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1 **Authors Contribution Statement:**

Contributor Role	Role Definition	Authors 1	2	3	4
Conceptualization	Ideas; formulation or evolution of overarching research goals and aims.	X	X		X
Data Curation	Management activities to annotate (produce metadata), scrub data and maintain research data (including software code, where it is necessary for interpreting the data itself) for initial use and later reuse.	X		X	
Formal Analysis	Application of statistical, mathematical, computational, or other formal techniques to analyze or synthesize study data.	X		X	
Funding Acquisition	Acquisition of the financial support for the project leading to this publication.				
Investigation	Conducting a research and investigation process, specifically performing the experiments, or data/evidence collection.	X		X	X
Methodology	Development or design of methodology; creation of models	X	X	X	
Project Administration	Management and coordination responsibility for the research activity planning and execution.		X		X
Resources	Provision of study materials, reagents, materials, patients, laboratory samples, animals, instrumentation, computing resources, or other analysis tools.	X			X
Software	Programming, software development; designing computer programs; implementation of the computer code and supporting algorithms; testing of existing code components.				
Supervision	Oversight and leadership responsibility for the research activity planning and execution, including mentorship external to the core team.		X		
Validation	Verification, whether as a part of the activity or separate, of the overall replication/reproducibility of results/experiments and other research outputs.		X		
Visualization	Preparation, creation and/or presentation of the published work, specifically visualization/data presentation.	X	X	X	
Writing – Original Draft Preparation	Creation and/or presentation of the published work, specifically writing the initial draft (including substantive translation).	X	X		
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14 **Discussion Points:** #MedicalStudents, are you interested in #sleep quality issues in young people? In this

15 technological era, are young people experiencing sufficient good quality of sleep? Does deprivation of good

16 quality sleep have long-term health impacts? Is it important to investigate sleeping habits of young people?

17

18 **Publisher's Disclosure:** *This is a PDF file of an unedited manuscript that has been accepted for publication.*

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1 **ABSTRACT.**

2

3 **Background:** Poor sleep quality among young people is a global health concern. The purpose of this study
4 was to explore the prevalence of poor sleep among young people in Mauritius, and to investigate associated
5 contributory factors.

6 **Methods:** In this cross-sectional study, 202 questionnaires were completed during face-to-face interviews with
7 participants aged between 14 and 29 years. The Pittsburgh Sleep Quality Index (PSQI) was used to measure
8 sleep quality. The Epworth Sleepiness Scale (ESS) was utilized to evaluate daytime sleepiness, and the
9 Adolescent Sleep Hygiene Scale (ASHS) was used to assess sleep hygiene.

10 **Results:** The mean global PSQI was 4.81 (95%CI: 4.4, 5.22). The prevalence of poor sleep quality (global PSQI
11 score > 5) was 30.7%. Our results showed that 35.6% of the participants slept less than seven hours over a
12 period of one month. Young people of the male gender reported better sleep quality than those of the female
13 gender (p=0.008), and sleep quality was significantly associated with longer sleep duration (p<0.0001), pre-
14 bedtime relaxing activities (p=0.01), and daytime physical exercise of more than 20 minutes (p=0.001). In
15 contrast, alcohol consumption after 18:00 (p<0.0001), tobacco smoking after 18:00 (p<0.0001), pre-bedtime
16 awakening activities (p=0.001), and poor sleep environment (p<0.0001) negatively influenced sleep quality.

17 **Conclusion:** This study showed that an important percentage of young people had poor sleep quality. This was
18 observed to be associated to several modifiable factors. These initial results can help to guide further research
19 on sleep quality in Mauritius.

20

21 **Key Words**: Sleep Quality, Global Health, Prevalence, Mauritius, Sleep Hygiene, Cross-Sectional Studies.

22

1 **INTRODUCTION.**

2

3 Sufficient sleep is an essential human need and is comparable to other basic needs such as food, clothing, and
4 shelter.[1] In a systematic literature review carried out by Ohayon et al.,[2] selected criteria were validated as
5 indicators of good sleep quality for teenagers and young adults. These were sleep latency within 30 minutes,
6 waking up at most once per night, not waking up within 20 minutes after sleep onset, and having a minimum
7 sleep efficiency, which compares sleep time to time spent in bed, of 85%. In addition, regarding sleep
8 architecture in young people, having a maximum of one daily nap of less than 20 minutes implied good sleep
9 quality.

