead a reciprocal relationship in which teenagers' sleep can end up influencing the quality of their family relationships (Roberts et al., 2002).

In this regard, a family system with warm, close, and responsive relationships between its members is referred to as having positive family relational factors (El-Sheikh & Kelly, 2017; Sasser et al., 2021). Therefore, these positive factors when combined with good sleep quality, will result in more family support, better relationships with parents, establishment and fulfilment of rules and also monitoring, which in turn will allow adolescents to have greater autonomy. When teenagers spend quality time with their parents, receive their support, adhere to bedtime rules, they become more likely to experience better sleep quality, which is reflected in longer periods of sleep and the absence of sleeping problems (Sasser et al., 2021). Additionally, longitudinal studies have found that when adolescents experience sleep issues (e.g., insomnia) this might impair the quality of their relationships with their parents while also leading to more conflicts at home (Roberts et al., 2002; Roberts et al., 2008).

On the other hand, negative relational family aspects can sometimes override the positive ones. It is really challenging for teenagers to accept and adapt to a new family structure (e.g., having a good relationship with their parent's new romantic partner; Koster et al., 2021). This situation can bring with it feelings of not belonging to the family (King et al., 2015). In addition, the parent's new partner might bring new parental practices, which in turn

may lead to conflicts and inconsistent rules and limits (e.g., related to sleep routines; Amato, 2010). Also, JPC might negatively affect teenagers' sleep quality due to the stress they feel from constantly moving from one house to another and sleeping in different environments (Turunen et al., 2021).

Therefore, family-related stressors, high family expectations and conflicts, influence adolescents' well-being and sleep (Khor et al., 2021). In this regard, cross-sectional studies found that higher levels of family tension and disagreement were linked to sleep disturbances (e.g., insomnia) (Khor et al., 2021). Simultaneously, adolescents who notice the high expectations of their relatives, tend to sleep for less time during the night (Fuligni & Hardway, 2006). Additionally, when the family environment is marked by disorder and chaos, the teenager is more likely to experience poor sleep quality and fewer hours of sleep (Billows et al., 2009). Nevertheless, longitudinal studies did not consistently reveal that negative family factors had a long-term impact on adolescents' sleep quality, they also suggested that this relationship could be bidirectional, (i.e., that adolescent's sleep problems may lead to more problems at home; Roberts et al., 2008).

It was possible to ascertain that several family factors and dynamics can promote adolescents' mental health while protecting them in hard periods of their lives. In other words, a nurturing family may operate as a protective factor, nevertheless, when negative relational family factors prevail, this protective capacity is reduced which in turn make teenagers more likely to experience negative health consequences (Maratia et al., 2023).

The conceptualization of behavioural addictions and introducing Food Addiction

Currently when we talk about addictions, this in itself no longer necessarily refers to the use and abuse of drugs or other substances (e.g., alcohol). This happens because other types of addiction have emerged, such as food addiction, internet addiction and smartphone addiction. All of these addictions belong to the category of behavioural addictions (Chamberlain et al., 2016). Behavioural addictions can be hard to define as they are lined with physical, psychological, and social factors. However, some of the common characteristics of all behavioural addictions are: 1) maintained engagement in a behaviour regardless of its negative consequences, 2) reduced control over involvement in the behaviour, compulsive engagement, and 3) craving urges that immediately lead to engagement in the behaviour (Chamberlain et al., 2016).

In this way, research into food addiction has revealed that there are two different currents that result in two different conceptualizations. Initially, investigation has concentrated on the chemical composition of food itself, leading to the development of the concept of "Food Addiction" (FA), which emphasizes addiction to specific foods (e.g., processed foods that are rich in salt, sugar, and fat; Hauck et al., 2020). On the other hand, the second line of research assumes that addiction is centred on eating behaviour rather than specific foods. This way, the term "Eating Addiction" emerged (Hauck et al., 2020). However, the concept of eating addiction has been criticized for not properly distinguishing this type of addictive behaviour from other eating disorders (e.g., bulimia nervosa). Therefore, FA addiction has attracted increased clinical and scientific attention (Hauck et al., 2020).

