Obesity and Its Association with Inadequate sleep and TV Watching

Georgina Ononaojoh

19330063

Supervisor: Mr Michael Cleary-Gaffney

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***Student Number*:** 19330063

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Abstract

This study explored obesity and its association with inadequate sleep and tv watching in Ireland. This was done by examining body mass index which was calculated and specific types of screens such as (television and computer) along with different indicators of sleep (quality and duration). The study also accounted for gender differences within variables. Previous studies suggest that tv watching leads to a reduced likelihood of engaging in social activity as screen time takes a large amount of free time and encourages unhealthy eating habits along with inadequate sleep, hence promoting the likelihood of weight gain. This research focused on buttressing the points identified in prior research with the sample of n = 59 ranging from 18-23 as these are the ages to be affected by changes in tv watching routine. A questionnaire was completed measuring sleep, tv watching (sedentary time) and BMI levels in young adults. With the use of a t-test, results showed that there was no significant difference in scores for males and females in relation to sleep and sedentary time. Pearson correlation demonstrated a significant relationship between the variables, and standard multiple regression explained 23.4% of the variation in BMI levels. The present study implies that policy or health guidelines in relation to the impact of obesity and lack of physical activity can be beneficial to society hence a reason to minimise sedentary behaviour and improve quality sleep between individuals.

Keywords: body mass index, sleep, tv watching, sedentary behaviours, weight gain, physical activity

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Introduction

Obesity according to the World Health Organization (WHO) is the accumulation of excess fat that may result in abnormalities in body function and impair health. An individual with a body mass index (BMI) above twenty-five is overweight while an individual with BMI above thirty is considered obese[1] (Jonathan Q Purnell, 2018). Studies have shown a steady uptick in the prevalence of obesity in developed and developing countries, with the latest statistics by the WHO showing that obesity has nearly tripled since it first became officially recognized as a disease in 1975 (Fanny Janssena, 2020). In 2016, studies showed that 13% of the world's adult population (>18 years old) were obese and 39% were generally overweight. They also showed that over 340 million of the world's adolescents (5 – 19 years old) were also overweight or obese. These statistics are alarming for a preventable condition, justifying the WHO classifying it as a global epidemic (American Obesity Foundation, 2016; Maliha Agha, 2017). A crisis that knows no borders, obesity has been linked to several chronic illnesses including but not limited to heart disease, diabetes, multiple types of cancer, and high blood pressure (Hu, 2003; Adela Hruby, 2015). Obesity has also been linked to depression (Floriana S. Luppino, 2010), with studies showing a bidirectional relationship between the two conditions with a 55% increase in the risk of developing depression over time for people living with obesity. However, there are contradictory results from studies as pointed out by (Blasco, 2020), with factors such as sex and ethnicity, influencing the relationship between obesity and depression observed in a test cohort. According to the Center for Disease Control (CDC), the costs of medical care for people living with obesity are significantly higher than for those with healthy weights. Estimates for the United States of

[1] https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight

America (USA) are as high as $1,429 more yearly[2]. Developed countries such as the USA and Ireland have implemented policies aimed at tackling the advent of obesity across all age groups with the USA implementing policies such as the Supplemental Nutrition Assistance Program (SNAP), the Women, Infants and Children Program (WIC), the Healthy Food Financing Initiative among others[3] and Ireland implementing a long term policy – the Obesity Policy and Action Plan[4] [5]as well as an increase in the taxes on products with high sugar contents as sugars are directly linked to the increase in the risk of obesity and heart disease.

Various factors have been found to influence the risk of obesity. Food intake has been linked to obesity, with monosaturated fats, animal fats and trans fats being found to be positively associated with weight gain. However, higher grain intake, as well as the consumption of fruits, vegetables and nuts were found to have any association with changes in body weight. Studies show that people with a higher intake of red meat, sweets, carbohydrates such as potatoes gained the most weight over successive follow-up studies. The opposite was however found to be true in people with higher fruit, vegetable, fish, and nut consumption. Results from studies have identified a reduction in the risk of obesity by as much as 24% for a 1.86-unit increment in the amount of fruit consumed by an individual daily. A more recent study of the effects of pomegranate juice on obesity showed a significant impact on fat accumulation when pomegranate juice is consumed as part of a daily diet. It however did not identify any clinically significant effect in terms of weight loss or body mass index (BMI) change (Sharma, 2016). This suggests that an increased fruit intake is

[2] https://www.cdc.gov/obesity/data/adult.html
[3] https://www.ncbi.nlm.nih.gov/books/NBK223184/
[4] https://assets.gov.ie/10073/ccbd6325268b48da80b8a9e5421a9eae.pdf
[5] https://www.hse.ie/eng/about/who/cspd/ncps/obesity/

useful for maintaining body weight, with greater effects such as weight loss being associated with a combined strategy such as high-intensity exercise along with a healthy diet (Fock, 2013). Eating time - (breakfast, lunch, and dinner) has also been shown to have a direct relationship to obesity with particular importance being habits such as skipping breakfast, eating high calories for dinner, and late lunches. A review by Harvard University researchers highlights that the circadian clock of the human body, as well as the human sleep cycle, plays an important role in digestion and nutrition metabolism[6]. Hence, researchers believe that the absorption of macro calories into the human body can be regulated by distributing calorie consumption according to the rate of metabolism for each time of the day. A study by (Lopez-Minguez, 2019) has shown that a high-calorie consumption rate less than two hours before bedtime increases the likelihood of obesity fivefold, while a higher calorie intake two hours after waking up lowers the odds of obesity and doubles the probability of having a healthy weight.