10

11 Research studies from across the world have provided insights on the measures of sleep in young people and
12 have suggested an important variation in sleep difficulties globally. A study from Hong Kong reported that 58.9%
13 of participants, aged between 12 to17 years, had obtained less than 7 hours of sleep daily, with 72.3% having
14 poor sleep quality, as assessed by the global PSQI score.[3] A longitudinal study among Korean adolescents
15 initially aged 15, showed that 22.8% of youths had poor sleep quality, and 25.6% had short sleep duration.[4] A
16 large study from Slovakia in 13- and 15-year old indicated that 30% of girls and 17% of boys had difficulties in
17 getting to sleep.[5] A cross-sectional survey among university students from 26 low- and middle-income countries
18 confirmed major differences in the prevalence of sleep problems from 3% in Thailand to 28.9% in Indonesia.[6]
19 In the study, it was revealed that 15.3% of Mauritian youths, of average age 20.9 years, had faced nocturnal
20 sleep problems in 2013. It was postulated that increased social stress could be a contributing factor; however,
21 reasons for this alarming figure could not be evaluated further due to the scarcity of sleep-related studies in
22 Mauritius.

23

24 Numerous vital and obligatory processes occur during sleep to help people stay healthy: physically, mentally
25 and emotionally. For children and adolescents, sleep is fundamental as important physical developments occur
26 in these age groups. Getting an adequate amount of sleep has multiple benefits: sleep stimulates tissue repair
27 and growth, enhances the immune system, and consolidates memory and learning.[7] On the other hand, failing
28 to reach the sleep recommendations may lead to behavioral problems; such as not being able to follow
29 instructions, cognitive impairment, depression, anxiety, and lack of self-control which can increase the risk of
30 severe illnesses and accidents.[8] Furthermore, dementia and chronic pain can result from advanced sleep
31 disturbances.[9] It has been noted that an irregular sleep pattern in adolescents and young adults is related to
32 negative changes in the development of the brain, decreases the duration of sleep, and prevents the medial
33 prefrontal cortex from functioning properly.[10] Smiley et al.[11] reported that both short and long sleep duration
34 increased the likelihood of developing metabolic syndrome. Both acute sleep deprivation of more than 2 hours
35 per night and chronic sleep deprivation of 1 to 4 hours per night worsened driving attitudes among youngsters
36 at the wheel.[12] In another study,[13] poor sleep quality was associated with aggression, anxiety, antisocial
37 personalities, attention-deficit/hyperactivity problems, depression, and somatic complaints in adolescents even
38 though they had good sleep hygiene.

39

40 Numerous factors can affect the sleep quality in young people. These include age, gender, substance use
41 (caffeine, alcohol, nicotine, cannabis, cocaine, and opioids), stimulants (prescribed or recreational), mobile

1 phone addiction, physical exercise, and the bedroom environment. Moreover, traveling to other countries with

2 a different time zone affects the sleep pattern as the circadian rhythm is disturbed.[3] Some studies have shown

3 that medical students have poor sleep hygiene as they choose to sleep less to cope with their heavy syllabus.

4 Almojali et al.,[14] reported that the prevalence of poor sleep quality in his study among Saudi medical students

5 was 76% and this was associated with a decline in academic performance. Furthermore, in the study by

6 Heijdenet al,[15] teenagers who had media devices in their bedroom were shown to have insufficient sleep and

7 had daytime sleepiness when compared to those who had few such devices. Regarding lifestyle factors, a

8 study[16] showed that one exercise session performed five or more days a week could enhance the perception

9 of sleep quality by 50% in youngsters.

10

11 Several studies have demonstrated that sleep problems are increasing in young people worldwide. However,

12 there is little documentation regarding the factors that impact the quality of sleep in young people with no

13 previously diagnosed sleep disorders in Mauritius. This study explores the factors associated with poor sleep in

14 such young people.

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16

17 **METHODS**

18

19 **Study Design**

20 This cross-sectional study was carried out to investigate the factors associated with poor sleep among young

21 people aged between 14 and 29 years in Mauritius. Ethical clearance was granted by the Ethics Sub-Committee

22 of the Ministry of Health and Wellness (Reference: MHC/CT/NETH/2019/V2). Participants were selected using

23 a snowball sampling method across a young population of 290,111 out of the 1.27 million inhabitants of

24 Mauritius. The time frame was from November 19, 2019, to January 31, 2020. University students were initially

25 recruited, and they subsequently referred their contacts from all over the island. A sample size of 384 was

26 calculated at a 95% confidence level with a 5% margin of error. The purpose of the study was explained to each

27 participant in a non-technical language. Consent forms were signed either by the participants themselves (if

28 they were above 18 years) or by responsible parties of minor participants. They were assured that anonymity

29 and confidentiality would be maintained throughout the research process, and that they could withdraw from the

30 study at any time. The questionnaires were completed with the help of the study investigator during face-to-face

31 interviews. Out of an initial 384 potential participants, only 202 people completed the study questionnaires.