Thus, Food Addiction refers to the hedonic behaviour of excessively consuming foods that are known as highly palatable foods (i.e., foods that are rich in salt, sugar, and fats) in quantities that exceed those needed to maintain energetic homeostasis (Hauck et al., 2020; Kalon et al., 2016; Najem et al., 2019). FA can originate from behavioural, nutritional, biological, and psychological factors (Gearhardt et al., 2011). FA is frequently mistaken for obesity. However, FA implies an insatiable desire to eat beyond what is thought to be a physical or metabolic needed (Hauck et al., 2020; Kalon et al., 2016; Najem et al., 2019), while obesity is described as having a body mass index (BMI) equal to or greater than 30 (WHO, n.d.). Therefore, it is possible to suffer from FA without being obese, as well as the opposite, that is, to be obese and not have FA, even though overweight and obesity can be a result of FA, which in turn can increase FA's incidence in these individuals (Falcon et al., 2021; Torres et al., 2017).

FA is not yet included in the DSM-V-TR. However, the mechanisms underneath FA are thought to be the same as those behind substance dependence (Najem et al., 2019; Gearhardt et al., 2011). Therefore, FA's conceptualization is based on the DSM-IV-TR diagnostic criteria for substance dependence disorder (Torres et al., 2017). Thus, the criteria to diagnose substance dependence consists of a maladaptative pattern of substance use causing clinically significant impairment or distress, that results in 3 (or more) of the following events happening at any moment during the same 12-month period: 1) tolerance, that can be manifested by a) the necessity for significantly higher dosages of the substance to accomplish the intended effect or intoxication or b) a considerably reduced effect even after using the same dosage of the substance repeatedly; 2) withdrawal, that can be showed by the following: a) the substance's distinguishing withdrawal symptoms or b) the substance in question or a

similar one is used to prevent or relieve withdrawal symptoms; 3) the substance is frequently consumed for longer periods of time or in higher quantities than intended; 4) there is an ongoing desire or have already been fruitless attempts to reduce or control substance use; 5) a significant amount of time is devoted to activities required to acquire or to use the substance (e.g., driving far away) or recover from its effects; 6) due to substance use, the individual abandon/drop significant recreational, occupational or social activities, and finally 7) the individual continues to use the substance despite being aware of having a persistent physical or psychological condition that is most likely to have been caused by or made worse by the substance (APA, 2000). In this way, the Yale Food Addiction Scale (YFAS) was developed to assess symptomatic expression congruent with FA, based on these criteria, adapting them to eating behaviour (Gearhardt el al., 2009).

Rodrigue et al. (2019) found that the prevalence of FA among adolescents ranged between 2-16%. However, a systematic review carried out by Skinner et al. (2021), found that among the 23 analysed studies, the prevalence of food addiction in adolescents was between 2.6-49.9%. These prevalence numbers are intrinsically related to each country's culture (e.g., gastronomical culture) and may vary according to the population being studied (Luo et al., 2022). Therefore, people might perceive consuming large quantities of food as excessive and typical of FA, whereas in other countries, it might be considered acceptable/normal (Torres et al., 2017). Additionally, it was found that adolescents with FA presented a higher BMI than those without FA (Skinner et al., 2021; Rodrigue et al., 2019).

Research has shown that there might be comorbidities between FA and mental health issues (e.g., anxiety and depression; Luo et al., 2022). In this regard, it has been showed that FA is significantly related to high levels of stress (Hong et al., 2020), depression (Borisenkov et al., 2018) and anxiety (Benzerouk et al., 2018), all of which may be predictors of the FA. However, it is still unknown how comorbidity works (Luo et al., 2022). This can be explained by the fact that some individuals may consume certain foods as a way to manage their negative emotions (Luo et al., 2022). This way, individuals suffering from anxiety and depression are more likely to consume highly palatable foods in order to improve their negative or depressed mood (Oliveira et al., 2020), highlighting the link between FA and impulsivity and mood (Kalon et al., 2016). Also, chronic stress may contribute to reward system dysregulation, increasing the likelihood of developing FA (Wei et al., 2019).

Additionally, previous research has showed that a person's diet can lead to insomnia, since it can predict sleep quality (Tan et al., 2015). Therefore, a diet high in fish, vegetables,

and vitamin D is linked to better sleep quality, whereas a high intake of sodas, sweets and carbohydrates is linked to poorer sleep quality (Tan et al., 2015). Moreover, FA can impact sleep quality in a negative way (Najem et al., 2019).

Internet Addiction: an overview

The internet has forever changed the way people take advantage of technology specifically in the way they interact with each other, enabling the creation of new forms of socializing and, as such, promoting the inclusion of everyone in society. In 2019, approximately 4,1 billion people were internet users (International Telecommunication Union, 2019).

