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Full Length Research Paper

Television watching and sleep promotes obesity in urban and semi-urban children in India

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Obesity is an emerging problem in urban and semi urban Indian children; it is associated with several health problems and social consequences. Poor eating habits in all the children plays major role in the development and increases in childhood overweight and obesity. The present study was aimed to evaluate the dietary and physical activity patterns as determinants of overweight in a sample of children, along with television watching with different food habits which lead to the development of different disorders in the children who are living at south Indian core of the country. Methodology was applied to study the selected parameters as a constraint to obesity in the given samples.

Key words: Obesity, body mass index, central adiposity, television, longitudinal studies, cohort studies.

INTRODUCTION

Obesity may be defined as excess accumulation of adipose tissue (Guillaume et al., 1999) in the body. It is a chronic disease in which body weight exceeds the normal by at least 20 percent, which becomes a psychosomatic, social economic and aesthetic problem. There is a growing concern due to its high prevalence and association with morbidity (Drewnowski and Popkin, 1997; Bandini, 2001; Must and Strauss, 1999). Obesity is linked to increasing adult morbidity through predisposing to a variety of conditions such as insulin resistance, lipoprotein abnormalities, diabetes mellitus type II, cardiovascular disease, deep vein thrombosis and elevated blood pressure (Bao et al., 1995; Kelishadi et al., 1993; Balaban et al., 2001).

Serdula found a risk for adult obesity at least twice as High in obese children as in non-obese ones; approximately one-third of preschool children and 50% of school-age children become obese adults (Serdula et al., 1993)

In a study in India, the children in the age group of 6-11 years, there has been 54% increase in the prevalence of obesity. There is strong evidence that the atherosclerotic process leading coronary heart disease (CHD) begins in childhood and adolescence (John et al., 1999). Children living with parents who are overweight and obese are at an increased risk of being obese. Other groups at higher risk of obesity include some people from black and ethnic minority groups and people with specific conditions such as learning difficulties.

Short stature (including measures of childhood leg length), a reflection of socioeconomic deprivation in childhood, is associated with an increased risk of CHD and stroke, and to some extent diabetes (Aboderin et al., 2002; Rich-Edwards et al., 1999; McCarron et al., 2001; Forsén et al., 2000; Forsén et al., 2000; Hart et al., 2000; Jousilahti et al., 2000; McCarron et al., 2000;

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Wannamethee et al., 1998; Marmot et al., 1997). Given that short stature, and specifically short leg length, is particularly sensitive indicators of early socioeconomic deprivation, their association with later disease very likely reflects an association between early under nutrition and infectious disease load (Gunnell et al.,1998; Davey-Smith et al.,1998).

Increasingly inactive lifestyles declining physical activity are major reasons for cause of obesity. Recent studies have shown that a higher level of television watching and sleep duration is an important behavioral forebear of obesity (Jean-Philippe et al., 2009).

In a study, children were studied for their physical activity pattern; sleep duration, sedentary habits and eating behaviors as potential determinants of over weight (Kelishadi et al., 2003; Del Rio-Navarro et al., 2004; Rashidi et al., 2005; El-Hazmi et al., 2002). Several methods have been developed to measure body fat, including densitometry, ultrasonography, computed tomography, magnetic resonance, assessment of body potassium content, levels of creatinine, and total body water content (Munday et al., 1994). Today, 15 to 25% of children and adolescents in this country are being affected (Mellova et al., 2004). For children, 6-11 years of age, there has been a 54% increase in the prevalence of obesity and a 98% increase in the prevalence of super obesity from 1966 to 1980 and there is substantially evidence that the atherosclerotic process leading to coronary hearth disease (CHD) begins in childhood and adolescence (Mellova et al., 2004).

METHODOLOGY

Obesity is not a disability (at 16 years) or longstanding illness (at 23 years), due to BMI and television watching. Obesity increases the risks for children (Rockville et al., 2001). Hypertension, Ischemic heart disease, stroke, type 2 diabetes, sleep apnea and orthopedic problems, increasingly inactive lifestyles and declining physical activity are chief suspects (Burke et al., 2005; Jago et al., 2005) among the lifestyle factors contributing to the recent and rapid increase in obesity. Television viewing is the most popular leisure-time pursuit; In 1999, UK children aged 4– 15 years watched an average of about 18 h of television per week and adults about 27 h (Church et al., 2005). Watching TV and taking fast food stuffs alongside leads to sleep for people from 11 to 45 years; this results in adipose tissue depositions, that cause obesity in both children and adults. Recent studies have shown that a higher level of television watching and sleep duration is an important behavioral forebear of obesity (Agras et al., 2004; Sekine et al., 2002; Marshall et al., 2004; Foster et al., 2006). Children were studied for their physical activity patterns; sleep duration, sedentary habits and eating behaviors which are potential determinants of overweight (Marshall et al., 2004). There are fewer longitudinal studies in children, but reports suggest that television viewing may have cumulative effects on body mass index (BMI) (Hancox et al., 2004) and influence subsequent change in fatness (Horn et al., 2001; Berkey et al., 2003; Kaur et al., 2003; Hancox et al., 2004; Jago et al., 2005; Viner and Cole, 2005). Now, prevention strategies are argued by many true people for an importance on childhood and efforts to inspire healthy behaviors early in life (Lobstein et al., 2004). Interventions to reduce television viewing in children have met with some success, and suggest that this is useful target behavior in explanatory obesity risk (Robinson et al., 1999; Kapil et al., 2002).