32

33 **Questionnaire**

34 The questionnaires used were the Pittsburgh Sleep Quality Index (PSQI), the Epworth Sleepiness Scale (ESS),

35 and the Adolescent Sleep Hygiene Scale (ASHS).

36

37 The PSQI is a self-report questionnaire used to assess sleep quality over one month and yields seven

38 component scores (Subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep

39 disturbances, use of sleeping medication, and daytime dysfunction). The questions are scored on a 0 to 3-scale

basis. The total of these scores gives the Global PSQI score, which ranges from zero to 21. A global PSQI score greater than 5 indicates poor sleep quality.

The ESS is a self-administered questionnaire used to assess daytime sleepiness. In this study, daytime sleepiness was assessed over a period of one month. The questionnaire comprises eight questions that include different circumstances in everyday life where a person may feel sleepy during the day. Each question has four responses: 0, 1, 2, or 3. The sum of all the responses gives the ESS score, ranging from 0-24. Higher scores indicate a greater tendency to fall asleep. Scores from 0 to 5 indicate lower normal daytime sleepiness, scores from 6 to 10 indicate higher normal daytime sleepiness, scores from 11 to 12 indicate mild excessive daytime sleepiness, scores from 13 to 15 indicate moderate excessive daytime sleepiness, and scores from 16 to 24 indicate severe excessive daytime sleepiness.[17]

The ASHS is a self-report questionnaire used to assess sleep hygiene behaviors. This section contains 33 questions based on sleep hygiene, which can affect sleep quality and quantity during the past month. The scale is divided into eight subscales: (1) physiological factor, (2) behavioral arousal factor, (3) cognitive/ emotional factor, (4) sleep environment factor, (5) sleep stability factor, (6) daytime sleep factor, (7) substances factor and (8) bedtime routine factor.[18] Each question has six responses: never, once in a while, sometimes, quite often, frequently, and always. One factor is reverse coded. In order to obtain the subscale and final scores, averages are taken so that the ASHS scores range from 1 to 6. The higher the scores, the better is the sleep hygiene.

Statistical Analysis

The data from all of the 202 questionnaires were inputted and analyzed in IBM SPSS Statistics 25. Results were shown in the form of tables and charts. Inferential statistics such as the chi-squared test were used to test for any relationships between the collected variables. If the p-value obtained was less than 0.05, the relationship was considered statistically significant.

RESULTS.

A total of 202 participants completed the questionnaire; 39.6% were males, and 60.4% were females. The mean age was 20.8 years (standard deviation (SD) = 4.3). The most typical age range was between 18 and 21 years (34.7%). Most of the participants (64.9%) were students. Table 1 shows a summary of the profile of the participants. None of the participants had any previously diagnosed sleep disorders.

Table 2 summarizes the sleep schedules and sleep latency of participants. Figure 1 shows the time at which participants went to bed. The mean bedtime was 23:08, and the most common bedtime interval was 22:00 to 23:00 (25.2%). The most popular wake-up time interval was 05:00 to 06:00 (34.2%), and the mean wake-up time was 06:55. Overall, 73.8% of the participants took at most 15 minutes to fall asleep, while 2.5% required more than 60 minutes. The mean time taken to fall asleep was 20.7 minutes (SD = 16.2). Regarding the duration of sleep, 64.4% of the participants slept for more than 7 hours, and 2.5% had less than 5 hours of sleep. The mean duration of sleep was 7.7 hours (SD = 4.1). On average, 35.6% of the participants slept for less than 7 hours and were considered poor sleepers, as described in recent literature.[3] Among the poor sleepers, 68.6% were females, and 31.3% were males.

Table 3 summarizes the distribution of the sleep hygiene practices of the participants during the past month of the study. Overall, 48.0% of the participants frequently or always performed some awakening activities such as playing video games or watching television in bed before sleeping and 62.9% of the participants never or rarely followed a bedtime routine. Furthermore, 16.8% of the participants took a nap in the evening after 6 o'clock.