The concept of Internet Addiction (IA) was introduced by Ivan Goldberg in 1995, to describe a pathological internet dependency (Young, 1998). It is estimated that around 5-15.2% of European adolescents are affected by IA (Wang et al., 2016), which has been proven to affect their academic performance, compared to their peers who do not suffer from IA (Boonvisudhi & Kuladee, 2017).

Research into the concept of Internet Addiction (IA) is based on the realization that some internet users have become addicted to it, just as people become dependent on alcohol, drugs, or gambling (Young, 1998). Therefore, IA consist of a long-term, problematic, and compulsive internet use that jeopardise an individual's functioning (Kapus et al., 2021). In order to characterize internet addiction, it was essential to come up with a group of criteria that distinguish internet addicts from non-internet addicts. If these criteria were viable enough to indicate a possible diagnosis of IA, this would enhance clinical treatment and simultaneously contribute to the ongoing investigation in this area (Young, 1998). However, it is complicated to make a diagnosis, given that the concept of "addiction" is not found in the DSM-IV (APA, 1994). So, after reviewing the diagnoses in the DSM-IV, the one that most closely resembles the characteristics of pathological internet use, was gambling disorder. Therefore, based on this diagnosis, it was possible to conceptualize IA as an impulse control disorder not promoted by a toxic substance (Young et al., 1999).

Young (1998), developed a brief 8-item questionnaire – Internet Addiction Diagnostic Questionnaire (IADQ) – which was administered to internet users. The final questionnaire, after adapting the gambling disorder criteria for internet addiction, resulted in: 1) anticipating when they will be online again or thinking about the last time they were online, 2) spending more and more time online to get pleasure, 3) unsuccessful attempts to

control or stop internet use, 4) becoming restless, moody, depressed or irritable when not using the internet, 5) stays online longer than intended, 6) has compromised or risked losing their job, academic education, career opportunity or an important relationship because of the internet, 7) has tried to hide their internet use by lying to family members, their therapist or other people and 8) uses the internet in order to escape from their problems or relieve feelings of powerlessness, anxiety, guilt or depression (Young, 1998). After applying the questionnaire, participants who had replied "yes" to 5 or more items were considered to be dependent of the internet (Young, 1998).

The questionnaire analysis enabled the comprehension of which applications were most commonly used by the two main groups in this study, which allowed to make a characterization of internet users with and without IA. This characterization was based on the following criteria: 1) total time spent on the internet, 2) weekly time spent on the internet, 3) most popular applications and 4) perceived consequences of internet use. In general, users with IA had been using the internet for less than a year, indicating that internet does not take long to become addictive. Additionally, they tended to spend approximately 8 times more time online per week than non-dependents, and this time increased gradually over time, as occurs in situations of abstinence, such as substance use disorders. Furthermore, addicts spent the majority of their time online in chat applications and reported that the primary consequences were physical, financial, academic/occupational, and relational, as is typical of substance use disorders. On the other hand, the majority of users without IA had been on internet for more than a year, spent approximately 4 hours per week online, used their time online to consult sources of information (e.g., journals), and stated that the most significant consequence of their time spent online was a loss of sense of time, but not to the point where it interfered with their daily responsibilities (Young, 1998). Despite being aware of the consequences of their internet misuse, more than 50% of users with IA have no intention of reducing or discontinuing their use of the internet, while the other half have attempted to do so in the past in order to protect themselves from the consequences of their use but were unsuccessful (Young, 1998).

This research served as the foundation for the study of IA and the Internet Addiction Test (IAT) was created using the IADQ and its respective findings. The IAT evaluates people's behaviour in terms of how they use the internet and how it affects them on a daily basis, categorizing internet addiction as normal, mild, moderate, or severe (Young, 1998).

IA can lead to depression, anxiety, interpersonal relationships issues and even insomnia (Boonvisudhi & Kuladee, 2017; Bhatt & Gaur, 2019) with higher levels of IA being associated with higher levels of insomnia (Bhatt & Gaur, 2019).

An introduction to Smartphone Addiction

This century has witnessed an exponential increase in the number of internet and smartphones users, to the point where they have now become essential elements of daily activities (AlBarashdi et al., 2016). Smartphones are electronic devices that are able to process far more information when compared to other mobile phones. They also offer the possibility of accessing the internet, communicate with other people through social networks, and play games on it (Demirci et al., 2015; Kim, 2013). This way, they simultaneously work as a mp3 player, a DVD player and even as a computer, (Kwon et al., 2013), which can explain why studies have shown that the prevalence of SA is higher than that of IA (Kwon et al., 2013). Because of the advancements in mobile technology and the increasing number of smartphones users, access to the internet is becoming progressively simpler. Recent data reveals that according to the Statista, in 2022 about 6,4 billion people had a smartphone, and the forecast is that by 2028, there will be 7,7 billion people using a smartphone (Statista, 2023).