Physical activity has also been related to the change in weight of an individual (John M Jakicic, 2018). Physical activity increases the rate of energy expenditure which is crucial in maintaining body energy balance (Hill J. O., 1996). It also decreases the amount of total body fat and slows the development of fat in the abdomen. However, recent studies have particularly found a modest increase in body fat loss when aerobic exercises and High intensity and high-frequency exercise are employed. Physical activity is strongly advocated by the WHO with the recommended daily amount of physical exercise being 60 minutes of moderate to intense physical activity (Susanne Kobel, 2019). Resistance training has also been found to have greater resting energy expenditure. (W H M Saris, 2003) recommend 225 to 300 minutes per week of modest to high-intensity physical exercise to prevent weight gain

[6] https://www.hsph.harvard.edu/nutritionsource/sleep/

and an eventual transition to obesity from normal weight while (Fock, 2013) recommend 200 to 300 minutes of exercise weekly to maintain a clinically significant weight loss. Sedentary behaviour, defined as an activity that requires low energy expenditure is directly related to weight gain. Evidence shows that there is a relationship between sedentary behaviour and an elevated metabolic risk profile (Panahi, 2018). The more time spent engaging in sedentary activity, the less energy is being expended and the higher the risk of weight gain due to the lack of an energy balance. A sedentary behaviour that has seen a dramatic rise over the years is screen watching. With the increasing permeation of screens such as televisions, mobile phones, tablets, among others, more time is spent in front of screens than outside engaging with other people and making individuals less likely to engage in physical exertion (Cha, 2018). Studies specifically studying television watching as a sedentary behaviour has associated tv watching with reduced physical exercise (Panahi, 2018), with alarming numbers of adolescents spending more and more time in front of screens such as mobile phones, television, laptops among others as opposed to spending time outdoors and expending energy on physical activity. This is associated with a positive energy balance (Hill J. W., 2012) which is highly correlated to weight gain in adulthood.

According to (Hill J. O., 1996), 60-80% of the bodyweight gained due to a positive energy balance is stored as body fat while 60 – 80% of the bodyweight lost during a negative energy balance is body fat. Simply put, the lower the energy balance, the lower the body weight. The energy balance is described by energy expenditure, energy intake, and the state of the body's energy stores such as fat cells. Studies have shown that energy intake is higher among TV watching individuals especially adolescents. This has been described by the likelihood of adolescents consuming snacks and drinks while watching television. Only 3.5% of respondents of a survey by (Avery, 2017) said no to consuming snacks and drinks while

watching tv. The frequency and duration of tv watching were also found to influence how often sweets, fast foods, snacks, and drinks are consumed. Furthermore, tv watching has been associated with the consumption of fewer fruits and vegetables. Such eating habits have been linked to weight gain. Tv watching also affects the amount of physical activity a person accomplishes in a day (Nyssa T. Hadgraft, 2015), with a 16% less likelihood that a person will walk over 10,000 steps with every hour of tv watching[7]. The permeation of gaming as a replacement for physical activity and social interaction as aided by tv watching has further compounded the likelihood of weight gain. The popularity of social gaming and competitive gaming among individuals put them at the most risk of falling into habits encouraging long hours of sedentary behaviour (Alshehri, 2019), high consumption rates of low-quality foods and increased weight gain risk (Avery, 2017). Esports and casual gaming have also been found to have significant effects on player health, with (Yin, 2020) advising the development of evidence-based guidelines to avoid the adverse health effects of gaming for long hours.

Sleep is an essential requirement for overall health, insufficient sleep can prompt eating behaviour (Golshevsky D. M., 2019). An increased focus on the screen could lead to an increased likelihood of falling into bad sleeping patterns (Fuller, 2017; AlbaCabré-Riera, 2019). The light emitted from the screens have been associated with interference with the natural sleep cycle (Ansari, 2016; Michelle D. Guerrero, 2019), with further studies highlighting a complex relationship between sleep and metabolism – and by extension, obesity (Patel, 2014). Epidemiological studies have shown a positive correlation between obesity and bad sleeping patterns including sleep deficiency (Fuller, 2017; Ann Vandendriessche, 2019). A publication from a study by Harvard University researchers has shown that adults in a sleep-restricted observation group have a higher calorie consumption

[7] https://www.sciencedaily.com/releases/2006/07/060731165525.htm

rate and increased hunger when allowed free access to food[8]. A preference for nighttime consumption of food as well as a preference for carbohydrates was also observed in this study. Clinical studies have associated the increased hunger felt as described above with a change in the leptin hormone levels – the hormone which controls the feeling of satisfaction. A release of leptin from fat cells signifies to the brain that the gut is full. The fatter cells a person has, the more leptin is produced. Sleep deprivation has been associated with leptin resistance in the brain, causing more consumption of food regardless of the amount of leptin being produced by the body (Taheri, 2004). Ghrelin, however, aptly nicknamed "the hunger hormone" is associated with sleep deprivation and therefore signals to the brain that the person is hungry and has not consumed enough food. The release of this hormone is also influenced by sleep patterns, with sleep deprivation found to trigger an increased production (Schmid, 2008). The studies investigating the effect of sleep on hormone-related changes to appetite level are largely inconclusive, with varying degrees of sleep required to constitute a full night of rest for a fully functional member of the different age groups. It has been noted, however, that the greatest risk of obesity is observed in people who report less than 5 hours or more than 9 hours of sleep per day especially among children (Elina Engberg, 2019). Thus, a range of 5 to 9 hours of sleep is considered healthy among adults[9]. Screen used in the evenings has been found to cause a delay in the circadian rhythm which affects the production of melatonin in the body due to the presence of blue light produced by screens (Siegfried Wahl, 2019). Also, the quality of sleep has been found to play an important role in the likelihood of obesity among people. The body's ability to metabolize food properly depends on the circadian rhythm of the body, with higher metabolic rates being reported for

[8] https://www.hsph.harvard.edu/nutritionsource/sleep/
[9] https://www.hsph.harvard.edu/nutritionsource/sleep/

certain periods of the day (Lopez-Minguez, 2019; Noh, 2018). This is disrupted by poor sleep quality, characterized by constantly waking up at night due to interruptions such as noises or discomfort while sleeping.

It has been observed that children and adolescents present one of the largest markets for consumption of technology, with Statista showing that 96% of adolescents between 18 to 35 owned and actively use a smartphone[10]. A study by the US government identified that 55.2% of time spent on leisure activities by adolescents and adults 15 years and older was spent watching television (Krantz-Kent, 2018). This permeation of technology into the mainstream everyday lives of children and adolescents presents a challenge to the ability of these age groups to get enough sleep as noted in (Nuutinen, 2013). Individuals who do not get enough sleep are more likely to have compromised physical and mental states as sleep is crucial to the proper functioning, growth, and development especially when it involves children and adolescents who develop into full adults hence contributing meaningfully to society. Emotional problems such as anxiety, depression, hyperactivity, physical problems, and attention deficit have all been linked to a lack of sleep (Nieto, 2021; Teija Nuutinen, 2014). In particular, the relationship between attention deficit, overstimulation and hyperactivity were studied. The results from their study showed a relationship between increased symptoms and television watching. Other studies have identified a higher likelihood of being obese for people with attention deficit and hyperactivity disorder (ADHD) (Fliers, 2013). The underlying reason for this has been linked strongly to the reduced social interaction, as well as the reduced likelihood of eating healthy. People with ADHD are also

[10] https://www.statista.com/statistics/489255/percentage-of-us-smartphone-owners-by-age-group/

less likely to pay attention to internal stimulation such as hunger or fatigue and instead focus more on external stimulation such as high-risk activities, which don't happen frequently[11].