Among the participants, 69.3% had good sleep quality, and 30.7% had a PSQI score of greater than 5, indicating poor sleep quality. More females (37.7%) reported poor sleep quality than males (20.0%). The mean PSQI score was 4.8 (SD = 2.9). Additionally, 29.7% and 57.9% of the participants reported their subjective sleep quality as "very good" and "fairly good" respectively. Moreover, 10.9% and 1.5% described their sleep quality as "fairly bad" and "very bad" respectively.

Regarding sleep quality, there was a positive association with the male gender (p=0.008), a longer sleep duration (p<0.001), doing relaxing activities one hour before bedtime (p=0.01), and physical exercise during the day for more than 20 minutes (p=0.001). In contrast, the following factors negatively impacted on sleep quality: alcohol consumption after 18:00 (p<0.001), tobacco smoking after 18:00 (p<0.001), pre-bedtime awakening activities (p=0.001), and poor sleep environment (p<0.001).The findings are summarized in Table 4.

Most of the participants (39.1%) had higher normal daytime sleepiness, and 28.2% had lower normal daytime sleepiness as measured by the ESS. 11.4% had mild excessive daytime sleepiness, and 17.8% had moderate excessive daytime sleepiness. 3.5% showed severe excessive daytime sleepiness.

1 **DISCUSSION.**

2

3 This is the first study on sleep quality among young people in Mauritius using validated questionnaires such as
4 PSQI, ESS and ASHS. There is a lack of local data on sleep issues in this age group, which makes
5 contextualization of results difficult. A previous international study, which had comprised Mauritian university
6 students,[6] had assessed nocturnal sleep problems based on a general question on sleep problems with five
7 options. Their results had shown that 15.3% of local participants had reported sleep problems in 2013. In our
8 study, we found that poor sleep quality, as quantified by the PSQI scale, was experienced by 30.7% of local
9 youngsters in 2019/2020. Although different methodologies underpinned the studies, the results suggest an
10 increase in poor sleep quality in Mauritian young people in the last decade.

11

12 Our findings are also consistent with selected international population estimates of sleep quality. In a study
13 carried out in China[19] among college students using the PSQI instrument in 2016, 31% of participants had poor
14 sleep quality. Higher prevalence of poor sleep have been reported in the literature. A recent study conducted in
15 three European countries[20] namely Spain, Iceland and Estonia showed that 44% of boys and 53% of girls aged
16 13 to 16 years had poor sleep quality as determined by the PSQI scale. Other studies using different
17 methodologies and instruments have also reported a high proportion of young people experiencing poor sleep.
18 A longitudinal study was carried out from 2015 to 2018 in New York city[21] where sleep quality was explored by
19 the use of wearable sleep tracking mobile technology, and it reported that good sleep quality was experienced
20 by only 21.56% of teenagers and 19% of young adults highlighting the high prevalence of poor sleep in young
21 people.

22

23 In our study, a significant relationship between gender and sleep quality was observed, with the male gender
24 experiencing better sleep quality on the PSQI scale. Several studies[22,23] have reported poorer sleep quality in
25 young people of the female gender, although this is not a consistent finding in all studies. A study[23] in college
26 students aged 18-24 years, which used 7-day sleep logs to assess sleep variables, revealed that the female
27 students had earlier bedtimes and rise times, longer sleep latency, woke up more frequently at night and had
28 poorer sleep quality than male students throughout the week and at weekends. With respect to the study,[23] it is
29 noteworthy that most of the female students were single, had no bed partners and no children which could have
30 contributed to the sleep disturbances. Although there are no clear explanations for the gender differences in
31 sleep quality, it has been postulated that biological, societal and psychosocial features play an important role,
32 and that gender differences in the self-reporting of symptoms also contribute to the findings.[22,23]

33

34 The relationship between alcohol consumption and sleep quality is not straightforward. Alcohol has sedative
35 effects via its effects on the mediators of sleep homeostasis, and decreases sleep latency in non-alcoholic
36 people, but it also disturbs sleep homeostasis and sleep architecture causing sleep disruptions in alcoholics.[24]
37 In a large community-based study in China, higher alcohol consumption and hard liquor were reported to be
38 significantly associated with poor sleep quality.[25] In our study, we did not quantify the alcohol intake nor the
39 type of alcohol consumed, and therefore could not assess the influence of alcohol on sleep precisely. However,
40 our results clearly showed that alcohol consumption after 18:00 negatively impacted on sleep quality. Similarly,
41 we found that tobacco smoking after 18:00 had an adverse effect on sleep quality. Other studies have also

reported an association between nicotine dependence and poor sleep and specifically between PSQI scores and number of cigarettes smoked per day[26]. Nicotine is a well-known stimulant and raises alertness, and if it is consumed before sleeping, can affect sleep latency and may change the circadian rhythm,[27] which leads to poor sleep.