Despite the benefits that smartphone use provides, such as ability to communicate with people quickly and efficiently (Aljomaa et al., 2016) and access academic content trough applications developed for this purpose (e.g., moodle), there are numerous drawbacks to using this type of technology, that mainly harm young people (Kim, 2013). These consequences can occur on a physical level (e.g., neck and shoulder pain; AlBarashdi et al., 2016; Kim, 2013) but also on a psychological level, since smartphone addiction can have serious consequences on sleep quality from those who suffer from it (Ibrahim et al., 2018), and can even lead to insomnia (Van Deursen et al., 2015). Furthermore, research has demonstrated that smartphone use can cause stress and anxiety (Demirci et al., 2015) and that it has a negative impact on young people's academic performance (Samaha & Hawi, 2016).

It was recently found that activities practised online (e.g., chatting, gaming) have equivalent levels of addiction to drug and substance abuse (Kwon et al., 2013). Additionally, studies have shown that smartphones also induced symptoms of addiction identical to the effects of internet addiction, such as craving, tolerance, withdrawal, daily-life disruption, and a preference for cyberspace-oriented relationship as confirmed by the diagnosis (Kim, 2013). Therefore, since smartphones make it easier to access the internet, they made people's lives

easier. However, there was an unplanned global increase in their use (Kwon et al., 2013) and the addiction pattern related to smartphones (e.g., difficulty of carrying out daily tasks) has become more common, and concerns about the phenomenon are increasing all over the world (Kwon et al., 2013).

The problem is that their accessibility and practicality can be both benefit and a risk for the user. Therefore, these two characteristics can motivate an addiction over the smartphone, which was named Smartphone Addiction (SA) (Kwon et al., 2013). SA can be defined as the excessive use of smartphones, to the point where it interferes with users' daily lives (Demirci et al., 2015). According to Xiong et al. (2023), the worldwide prevalence of SA among adolescents is 25,7%. Adolescents are more prone to develop SA because of their poor self-control and curiosity (Kim & Lee, 2022; Munno et al., 2017).

In order to overcome the limitations of the previous scales that assessed SA, Kwon et al. (2013) created and tested the Smartphone Addiction Scale, which consists of 33 self-report items to assess smartphone addiction. However, the validation had some inconclusive results, in particular it showed that the scale makes it difficult to make comparisons between the levels of SA of both sexes (Kwon et al., 2013). So, Kwon et al. (2013) developed the Smartphone Addiction Scale – Short Version to overcome the limitations of the previous scale.

Additionally, studies have shown that women, specifically in younger ages are more prone to develop a smartphone addiction. This can be explained by the different patterns of smartphone use shown by both sexes, with females spending more time on social networks than their male counterparts (Demirci et al., 2015).

As mentioned above, smartphone and internet problematic use might influence sleep initiation and development since it can affect rapid eye movement (REM) sleep, sleep efficiency and also slow-wave sleep (Higuchi, Motohashi, Liu & Maeda, 2005). Additionally, the bright of the smartphone/computer screen may reduce melatonin secretion – sleep hormone, and therefore, postpone sleep onset (Higuchi et al., 2003). Cain and Gradisar (2010), proposed the following mechanisms that explain the relationship between electronic media use and poor sleep quality: 1) the utilization of electronic media can disrupt sleep, 2) use of electronic media might be liked to physiological, cognitive, or emotional arousal, 3) the light emitted by electronic media screens could influence sleep and 4) using electronic media inside the bedroom might disrupt teenagers' sleep by waking them at night.

Relevance and objectives of the present study

To sum up, it has been possible to see that the research carried out to date on the themes of this work has shown that, 1) sleep disturbances in healthy teenagers with ages between 10 and 16, lead to a reduction in positive affect and higher levels of anxiety experienced (Dagys et al., 2012), 2) teenagers with sleep disturbances also experienced impulse control issues, and simultaneously, difficulties on impulse regulation were also related with more sleep problems (Bauducco et al., 2019), 3) adolescents in single-parent or stepparent families may have later bedtimes, shorter sleep duration and more sleep disturbances than those in nuclear families (Delaruelle et al., 2021; Troxel et al., 2014, 4) FA can impact sleep quality in a negative way (Najem et al., 2019, 5) higher levels of IA are associated with higher levels of insomnia (Bhatt & Gaur, 2019) and 6) the bright of the smartphone/computer screen may reduce melatonin secretion, and therefore, postpone sleep onset (Higuchi et al., 2003).