Review of the findings

Overall findings suggest that tv watching also notably leads to a reduced likelihood of engaging in social activity, with screen time taking up large amounts of free time. Tv watching also encourages unhealthy eating habits as promoted by commercials advertising snacks and fast foods as the meal of choice when in front of the television (Harris, 2009; Colin D. Chapman, 2014). This is also associated with an increased likelihood of weight gain. Furthermore, sedentary watching of television for long periods is detrimental regardless of physical exercise behaviour which further highlights the need to cut down on screen time (Lauren Arundell, 2016). In summary previous studies have suggested and explored the relationship between sleep and obesity, with sleep duration, time and quality being of particular interest (Daniel M Golshevsky, 2019). Based on prior research, there seems to be a predominant focus on younger age groups (under 18s) and limited information on gender differences on the current topic of research. Future studies about this topic should include gender differences, specific types of screens, different indicators of sleep and a wide range of age as they do not focus much on these areas. The body mass index (BMI) was used as an indicator of obesity and therefore influenced hypothesis on television watching and inadequate sleep (being causes for energy intake) impacting BMI levels.

The present study

In consideration of the high levels of sedentary behaviour in modern society and the growing body of research dealing with adverse effects of prolonged screen use and lack of

[11] https://www.nimh.nih.gov/health/publications/attention-deficit-hyperactivity-disorder-in-children-and-teens-what-you-need-to-know

sleep, this research focused on buttressing the points identified in prior research which points to the high likelihood of increasing television watch leading to a largely sedentary lifestyle with less involvement in physical activity and a reduced likelihood of maintaining healthy eating habits. The research aim for this study was to discover if there is a correlation between sleep and the amount of television watched to determine if both factors independently affect BMI levels or if there is a combined effect that makes one of these variables less important as a factor affecting obesity. The present study has been narrowed to recreate a similar study of the effects in Irish Society as guided by existing literature whilst integrating different aspects of previous studies, such as (1) both genders, (2) specific types of screens (television, computer) and (3) different indicators of sleep – (quality, duration). This study is important as many previous studies are focused on under 18s and there seems to be less attention on younger adults hence, the sample age of 18-23 was included as these are the ages to be affected by changes in tv watching routine. The current study included males and females along with other types of screens as a lot of the previous studies do not emphasize gender differences plus other screen use. Specifically, the research questions are is there a relationship between poor quality sleep and BMI levels in young adults, is there a significant difference in sleep duration and tv viewing time (hours/day) between males and females and lastly, does sedentary time and sleep quality impact levels of BMI. Based on previous literature the hypothesis includes that there is a relationship between poor quality sleep and BMI levels in young adults. The second hypothesis is that there is a significant difference in sleep duration and tv viewing time (hours/day) between males and females and finally, gender, hours of sleep, sdf, sdw, total_sbq and total_psqi as (PV) impacts levels of BMI (CV).

Methodology

Participants

The current study included the sample of n = 59 young adults (Males: n = 25; Females: n = 34). G power is a statistical tool used to determine sample sizes for researchers and other power analyses (Franz Faul, G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences, 2007). For this study, the G power was used to calculate the sample size. The calculation of the sample size using G power included several steps, (1) selecting the t-test for differences between two independent means, (2) selecting a two-tailed test with an effect size of 0.5, (3) including an alpha level of 0.05, along with a power of 0.8 which indicated an even ratio of the two groups. Participants included in this study involved individuals who were currently living in the Republic of Ireland ranging from the ages of 18-20 (55.9%) and 21-23 (44.1%). This study consisted of a non-probability method such as convenience sampling to recruit the participants. The participants were approached online to take part in the voluntary survey which included 29 students (49.2%), 2 unemployed (3.4%), part-time employment 13 (22.0%) and full-time employment 15 (25.4%).

Measures/ Materials

This study included the use of Google Forms to formulate the survey that was delivered to the participants. The study questionnaire was comprised of the Pittsburgh sleep quality index, the Munich chronotype questionnaire and the Sedentary behaviour questionnaire that were amalgamated to form open and closed-ended questions. To enable a general description of the participants involved in this study, 3 demographical questions such as age, gender and employment status were included. To complete the survey, the participants had to have access to an electronic device as it was delivered and completed online. The BMI

(body mass index) was calculated by the completion of self-reported questions on height and weight.

The Pittsburgh Sleep Quality Index (PSQI): This effective questionnaire consists of 24-items that measures sleep disturbances along 7 dimensions, 19 of these questions are self-rated whilst the remaining 5 are answered by roommates or bed partner (if any). Questions relating to daytime symptoms, restoration after sleep, problems initiating sleep, daytime dysfunction, maintaining sleep, difficulty waken, sleep latency, use of sleeping medication, sleep satisfaction along with sleep duration and quality of individuals over the last month are included (D J Buysse, 1989). The PSQI has shown to be valid for younger and older adults including patients with primary insomnia by demonstrating reasonably good internal homogeneity. Cronbach's alpha coefficient for the PSQI was 0.83, indicating a high level of internal consistency for this scale along with test-retest reliability of .87 (Jutta Backhaus, 2002; Md. Dilshad Manzar, 2015). Participants are required to select the options that best apply to them concerning their sleep behaviours **(See Appendix E)**. The total scoring of the self-rated items is then divided into 7 components and ranges between 0-3 points. A high score of 3 would signify severe sleep difficulty whilst a score of 0 indicates no sleep difficulty. To acquire the "global" score, the 7 components are then added up ranging from 0-21 points, as 21 would indicate severe sleep difficulty whilst 0 would suggest no sleep difficulty.