We found that awakening activities performed 1 hour before bedtime using screen-based electronic devices such as television viewing, video games, computer, tablet and smartphone use was associated with poor sleep quality. This finding is consistent with an increasing body of evidence linking the usage of electronic and screen media devices in the bedroom with poor sleep in young people.[28,29] Explanations for this finding include displacement of sleep by awakening activities, physiological and psychological stimulation of the user with interactive forms of the media especially social media use, and exposure to bright light influencing the circadian rhythm.[28,29] Indeed, some studies have shown that sleep quality and other sleep variables can be negatively influenced by the only presence of a portable screen-based media device in the bedroom[28,29] highlighting the insidious negative impact of such devices on sleep.

The sleep environment is important for sleep quality, and it has been reported that both physical and social features of the environment at both household and neighborhood levels can influence sleep health.[30] In our study, we found a significant association between sleep environment and sleep quality. We focused on the physical aspects of the sleep environment at the household level namely the brightness of the room, the room temperature and the quality of the bed. We did not study the neighborhood context, family structures, socioeconomic environments or parental behaviors that could also influence sleep habits.[30] On the other hand, we noted that good sleep quality was significantly associated with longer sleep duration, pre-bedtime relaxing activities, and daytime physical exercise of more than 20 minutes.

This study has several limitations. A snowball sampling method was used to recruit participants and hence caution has to be exercised when extrapolating the findings to the young population of the island. The study relied on the self-reporting of symptoms. These may be less reliable than sleep studies using sleep-tracking devices and actigraphy. The utilization of more objective measures of sleep could have added further insights into the sleeping patterns of the participants. Comparison of the results with other local studies was limited due to a lack of local published literature. In addition, the questionnaires used in this study assessed sleep over a limited period of time, so the results do not necessarily reflect enduring patterns. Nonetheless, our findings add to the current body of knowledge regarding sleep quality, expand on sleep data that could guide future research in the topic and promote awareness of the factors which contribute to poor sleep in Mauritius so that remedial actions can be taken to prevent detrimental health consequences of poor sleep in young people.

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1 **SUMMARY - ACCELERATING TRANSLATION**

2

3 **Title:** Factors Associated with Poor Sleep among Young People in Mauritius: A Survey-Based Study

4 **Main problem to solve:** There is a lack of data regarding sleeping habits in young people in Mauritius. This is

5 an important topic as deprivation of good quality sleep at a young age can contribute to many health conditions

6 in later life.

7 **Aims of the study:** In this study, we are investigating the prevalence of poor sleep among young people in

8 Mauritius, and its associated contributory factors.

9 **Methodology:** We conducted a survey among young people in Mauritius. We were able to recruit 202

10 participants. We used well-known questionnaires to determine the quality of sleep such as the Pittsburgh Sleep

11 Quality Index (PSQI) to measure sleep quality, the Epworth Sleepiness Scale (ESS) to evaluate daytime

12 sleepiness, and the Adolescent Sleep Hygiene Scale (ASHS) to assess sleep hygiene.

13 **Results:** The prevalence of poor sleep quality was 30.7%. Our results showed that 35.6% of the participants

14 slept less than seven hours over a period of one month. Young people of the male gender reported better sleep

15 quality than those of the female gender, and sleep quality was associated with longer sleep duration, pre-

16 bedtime relaxing activities, and daytime physical exercise of more than 20 minutes. In contrast, alcohol

17 consumption after 18:00, tobacco smoking after 18:00, pre-bedtime awakening activities, and poor sleep

18 environment negatively influenced sleep quality.