FA has been associated with impulsivity (Kalon et al., 2016) and poorer emotional regulation (Kozak et al., 2017). However, it is necessary to continue exploring how these interactions influence teenagers' sleep. Additionally, it is known that IA and SA are positively associated (Ben-Yehuda et al., 2016) and both have been tested regarding its relationships with self-control. Therefore, studies have found that a lack of self-control is associated with SA, and may be associated with IA (Jeong et al., 2020; Li et al., 2021). Nevertheless, it is yet undefined how these associations impair adolescent's sleep quality.

Therefore, the aim of the present study is to 1) analyse and understand which of the above-mentioned variables can predict insomnia in this sample of Portuguese adolescents and 2) which variables mediate the relationships between: a) FA and insomnia, b) IA and insomnia and c) SA and insomnia.

Appendix B – Participants' Online Informed Consent Term

O objetivo deste estudo é compreender o uso da Internet em jovens portugueses. A tua participação é voluntária e muito útil. Os dados são anónimos e confidenciais, podendo os resultados deste estudo ser divulgados à comunidade (escolar, científica, etc.), através de comunicações em congressos, palestras e/ou artigos científicos, sem nunca qualquer dado de identificação do participante ser divulgado.

Caso concordes participar voluntariamente neste estudo anónimo e confidencial quanto à divulgação de dados, por favor seleciona a opção abaixo:

(__) Li a informação acima e aceito participar no estudo.

Muito obrigado pela tua disponibilidade e interesse.

É muito importante que preenchas todas as questões do questionário.

Appendix C – Sociodemographic Questionnaire

Idade: ___ anos

Sexo: Rapaz/Homem____ Rapariga/mulher ____

Nível de escolaridade:

__Ensino Básico/3º Ciclo

__Ensino Secundário

__ Ensino Universitário

Em que tipo de zona vives?

_Urbana (cidades)

_Rural (campo/aldeias)

Qual o teu rendimento escolar?

__Aluno com notas negativas (a maioria das notas no nível insatisfaz)

__Aluno com notas suficientes (a maioria das notas no nível satisfaz)

__Aluno com notas boas (a maioria das notas no nível bom)

__Aluno com notas elevadas (a maioria das notas no nível muito bom/excelente)

Já ficaste algum ano retido?

__ Sim

__ Não

Qual o teu peso? ____ kg

Qual a tua altura? _____m

Appendix D – Internet Access and Use Questionnaire

Tens Smartphone?

__Sim, tenho Smartphone

__Não, não tenho Smartphone, mas tenho um telemóvel

__Não, não tenho Smartphone, nem tenho telemóvel

Levas o smartphone/telemóvel para a Escola?

Sim, levo___

Não, não levo___

Não, não tenho smartphone/telemóvel___

Quantas vezes por dia usas o telemóvel/smartphone (para enviar SMS, ligar, redes sociais, jogos, apps)?

__ Não tenho telemóvel/smartphone

__1-10 vezes

__11-20 vezes

__21-30 vezes

__Mais de 31 vezes

Quanto tempo por dia (aproximadamente), de segunda a sexta, costumas usar a Internet, por lazer ou passatempo?

- Até 30 minutos
- De 30 a 60 minutos
- De 1h a 2h
- De 2h a 4h
- De 4h a 6h
- De 6h a 8h
- Mais de 8h

Quanto tempo por dia (aproximadamente), ao sábado e domingo, costumas usar a Internet, por lazer ou passatempo?

- Até 30 minutos
- De 30 a 60 minutos
- De 1h a 2h
- De 2h a 4h
- De 4h a 6h
- De 6h a 8h
- Mais de 8h

No geral, quanto tempo por dia (aproximadamente), costumas usar a Internet, para socializar com os amigos/colegas?

- Até 30 minutos
- De 30 a 60 minutos
- De 1h a 2h
- De 2h a 4h
- De 4h a 6h
- De 6h a 8h
- Mais de 8h

Costumas fazer as refeições à mesa em família?

__Sim

__Não

Se sim, costumas utilizar os aparelhos móveis durante as refeições com a família?