The Munich Chrono Type Questionnaire (MCTQ): was designed by (Till Roenneberg A. W.-J., 2003) to understand individual chronotypes in humans and consists of 17 items. The MCTQ can be used to examine sleep duration, sleep schedules, self-assessed chronotype energy levels throughout the day, self-reported light exposure, along with sleep latency during work and free days **(See Appendix F)**. This MCTQ enables a better insight

regarding one preferred sleep and wake time along the period they feel most energetic throughout the day. The MCTQ has shown to be valid for sampling the circadian rhythm of more than 25,000 participants including younger and older adults. It has been demonstrated to be valuable for clinical purposes (e.g., to diagnose circadian rhythm sleep-wake disorders), and in research (Azmeh Shahid, 2011). A comparison was made between the Horne-Ostberg Morningness-Eveningness Questionnaire to the MCTQ, the findings suggest that sleep schedule on free days can be used as a predictor of chronotype (Andrei Zavada, 2005). The total scoring of the self-rated items ranges from 16 to 86 as lower scores are indicative of late chronotype in individuals. The MCTQ assessment of the chronotype showed a good test-retest reliability of rho = 0.905; $p < 0.001$ (Cátia Reis, 2020). Although the MCTQ has produced new concepts such as social jetlag (Till Roenneberg L. K., 2019), there seems to be a limited amount of information of research for re-test reliability.

The Sedentary Behaviour Questionnaire (SBQ): consists of 18 items that evaluate sedentary behaviour between adults on the week and weekend days. The SBQ includes television watching, use of computer along with video games, sitting whilst engaging in music listening, phone conversation whilst sitting, paperwork, or computer work, book reading, doing artwork or crafts along sitting and transportation durations. Participants are required to identify their duration per sedentary behaviour in which they engage, these range from "*15 minutes or less"* to "*6 hours or more"* **(See Appendix G)**. These sedentary behaviours can relate to obesity, especially among adults (Ann Smith Barnes, 2012; James F. Sallis, 2020). A sample of 49 adults was used including the total score of ICC range = 0.64 to 0.90 on weekdays and 0.48-0.93 for weekend days indicating a high level of internal consistency along with test-retest reliability at a 2-week interval for this questionnaire. The SBQ has shown to be valid in overweight men and women, a comparison between the

International Physical Activity Questionnaire was conducted and the findings indicate a significant correlation between the total scores. The scoring procedure includes changing times into hours and separating the hours for weekend and weekday items, these are then summed up to obtain weekly estimates. Weekday hours are then multiplied by 5 whilst the weekend hours are multiplied by 2. Any score over 24 hours in a day can also be classified or shorted to 24 hours (Dori E Rosenberg, 2010).

Design and analyses

This study involved an experimental cross-sectional design considering data was collected at a specific point in time. A quantitative research approach was taken to quantify the data received with the use of numbers. The inferential statistical techniques and descriptive statistics were also used to develop a better insight into the association between inadequate sleep, television watching, and obesity. Finally, the use of a between-subjects design was incorporated as the study involved testing for differences between gender groups (male and female as categorical variables) on sleep duration and sedentary time (as the continuous variables). Pearson's correlation was used to assess the first hypothesis on examining the relationship between poor quality sleep and BMI levels in young adults. The independent samples t-test was then conducted for the second hypothesis to examine significant differences in sleep duration and sedentary time as (continuous variable) between males and females as (categorical variables). Lastly, A standard multiple regression was carried out for the final hypothesis. This examined if the (predictor variables) would impact the (criterion variable).

Procedure

Data were collected electronically through a web-based questionnaire that took approximately 10-15 minutes to complete with no breaks. Recruitment of participants was

done through uploading the survey on social media platforms such as group chat and Snapchat, whereby a link was included that directed the participants straight to the survey for completion. Consent from participants was obtained by including the consent and information sheet on the first and second page before the survey, hence explaining in detail the project, the right to withdraw and discontinue along with the purpose and duration of the study **(See Appendix A and C).** Participation in this study was completely voluntary as stated in the consent form, this form included the option of selecting "yes" indicating that they have accepted to take part while ranging from 18-23 years of age. After the participants had given consent, it was safe to proceed to the survey which consisted of questions from (1) a health awareness obesity survey, (2) a screen time questionnaire and a sleep quality scale that were amalgamated using google docs. After completion of the survey, a debrief form was attached at the end consisting of my contact details along with the contact details of my supervisor for this project. In a situation where anyone might have been psychologically distressed due to the study itself, helplines were also provided in the debrief form for support to the participants **(See Appendix B for more details).**

Ethical concerns: Considering ethical requirements, the identity and data of the participants involved were undisclosed and kept strictly confidential. Consent from participants was provided and participation was voluntary. Participants were informed that members of the research team could have access to their anonymised responses along with the risk and befits of the study as stated in the debrief sheet. Information about the data being kept on file for at least 5 years according to NCI data retention policies before being deleted was included. The debrief sheet also consisted of helplines such as Aware, Mental Health Ireland, Mental Health Support and Recovery Organisation for individuals who might have been distressed because of their participation in the study (**See Appendix A and B)**.

Results

Descriptive Statistics

Descriptive statistics were implemented for all continuous variables with the results presented in table 1. This procedure included the means, standard deviations, medians, and range which can be seen below. The data provided includes a sample of n=59 in which males n= 25 (42.4%); Females n= 34 (57.6%). Most of the participants were ranging from the ages of 18-20 (55.9%) then 21-23 (44.1%). A total of 29 students (49.2%), 2 unemployed (3.4%), part-time employment 13 (22.0%) and full-time employment 15 (25.4%) were included in the data. Preliminary analysis was implemented on the data set for assumptions of normality.