19 **Conclusion:** This study showed that an important percentage of young people had poor sleep quality. This was

20 observed to be associated to several modifiable factors. These initial results can help to guide further research

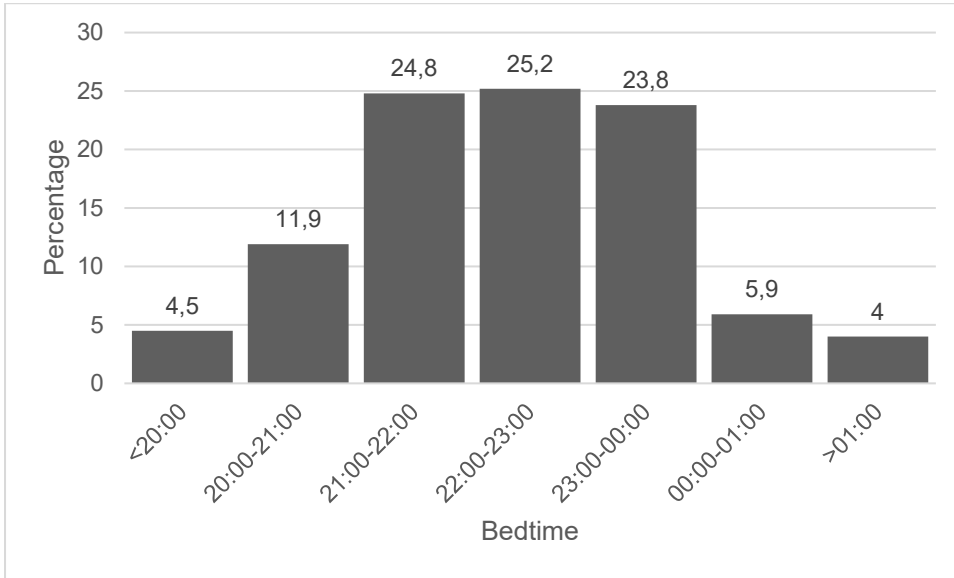21 on sleep quality in Mauritius.

1 **FIGURES AND TABLES.**

2

3 **Figure 1. Time at Which Participants Went to Bed in the Study "Factors Associated with Poor Sleep**

4 **among Young People in Mauritius."**

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1 **Table 1. Gender, Age, and Employment Profile of the Participants in the Study "Factors Associated with**
2 **Poor Sleep among Young People in Mauritius."**
3

Variables	Number of participants	Percentage (%)
Gender		
Male	80	39.6
Female	122	60.4
Age		
14-17	49	24.3
18-21	70	34.7
22-25	48	23.8
26-29	35	17.3
Employment Status		
Employed	53	26.2
Unemployed	18	8.9
Student	131	64.9
Total	202	100

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Table 2. Gender, Age, and Employment Profile of the Participants in the study "Factors Associated with Poor Sleep among Young People in Mauritius."

Wake-up time (hour)	Percentage (%)
04:00-05:00	18.3
05:00-06:00	34.2
06:00-07:00	18.3
07:00-08:00	15.8
08:00-09:00	7.4
09:00-10:00	5.4
10:00-11:00	0.6
Time taken to fall asleep (minutes)	Percentage (%)
Less or equal to 15	73.7
16 to 30	23
31 to 60	25
More than 60	5

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1 **Table 3. Sleep Hygiene Practices of Participants in the study "Factors Associated with Poor Sleep**
2 **among Young People in Mauritius."**

3

Sleep hygiene practices	Percentage
Have caffeinated drinks after 06.00 pm	
Never/Rarely	73.8 (149)
Frequently/Always	26.2 (53)
Perform physical activities after 6:00 pm	
Never/Rarely	77.2 (156)
Frequently/Always	22.8 (46)
Smoke after 06:00 pm	
Never/Rarely	93.6 (189)
Frequently/Always	6.4 (13)
Consume alcoholic drink after 6:00 pm	
Never/Rarely	93.1 (188)
Frequently/Always	6.93 (14)
Perform relaxing activities 1 hour before bedtime	
Never/Rarely	36.6 (74)
Frequently/Always	63.4 (128)
Do things that make the participants awake in bed	
Never/Rarely	52.0 (105)
Frequently/Always	48.0 (97)
Have a bedtime routine	
Never/Rarely	62.9 (127)
Frequently/Always	37.1 (75)
Take a nap after 06:00 pm	
Never/Rarely	83.2 (168)

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Frequently/Always	16.8 (34)

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1 **Table 4. Factors Associated with Sleep Quality among the Participants in the study "Factors Associated**
2 **with Poor Sleep among Young People in Mauritius."**
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	χ^2 **value**	**p* value**
Sleep quality versus gender	7.120	0.008
Sleep quality versus sleep duration	58.180	<0.001
Sleep quality versus alcohol consumption	111.207	<0.001
Sleep quality versus smoking	166.386	<0.001
Sleep quality versus awakening activities	127.759	0.001
Sleep quality versus sleep environment	536.299	<0.001
Sleep quality versus physical exercise	124.380	0.001
Sleep quality versus relaxing activities	15.030	0.010

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