__Não, nem eu, nem a minha família utilizamos

__Sim, eu utilizo, mas a minha família não utiliza

__Sim, eu e a minha família utilizamos

__Eu não utilizo, mas outros membros da minha família utilizam

Tens acesso durante a noite, no teu quarto, a ecrãs (ex. computador portátil, smartphone/telemóvel, tablet, consola portável, televisão)?

__Sim

__Não

Com que frequência costumas usar ecrã(s) (computador portátil, smartphone/telemóvel, tablet, consola portável, televisão.) imediatamente antes de dormir ou até adormeceres?

__Nunca

__Raramente

__Às vezes

__Muitas vezes

__Todos os dias

Appendix E – Portuguese Yale Food Addiction Scale (P-YFAS)

Neste questionário vai encontrar perguntas sobre os seus hábitos alimentares nos últimos 12 meses. Por vezes, as pessoas têm dificuldade em controlar o consumo de certos alimentos, como por exemplo:

- Doces, tais como gelados, chocolates, croissants, biscoitos, bolachas, bolos e guloseimas.
- Farináceos, tais como pão, massas e arroz.
- Salgados, tais como batatas fritas de pacote, salgadinhos, e bolachas de água e sal.
- Alimentos gordos, tais como bifes, enchidos, queijos, hambúrgueres, pizzas, e batatas fritas.
- Bebidas açucaradas, tais como refrigerantes.

Quando neste questionário te forem feitas perguntas sobre "CERTOS ALIMENTOS", por favor considera:

QUALQUER alimento semelhante aos indicados anteriormente, OU

QUALQUER OUTRO alimento com o qual tenhas tido problemas nos últimos 12 meses.

Nos últimos 12 meses	Nunca	1 vez por mês	2-4 vezes por mês	2-3 vezes por semana	4 ou mais vezes por semana, ou diariamente
1. Noto que quando começo a comer certos alimentos, acabo por comer muito mais do que tinha planeado.					
2. Dou por mim a continuar a comer certos alimentos, mesmo quando já não tenho fome.					
3. Como até ao ponto de me sentir mal-disposto(a).					
4. Não comer certo tipo de alimentos, ou reduzir certo tipo de alimentos, é algo que me preocupa.					
5. Senti-me mole ou cansado(a) por ter comido demais.					

6. Dou por mim a comer constantemente certos alimentos ao longo do dia.					
7. Noto que quando certos alimentos não estão disponíveis, arranjo maneira de os obter. Por exemplo, posso sair de casa para ir comprar certos alimentos, mesmo que tenha outras opções disponíveis em casa.					
8. Houve alturas em que comi certos alimentos tantas vezes (ou em quantidades tão grandes) que acabei por comer em vez de estudar, estar com a minha família ou amigos, ou envolver-me noutras atividades importantes, ou em atividades de diversão de que gosto.					
9. Houve alturas em que comi certos alimentos tantas vezes (ou em quantidades tão grandes) que acabei por passar o tempo a lidar com sentimentos negativos por comer demais, em vez de estudar, estar com a minha família ou amigos, ou envolver-me noutras atividades importantes, ou em atividades de diversão de que gosto.					
10. Houve alturas em que evitei situações escolares ou sociais onde havia certos alimentos, porque tinha medo de comer demais.					
11. Houve alturas em que evitei situações escolares ou sociais, por não poder consumir certos alimentos nessas situações.					
12. Tenho sentido agitação, ansiedade, ou mal-estar físico quando reduzo ou paro de comer certos alimentos. (Por favor, NÃO incluas mal-estar causado pela redução do consumo de bebidas com cafeína, tais como refrigerantes, café, chá, bebidas energéticas, etc.)					

13. Tenho consumido certos alimentos para impedir sentimentos de ansiedade, agitação, ou mal-estar físico, que se estavam a desenvolver (Por favor, NÃO incluas o consumo de bebidas com cafeína, tais como refrigerantes, café, chá, bebidas energéticas, etc.)					
14. Percebi que tenho um forte desejo ou ânsia de consumir certos alimentos quando os reduzo ou paro de os comer.					
15. O meu comportamento em relação à comida e à alimentação causa-me bastante sofrimento.					
16. Sinto muita dificuldade em funcionar de forma eficaz (rotinas diárias, escola, atividades sociais, atividades familiares, problemas de saúde) por causa dos meus problemas com a comida e a alimentação.					
17. O meu consumo alimentar tem-me causado sérios problemas psicológicos, tais como depressão, ansiedade, repulsa em relação a mim próprio(a), ou culpa.					
18. O meu consumo alimentar tem-me causado sérios problemas físicos ou agravado um problema físico que já tinha.					
19. Continuei a consumir o mesmo tipo de alimentos (ou a mesma quantidade de comida), mesmo quando estava a ter problemas emocionais e/ou físicos.					
20. Com o tempo, percebi que preciso de comer cada vez mais para obter a sensação que quero, como diminuir emoções negativas ou aumentar o prazer.					