Table 1: *Descriptive statistics for all continuous variables can be seen in table 1, N=59.*

Variable	***M* [95% CI]**	***SD***	**Range**
Hours of sleep	6.53 (6.19-6.86)	1.28	4-9
Total_PSQI	12.63 (11.47-13.79)	4.46	5-20
Total_MCQ	21.45 (19.27-23.63)	7.58	14-44
Total_SBQ	23.25 (18.86-27.64)	16.85	0-140
SDf	4.79 (3.82-5.75)	3.38	0-11
SDw	4.96 (4.40-5.51)	2.08	0-10
BMI	27.79 (25.35-30.23)	8.85	15.62-54.34

Table 2: *Descriptive statistics for categorical variables on age groups, employment, gender, and sleep quality (N=59).*

Variable	Frequency	Valid %
Age_Groups		
18-20	33	55.9
21-23	26	44.1
Employment		
Student	29	49.2
Unemployed	2	3.4
Full time employment	15	25.4
Part time employment	13	22
Gender		
Male	25	42.4
Female	34	57.6
Sleep Quality		
Very bad	1	1.7
Fairly bad	14	23.7
Fairly good	40	67.8
Very good	4	6.8

Inferential Statistics

A Pearson product-moment correlation coefficient was computed to assess the first hypothesis on examining the relationship between poor quality sleep (Total_PSQI) and (BMI) levels in young adults. Preliminary analysis was implemented on the data set for

assumptions of normality, linearity, and homoscedasticity. There was a significant relationship between the variables, r = -.27, n = 53, p = .047. Results indicate that poorer sleep quality is associated with BMI.

An independent samples t-test was conducted to compare sleep duration between males and females. The results revealed there was no significant difference in scores for males (M = 6.16, SD = 1.34) and females (M = 6.79, SD = 1.18), t (57) = -1.93, p = .06, (two tailed). The magnitude of the differences in the means (mean difference = -.63, 95% CI: -1.29 to 0.25).

An additional independent samples t-test was conducted to compare sedentary time (tv watching) between males and females. The results revealed there was no significant difference in scores for males (M = 21.30, SD = 7.26) and females (M = 24.68, SD = 21.34), t (57) = -76, p = .45, (two tailed). The magnitude of the differences in the means (mean difference = - 3.38, 95% CI: - 12.30 to 5.54).

A standard multiple regression analysis was carried out to examine if the predictor variables which included gender, hours of sleep, sdf (sleep duration on free days), sdw (sleep duration on workdays, total_sbq (sedentary duration) and total_psqi (sleep quality) would have an impact on BMI levels as the criterion variable. Preliminary analyses were conducted to assure no violation of the assumption of normality, linearity, multicollinearity, and homoscedasticity. The model explained 23.4% of the variation in BMI levels, F (6,39) = 1.983, p =.092.

Table 3: *standard multiple regression*

Variable	R^2	B	SE	β	*t*	*p*
	23.4					
Gender		-3.441	2.871	-.194	-1.199	.238
Hours of sleep		-.742	1.259	-.107	-.590	.559
Sdf		.264	.379	.101	.697	.490
Sdw		.723	.701	.170	1.032	.309
Total_sbq		-.144	.085	-.274	-1.690	.099
Total_psqi		-.618	.355	-.311	-1.743	.089

Discussion

This current study explored the topic of obesity and its association with inadequate sleep and tv watching in Ireland. This was done by examining body mass index which was calculated and specific types of screens such as (television and computer) along with different indicators of sleep including (quality and duration). The study also accounted for gender differences (male and female) within variables. Previous studies have established the relationship between sleep duration, screen time and obesity, postulating that it is not so much the act of watching television but the accompanying factors such as the eating of snacks which are usually high in calories as well as the sedentary way television is watched that influences obesity (Daniel M Golshevsky, 2019). It is important to note that both duration and quality of sleep have a role to play on an individual BMI, epidemiological studies have demonstrated the association between insufficient sleep with higher risks of

obesity hence, increased hunger and calorie intake (Sanjay R. Patel, 2006; Cooper CB, 2018 Oct).

Related to this, previous research also suggests that shift work disorders can arise from individuals that work overnight, early or rotation shifts, as a result, they are more likely to develop obesity, insomnia along with other sleeping problems such as a disturbance to the circadian rhythm (The Nutrition Source, 2021; Maria Carlota Borba Brum, 2020). Given the effects of obesity on individuals, it is important to cut down on sedentary behaviour along improving quality of sleep to reduce the chances of poorer mental health along with the possibility of heart disease, certain types of cancer or stroke (Xavier Pi-Sunyer, 2009 Nov). Based on previous research, there seems to be a predominant focus on children and limited information on gender differences in this topic area. Based on the study, there were three hypotheses developed to address the study aims.

In relation to the first hypothesis, previous literature suggests that there would be a relationship between poor quality sleep (Total_PSQI) and BMI levels (Fatima Y, 2016 Nov). This hypothesis was examined with the use of a correlation analysis, the results showed that there was a significant relationship between the variables, $r = -.27$, $n = 53$, $p = .047$. Results indicate that poorer sleep quality is correlated with BMI between young adults. This of course supports previous findings on the association of sleep quality towards BMI levels and therefore supports our hypothesis.

The second hypothesis stated that there will be a significant difference in sleep duration and sedentary time between males and females. An independent samples t-test was conducted to examine differences in sleep duration and sedentary time as (continuous variable) between males and females (categorical variables). The results showed that there was no significant difference in scores between males (M = 6.16, SD = 1.34) and females (M

= 6.79, SD = 1.18) on sleep duration along a non-significant difference for sedentary time between males (M = 21.30, SD = 7.26) and females (M = 24.68, SD = 21.34) (Bellettiere J, 2015).

Lastly, A standard multiple regression was carried out for the final hypothesis. This examined if the (predictor variables) on gender, hours of sleep, sdf, sdw, total_sbq and total_psqi would impact BMI levels (criterion variable). The third hypothesis stated that sedentary time and sleep quality (PV) impacts levels of BMI (CV). Surprisingly, the overall model was non-significant with 23.4% of the variation explained in BMI levels, F (6,39) = 1.983, p =.092 (Grandner, 2015).