21. Percebi que comer a mesma quantidade de comida já não diminui as minhas emoções negativas, nem aumenta os sentimentos de prazer, tal como acontecia antes.					
22. Quero reduzir ou parar de comer certo tipo de alimentos.					
23. Tenho tentado reduzir ou parar de comer certo tipo de alimentos.					

Nos últimos 12 meses	1 ou menos vezes	2 vezes	3 vezes	4 vezes	5 ou mais vezes
24. Quantas vezes tentaste reduzir ou parar de comer por completo certos alimentos?					

Appendix F – Internet Addiction Test (IAT)

As perguntas que se seguem avaliam alguns dos teus hábitos em relação ao uso da Internet. Por isso, ao responder às perguntas deves ter em consideração SOMENTE o tempo que passas online por MOTIVOS RECREACIONAIS ou DIVERSÃO, e não o tempo gasto na Internet com trabalhos escolares ou laborais.

Com que frequência:

1. Ficas online mais tempo do que pretendias?

2. Deixas de fazer as tarefas em casa para poderes ficar mais tempo online?

3. Preferes a excitação da internet à intimidade com o teu(tua) namorado(a)?

4. Crias novas relações com outros utilizadores online?

5. As outras pessoas queixam-se em relação à quantidade de tempo que passas online?

6. O teu trabalho/estudo é prejudicado (ex. adias tarefas, atrasas-te na entrega de trabalhos) devido à quantidade de tempo que passas online?

7. Verificas o teu e-mail (ou Facebook, Twitter, Instagram, etc.) antes de fazeres qualquer outra coisa que precises?

8. O teu desempenho ou produtividade na escola/estudo é prejudicado por causa da Internet?

9. Ficas defensivo ou guardas segredo quando alguém te pergunta o que está a fazer online?

10. Bloqueias pensamentos perturbadores sobre a tua vida com pensamentos calmantes da internet?

11. Dás por ti a pensar sobre quando irá estar online novamente?

12. Receias que a vida sem Internet seria chata, vazia e sem graça?

13. Explodes, gritas ou ficas irritado(a) se alguém te incomoda enquanto estás online?

14. Perdes o sono por estar online até tarde durante a noite?

15. Te sentes preocupado(a) com a Internet quando estás desconectado(a) ou fantasias estar online?

16. Dás por ti a dizer “só mais alguns minutos” quando estás online?

17. Tentas reduzir a quantidade de tempo que passas online e não consegues?

18. Tentas esconder a quantidade de tempo que estiveste online?

19. Preferes ficar mais tempo online do que sair com outras pessoas?

20. Te sentes deprimido(a), mal-humorado(a) ou nervoso(a) quando estás desconectado(a) e, deixas de estar assim quando entras online novamente?

0: Não Aplicável; 1: Nunca; 2: Raramente; 3: Ocasionalmente; 4: Várias Vezes; 5: Sempre.

Appendix G – Smartphone Addiction Scale – Short Version (SAS-SV)

Escolhe, para cada uma das frases, a opção que mais se adequa a ti.

1. Não acabo os trabalhos planeados devido ao uso do smartphone.
2. Tenho dificuldade em concentrar-me na aula, durante tarefas, ou durante o horário de estudo, devido ao uso do smartphone.
3. Sinto dor nos pulsos e na parte detrás do pescoço durante a utilização do smartphone.
4. Não consigo suportar estar sem o smartphone.
5. Sinto-me impaciente e irritado quando não estou a segurar o meu smartphone.
6. Tenho o meu smartphone em mente, mesmo quando não estou a usá-lo.
7. Nunca vou deixar de usar o meu smartphone, mesmo sabendo que a minha vida diária está já muito afetada por isso.
8. Verifico constantemente o meu smartphone para ter a certeza que não perco conversas entre outras pessoas nas redes sociais que uso.
9. Costumo usar o meu smartphone durante mais tempo do que tencionava.
10. As pessoas à minha volta dizem-me que uso demasiado o meu smartphone.

1: Discordo Totalmente; 2: Discordo; 3: Discordo em parte; 4: Concordo em Parte; 5: Concordo; 6: Concordo Totalmente

Appendix H – General Functioning dimension of the Family Assessment Device (GF-FAD)

Escolhe a opção que melhor representa a tua família nas seguintes afirmações.

1. Planear atividades em família é difícil porque não nos compreendemos uns aos outros.
2. Em tempos de crise podemos contar uns com os outros quando precisamos de apoio.
3. Nós não podemos falar uns com os outros sobre a tristeza que sentimos.
4. Os indivíduos são aceites pelo que são.
5. Nós evitamos discutir acerca dos nossos medos e preocupações.
6. Nós podemos expressar sentimentos uns aos outros.
7. Existem muitos sentimentos negativos nesta família.
8. Nós sentimo-nos aceites pelo que somos.
9. Tomar decisões é um problema para a nossa família.
10. Nós somos capazes de tomar decisões sobre como resolver problemas.
11. Nós não nos damos bem
12. Nós confiamos uns nos outros.

1: Discordo Plenamente; 2: Discordo; 3: Concordo; 4: Concordo Plenamente

Appendix I – Psychological Well-being and Mental State Questionnaire

Como avalias o teu bem-estar psicológico?

(Extremamente mau) (Extremamente bom)

1 2 3 4 5 6 7 8 9 10

Depressão, Ansiedade, e Stress

Escolhe a resposta que mais se adequa a ti, tendo em conta a última semana. Não leves muito tempo a indicar a tua resposta.

1. Quão frequentemente sentes níveis elevados de humor deprimido/de depressão?

2. Quão frequentemente sentes níveis elevados de ansiedade?

3. Quão frequentemente sentes níveis elevados de stress?

0: Nunca; 1: Poucos dias; 2: Alguns dias; 3: Muitos dias ; 4: Quase todos os dias ; 5: Todos os dias

Appendix J – Brief Self-Control Scale (BSCS)

1.Sou bom a resistir à tentação.

2.Tenho dificuldades em acabar com maus hábitos.

3.Sou preguiçoso.

4.Digo coisas inapropriadas.

5.Faço coisas que me são prejudiciais, se forem divertidas.

6.Recuso-me a fazer coisas que me sejam prejudiciais.

7.Gostava de ter mais auto- disciplina.

8.As pessoas diriam que tenho uma auto- disciplina de ferro.

9.Por vezes, o prazer e o divertimento impossibilitam-me de fazer ou acabar o meu trabalho (ex.: escolar).

10.Tenho dificuldades em concentrar-me.

11.Sou capaz de trabalhar eficazmente em direção a objetivos de longo prazo.

12.Às vezes não consigo parar de fazer determinada coisa, mesmo que saiba que está errada.

13.Muitas vezes comporto-me sem pensar em todas as alternativas.

1: Nada a ver comigo; 2: Um pouco a ver comigo; 3: Nem muito, nem pouco a ver comigo; 4: Muito a ver comigo; 5: Tudo a ver comigo

Appendix K – Athens Insomnia Scale (AIS)

Assinala os itens abaixo que melhor reflitam a tua avaliação quanto à presença de qualquer dificuldade ao nível do sono, pelo menos três vezes por semana durante o último mês.

1. Indução do sono (tempo que demoras a adormecer depois de apagar as luzes)

0: Nenhum Problema

1: Ligeiramente demorado

2: Marcadamente demorado

3: Muito demorado ou não dormi de todo

2. Despertares durante a noite

0: Nenhum Problema

1: Problema Menor

2: Problema Considerável

3: Problema sério ou não dormi de todo

3. Despertares antes do desejado

0: Não foi cedo

1: Um pouco cedo

2: Marcadamente cedo

3: Muito cedo ou não dormi de todo

4. Duração total do sono

0: Suficiente

1: Ligeiramente insuficiente

2. Marcadamente insuficiente

3: Muito insuficiente ou não dormi de todo

5. Qualidade geral do sono (sem ter em conta quanto tempo dormiste)

0: Satisfatória

1: Ligeiramente insatisfatória

2: Notavelmente insatisfatória

3: Muito insatisfatória ou não dormi de todo

6. Sensação de bem-estar durante o dia

0: Normal

1: Ligeiramente diminuída

2: Marcadamente diminuída

3: Muito diminuída

7. Funcionamento (físico e mental) durante o dia

0: Normal

1: Ligeiramente diminuído

2: Marcadamente diminuído

3: Muito diminuído

8. Sonolência durante o dia

0: Nenhuma

1: Pouca

2: Considerável

3: Intensa