The findings from this study revealed that students have the highest BMI scores, surprisingly the unemployed have the lowest levels in BMI, suggesting that more attention should be directed towards students and their health. The study further revealed a higher body mass index for 18-20 in comparison to the 21-23 age group. Related to this, published literature suggests that obesity has a greater effect on some ethnic groups compared to others. This study suggests that for non-Hispanic black adults, approximately 49.6% had higher obesity levels than Hispanic adults which were at 44.8%, non-Hispanic white adults are at 42.2% and non-Hispanic Asian adults are 17.4% with 40.0% being adults aged 20-29 years of age, 44.8% being 40-59 years of age and 42.8% being 60 and older. Given obesity and the association with socioeconomic status, it is found that individuals who have some sort of college degree have lower obesity prevalence in comparison to those with lower to no education. This can of course be understood as the uneducated majority may not be aware of the risks and impact of certain calorie intake, the importance of sleep or exercise, making people aware of the importance to cut down on sedentary behaviours and improving on quality sleep could make a huge positive impact to society hence reducing the likelihood of

developing obesity. Considering lower education status, ones unemployment status, food insecurity and greater access to poor quality food can also influence obesity (Craig M Hales, 2017 Oct). Furthermore, obesity seems to be lower in higher-income groups compared to middle or lower income. Findings from this study suggest longer sleep duration, sedentary behaviour, and sleep quality for females in comparison to males. In addition, tv viewing (as part of sedentary behaviour) and non-tv sedentary time such as reading or computer use can contribute to obesity (I Heinonen, 2013). Future research should include cultural differences in the context of obesity as this can be beneficial. Additionally, lack of physical activity has been proven to have several beneficial advantages to individuals such as improving general physical and mental health, improving respiratory, reducing the risk of type 2 diabetes, heart disease and some cancers.

Strengths

The age group of 18-23 for this study is a strength along with the wide range of sedentary behaviour included in the questionnaire as previous studies are predominately focused on obesity with children hence, less attention on younger adults. Findings suggest that these age samples are likely to be affected by changes in tv watching routine as more than 60% of adults do not engage in the recommended activity (Craig M Hales, 2017 Oct), hence the risk of developing higher BMI scores and a need to cut back on sedentary behaviours.

Implications

The current studies detailing the effect of tv watching on obesity have important implications for society at large in the present day, as a result, further research should examine these areas. Obesity as a phenomenon potential directly affects social, physical, and emotional interactions between people. Research indicates that inadequate sleep along with

sedentary behaviours such as tv watching is associated with weight gain as well. Further, to improve and encourage physical exercise the Health Service Executive should consider conducting a policy or health guidelines in relation to the effect of obesity, lack of physical activity on individuals hence a reason to cut down on sedentary behaviour and improve on sleep as this affects the quality of life. As previous studies have demonstrated the impact of BMI levels on health, implementing the above recommendation would be an advantage to people in society, hence decreasing negative outcomes.

Limitations and future research

The limitations for this study include the participants residing only from Ireland. Furthermore, the sample size for this study does not include cultural differences. This study was underpowered by g power as it recommended more participants than acquired. Regarding the findings, future studies should account for various age groups. In terms of cultural differences, there should be an increase in data collection involving various countries along with the examination of different ethnic groups. Future studies about this topic should include various types of screens such as tablets, mobile screens. It might be beneficial to develop a questionnaire that aims to understand why individuals engage in certain sedentary behaviours along with more updated surveys built for examining the cause for inadequate sleep, that way it will be easier to examine the reasons hence, coming up with new strategies to improve ones quality of life.

Conclusion

To conclude, it would be beneficial for future studies to develop questionnaires aiming to understand why individuals engage in certain sedentary behaviours along with more updated measures built for examining the causes of inadequate sleep rather than obtaining time spent watching tv and hours of sleep, hence developing strategies to improve

an individual's quality of life. Therefore, obesity is not simply the problem of an individual but also a society-wide problem. Additionally, a framework should be introduced on obesity prevention interventions, evaluation and identification which can of course be an advantage to a broad community. This framework can be important for researchers or future studies hence, decreasing the likelihood of developing obesity and considering contextual factors that may influence decision making. Sleep is an important aspect of life that can easily be influenced. Insufficient sleep has been linked with higher risks of obesity hence, increased hunger and calorie intake as a result it is necessary to continuously emphasise adequate sleep (Sanjay R. Patel, 2006; Cooper CB, 2018 Oct). Overall, to improve and encourage physical exercise the Health Service Executive should consider conducting a new policy or health guidelines in relation to obesity, this procedure will inform society of the importance to cut down on sedentary behaviour and improving on sleep thus reducing negative outcomes.

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Appendices

Appendix A: Consent form

Consent form

Title of Research Project: weight gain and its association with sleep and tv watching.

Study information and participation

Thank you for taking time out of your day to partake in this study, this study aims to examine the association between weight gain, sleep and tv watching. This research is being conducted by Georgina Ononaojoh, an undergraduate student at the National College of Ireland. This research project has been approved in principle by the Departmental Ethics Committee. Data from participants will be analysed and submitted in a report to the Psychology Department in the School of Business. This study will include a questionnaire that will be delivered and completed online taking approximately 10-15 minutes to complete.

Participation is voluntary and all data is De-Identified, as it is my job as the researcher to respect the privacy of participants. This project requires individuals between the ages of 18-23 and all responses will be anonymous.

Benefits/ risks

There are no direct benefits to you for taking part in this research. However, the information gathered will contribute to research that helps give a better insight into weight gain and its association with sleep and screen time. Apart from that, you will be helping an undergraduate student to complete her project. One or two questions contained within this survey may be sensitive for example “How much do you weigh? (Kilograms)”. If this is the case, you are free to discontinue participation and exit the questionnaire. Helplines will also be attached.

- I confirm that I have read and understood the information that is being provided explaining the research project and am aware that I can ask questions about the project at any time.
- I comprehend that my participation is voluntary and that I am free to withdraw at any time. If I wish not to answer any questions, I am free to decline.
- I understand that my responses will be kept strictly confidential and adhere to ethical guidelines. I am aware that my name will not be linked and will not be identified or identifiable in the report or reports that result from the research.

Contact information

For any questions about this study please feel free to contact me on my email: X19330063@student.ncirl.ie Georgina Ononaojoh or my supervisor Mr Michael Cleary-Gaffney for this project on the email: Michael.cleary-gaffney@ncirl.ie

For the use of participant (please tick the box if you consent to take part in this study and you are between 18-23 years of age) □

Appendix B: Debriefing sheet

Debriefing sheet

Title of Research Project: weight gain and its association with sleep and tv watching.

Thank you for participating in this questionnaire, this study aims to examine the association between weight gain, sleep and tv watching. A survey will be distributed between participants, the reason for asking for your participation is to enable a better insight into the correlation between sleep duration and screen use on BMI. This study will examine different

aspects such as (1) both genders, (2) specific types of screens (television, computer) and (3) different indicators of sleep – (quality, duration).

The participation of every participant in this study is voluntary and he/ she is free to withdraw at any time. If you wish not to answer any questions you are free to decline. During this study, the responses will be kept strictly confidential. It is important to note that submitted responses cannot be withdrawn or removed but considering the questionnaire is anonymous, it makes it impossible to identify participants based on their responses. Members of the research team can have access to the anonymised responses and data will be kept on file for 5 years after which will be deleted. Names will not be linked and will not be identified or identifiable in the report or reports that result from the research.

Support service

If he/she becomes psychologically distressed as a result of their involvement in this study there are helplines to contact in which I have provided, (1) Aware on **1800 80 48 48**, (2) Mental Health Ireland on **01 284 1166** and Mental Health support and Recovery Organisation**, Tel: 1890 474 474.**

Contact information

For any questions about this study please feel free to contact me on my email: X19330063@student.ncirl.ie (Georgina Ononaojoh) or my supervisor Mr Michael Cleary-Gaffney for this project on the email: Michael.cleary-gaffney@ncirl.ie

I would like to sincerely thank every participant for partaking in my study.

Appendix C: Participant Information Leaflet

Participant Information Leaflet

Title: Weight gain and its association with inadequate sleep and Tv watching

This is a research study in which you are invited to take part, if you would want to take part, please take a few minutes to read this document that highlights (1) why the research is being conducted and (2) what it involves. My contact details can be located at the end of this sheet if any questions arise about the information provided.

I am a final year student in the BA in the Psychology programme at the National College of Ireland. I am required to carry out an independent research project. For my project, I will be investigating whether inadequate sleep and excessive tv watching are associated with weight gain. This project will also be under academic supervision.

Participants involved in this study will be given a survey that will take approximately 10-15 minutes to complete the questions. Along with the survey will include a debrief, consent form and participants information sheet. You will be asked to complete an online questionnaire, that will be covering BMI, sleep, and screen time. There might be sensitive questions for example “How much do you weigh? (Kilograms)”.

You can take part in this survey if you are between the ages of 18-23 and living in Ireland, it is important to note that participation is voluntary, and you have the right to discontinue at any point or stage. Once you have submitted your questionnaire, it will not be possible to withdraw your data from the study as the questionnaire is anonymous and individual responses cannot be identified.

There are no direct benefits to you for taking part in this research. However, the information gathered will contribute to research that helps give a better insight into weight gain and its association with sleep and screen time. Apart from that, you will be helping an undergraduate student to complete her project. If he/she feels distressed because of the question (s), you are free to discontinue participation and exit the questionnaire. Helplines will also be attached.

I will take this opportunity to mention that the identity and data of the participants in this study are protected and secured by ensuring all the information is de-identified and stored online, it will also be password protected. I further ensure privacy and anonymity towards participants. Considering the questionnaire is anonymous, it makes it impossible to identify participants based on their responses. The data of participants involved will be stored under each of their ID codes that are separated from identifying information, only the researcher and academic supervisor will have access to this. The data will be retained for 5 years following the NCI data retention policy after which data will be destroyed.

The results of this study will be presented in my final dissertation, which will be submitted to the National College of Ireland. It is also possible for the results to be presented at conferences or in an academic journal for publication. For any questions about this study please feel free to contact me on my email: X19330063@student.ncirl.ie (Georgina Ononaojoh) or my supervisor for this project Mr Michael Cleary-Gaffney on the email: Michael.cleary-gaffney@ncirl.ie

Appendix D: Proof of Data and SPSS Output

Spss data file new.sav [DataSet1] - IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Graphs Utilities Extensions Window Help

	Name	Type	Width	Decimals	Label	Values	Missing	Columns
1	Age_Groups	Numeric	8	0	Age_Groups	{1, 18-20}...	None	8
2	Employment	Numeric	8	0	Employment	{1, student}...	None	8
3	Gender	Numeric	8	0	Gender	{1, male}...	None	8
4	PSQI1	Numeric	8	2	During the past...	None	None	8
5	PSQI2	Numeric	8	0	Minutes to fall ...	None	None	8
6	PSQI3	Numeric	8	2	During the past...	None	None	8
7	PSQI4	Numeric	8	1	Hours of sleep	None	None	8
8	PSQI5	Numeric	8	0	Trouble sleepin...	{1, Three or ...	-99	8
9	PSQI6	Numeric	8	0	Trouble sleepin...	{1, Three or ...	-99	8
10	PSQI7	Numeric	8	0	Trouble sleepin...	{1, Three or ...	-99	8
11	PSQI8	Numeric	8	0	Trouble sleepin...	{1, Three or ...	-99	8
12	PSQI9	Numeric	8	0	Trouble sleepin...	{1, Three or ...	-99	8
13	PSQI10	Numeric	8	0	Trouble sleepin...	{1, Three or ...	-99	8
14	PSQI11	Numeric	8	0	Trouble sleepin...	{1, Three or ...	-99	8
15	PSQI12	Numeric	8	0	Trouble sleepin...	{1, Three or ...	-99	8
16	PSQI13	Numeric	8	0	Trouble sleepin...	{1, Three or ...	-99	8
17	PSQI14	Numeric	8	0	Trouble sleepin...	{1, Three or ...	-99	8
18	PSQI15	Numeric	8	0	sleep quality R...	{1, Very bad...	None	8
19	PSQI16	Numeric	8	0	Medicine to hel...	{1, Three or ...	None	8
20	PSQI17	Numeric	8	0	Trouble staying...	{1, Three or ...	None	8
21	PSQI18	Numeric	8	0	Problem with e...	{1, A very bi...	None	8
22	PSQI19	Numeric	8	0	Do you have a ...	{1, Partner i...	None	8

Output 22.spv [Document1] - IBM SPSS Statistics Viewer

File Edit View Data Transform Insert Format Analyze Graphs Utilities Extensions Window Help

Statistics
Frequency Table
Title
Age_Groups
Employment
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Frequency Table

Age_Groups

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18-20	33	55.9	55.9	55.9
	21-23	26	44.1	44.1	100.0
	Total	59	100.0	100.0	

Employment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	student	29	49.2	49.2	49.2
	unemployed	2	3.4	3.4	52.5
	part time employment	13	22.0	22.0	74.6
	full time employment	15	25.4	25.4	100.0
	Total	59	100.0	100.0	

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	25	42.4	42.4	42.4
	female	34	57.6	57.6	100.0
	Total	59	100.0	100.0	

Appendix E: Pittsburgh Sleep Quality Index

Pittsburgh Sleep Quality Index (PSQI)

(D J Buysse, 1989)

Instructions: The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.

1. During the past month, what time have you usually gone to bed at night? _____

2. During the past month, how long (in minutes) has it usually taken you to fall asleep each night? _____

3. During the past month, what time have you usually gotten up in the morning? _____

4. During the past month, how many hours of actual sleep did you get at night? (This may be different than the number of hours you spent in bed.) _____

5. During the past month, how often have you had trouble sleeping because you…	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
(a) Cannot get to sleep within 30 minutes				
(b) Wake up in the middle of the night or early morning				
(c) Have to get up to use the bathroom				
(d) Cannot breathe comfortably				
(e) Cough or snore loudly				
(f) Feel too cold				
(g) Feel too hot				
(h) Have bad dreams				
(i) Have pain				

(j) Other reason(s), please describe:				
	Very good	Fairly good	Fairly bad	Very bad
6. During the past month, how would you rate your sleep quality overall?				
	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
7. During the past month, how often have you taken medicine to help you sleep (prescribed or "over the counter")?				
8. During the past month how often have you had trouble staying awake while driving, eating meals, or engaging in social activity.				
	No problem at all	Only a very slight problem	Somewhat of a problem	A very big problem
9. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?				
	No bed partner or roommate	Partner/room mate in other room	Partner in same room but not same bed	Partner in same bed
10. Do you have a bed partner or roommate?				
	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
If you have a roommate or bed partner, ask him/her how often in the past month you have had:				
a. Loud snoring				
b. long pauses between breaths while asleep				

c. Legs twitching or jerking while you sleep				
d. Episodes of disorientation or confusion during sleep				
e. other restlessness while you sleep, please describe:				

Appendix F:

Munich ChronoType Questionnaire (MCTQ)

(Till Roenneberg A. W.-J., 2003)

Instructions:

In this questionnaire, you report on your typical sleep behaviour over the past 4 weeks. We ask about workdays and work-free days separately. Please respond to the questions according to your perception of a standard week that includes your usual workdays and work-free days.

I have a regular work schedule (this includes being, for example, a housewife or househusband):

(a) Yes, I work on 1 2 3 4 5 6 7 day(s) per week.
(b) No

Is your answer "Yes, on 7 days" or "No", please consider if your sleep times may nonetheless differ between regular 'workdays' and 'weekend days' and fill out the MCTQ in this respect.

Please use a 24-hour time scale (e.g., 23:00 instead of 11:00 pm)!

On workdays

I go to bed at _____o' clock.

Note that some people stay awake for some time when in bed!

I actually get ready to fall asleep at _____o 'clock.

I need _____ minutes to fall asleep.

I wake up at _____o 'clock.

After _____ minutes I get up

I use an alarm clock on workdays

(a) Yes
(b) No

If “yes”, I regularly wake up BEFORE the alarm rings

(a) Yes
(b) No

On work free days (please only judge normal free days, i.e., without parties etc.)

I go to bed at _____o’ clock.

Note that some people stay awake for some time when in bed!

I actually get ready to fall asleep at _____o ’clock.

I need _____ minutes to fall asleep.

I wake up at _____o ’clock.

After _____ minutes I get up

My wakeup time is due to the use of an alarm clock:

(a) Yes
(b) No

There are particular reasons why I cannot freely choose my sleep times on free days

(a) Yes
(b) No

If “yes”, it is due to

(a) Children/ pet(s)
(b) Hobbies
(c) Other _____

Appendix G: Sedentary Behavior Questionnaire

SEDENTARY BEHAVIOR: Weekday

(Dori E Rosenberg, 2010)

On a typical WEEKDAY, how much time do you spend (from when you wake up until you go to bed) doing the following?

	None	15 min. or less	30 min.	1 hr	2 hrs	3 hrs	4 hrs	5 hrs	6 hrs or more
1. Watching television									
2. Playing computer or video games.									
3. Sitting listening to music on the radio, tapes, or CDs.									
4. Sitting and talking on the phone									
5. Doing paperwork or computer work (office work, emails, paying bills, etc.)									
6. Sitting reading a book or magazine.									
7. Playing a musical instrument									
8. Doing artwork or crafts.									
9. Sitting and driving in a car, bus, or train.									

SEDENTARY BEHAVIOR: Weekend Day

On a typical WEEKEND DAY, how much time do you spend (from when you wake up until you go to bed) doing the following?

	None	15 min. or less	30 min.	1 hr	2 hrs	3 hrs	4 hrs	5 hrs	6 hrs or more
1. Watching television									
2. Playing computer or video games.									
3. Sitting listening to music on the radio, tapes, or CDs.									
4. Sitting and talking on the phone									
5. Doing paperwork or computer work (office work, emails, paying bills, etc.)									
6. Sitting reading a book or magazine.									
7. Playing a musical instrument									
8. Doing artwork or crafts.									
9. Sitting and driving in a car, bus, or train.									

Appendix H: Weight Status and BMI Calculator

(BRAMLET, 2016)

BMI," says Ann-Marie Hedberg, associate director of Clinical Nutrition at MD Anderson. "For some cancers there is a correlation between a high BMI and a increased risk."

And while BMI is a common indicator, it's not the only factor that should be considered.

"BMI doesn't always tell the whole story," Hedberg says.

Here's what you should know about BMI.

BMI is a tool

BMI is a scale that can help determine if your weight is healthy in relation to your height. Your BMI is calculated by dividing your weight by the square of you height.

To find your BMI, simply use the chart below. Find your weight in pounds along the bottom and follow the chart to the spot where it meets your height in feet and inches. That number is your BMI.

For women and men, the following BMI ranges indicate your weight status:

- 18 or lower: underweight
- 18.5 to 24.9: normal, healthy weight
- 25 to 29.9: overweight
- 30 or higher: obese

As BMI increases, so does your risk for major health problems

If you have a higher BMI, you're more likely to have health problems like heart disease, stroke, diabetes, gallbladder disease, sleep apnea and osteoarthritis. Obesity also has been linked to an increased risk of several cancers, including esophageal, pancreatic, colorectal, breast, endometrial and kidney cancer.

BMI doesn't tell the whole story

"It's important to remember that BMI is just one factor in determining your overall health," Hedberg says.

(BMI caculator | Check your BMI - NHS | Please fill in your details , n.d.)