Measures of BMI with reference of scales and standardized growth charts

Body Mass Index (BMI) is currently the preferred standard for evaluating weight status in children (Willett et al., 1999). BMI is a practical method to estimate body fat. According to scientific panels BMI provides a reasonable index of overweight in children. Children with a BMI between 85-95th percentile and those who exhibit an excess rate of weight gain are considered at high risk for developing obesity (Cole et al., 2000; Willett et al., 1999). BMI scales and standardized growth charts are available to compare children's size and growth patterns to standards (WHO). Growth charts showing weight for height are used for children up to two years of age and BMI for age is used for children of 2 to 20 years. Children with a positive family history for obesity and those with a chronic illness or disability are at high risk for development of obesity (Troiano and Flegal, 1998).

Risk of obesity crosses all social-economic and ethnic groups, but is slightly more prevalent in low income groups, Native American, Hispanic and African American populations (Goodman et al., 1999; Dietz et al., 1999). These methods are not widely available and are usually expensive and time-consuming and require qualified personnel. BMI is the preferred method of expressing body fat percentile of groups in childhood and adolescence. This method studies the prevalence of overweight and obesity between males and females and between the age groups. The children were classified into 3 domains on the basis of overweight or normal weight, based on their BMI (Cole et al., 2000): sedentary activities (all sedentary activities at school and home), rigorous activities (physical training at school, games and exercise at and after school) and sleep.

Self reporting methodology

Self-report methods are frequently used to collect EI data, including 24-h food recall and pen-and-paper food records. When estimating EI with 24-h food recall, a trained individual interviews the participant about his/her food and beverage consumption over the previous 24-h.

This method relies on the ability of the participant to accurately recall the types and amounts of foods consumed during the previous 24-h, and it is assumed that these foods are representative of habitual EI.

Consequently, this method is subject to error (O'Neil, 2001; Samuel-Hodge et al., 2004). Efforts to improve the accuracy of 24-h recall have been disappointing. For example, financial incentives were not found to improve diet recall (Hendrickson et al., 2007).

Measures of BMI at different time points within individuals

BMI is an internationally acceptable definition of child overweight and obesity, specifying the measurement, reference population, and age and sex specific cut off points. Data on body mass index (weight/height) were obtained. BMI study included males and females from birth to 11 to 45 years of age. It should help to provide internationally comparable prevalence rates of overweight and obesity in children (Cole et al., 2000). For each of the survey, centile curves were drawn that 16 years of age has passed through the widely used cut-off points of 25 and 30 kg/sq. m for adult weight and obesity. The resulting curves were averaged to provide age-and sex-specific cut-off points from 2 to 18 years. Measures of BMI at different time points within individuals are correlated with reference to population, and age and sex specific cut off points, which allow for these correlations, fitting BMI as a repeated measure and also models allow for missing outcomes; thus all participants with at least one BMI measure (and data on all independent variables) were included. About a third of participants had BMI data at all four time points from 11 to 25 years, and a further 29% of 45 years had data at three time points. There was no clear trend between BMI at 45 years and number of measurements available, supporting the model assumption of data missing at random. All analyses were performed using MLwiN version 1.10 (Institute of Education, London, UK) (Rasbash et al., 2000). The tool used to measure the increase in the number of overweight children in the U.S. population is body mass index, BMI (kg/m^2, see 2000 CDC Growth Charts: United States).

There is consensus by several scientific panels that BMI provides a reasonable index of overweight in children (Dietz and Robinson, 1998; Barlow and Dietz, 1998; Himes and Dietz, 1994). Several studies have shown that BMI is adequately associated with body fat in boys and girls of different ages and ethnic groups (For a review of the issue, See Dietz and Beliizzi, 1999; Flegal et al., 2006). For example, Mei and colleagues (2002) showed that BMI was associated with both dual energy X-ray absorptiometry (DXA) measurement of body fat (approx. r =.80) and, in a sample of over 10,000 children, with skin fold measurements (approx. r =.80 to .90).

First,change in BMI with age was modeled, using both linear and quadratic age terms. Age was centered at 33 years. Random effects at the individual level were included for the intercept and linear age term, allowing both intercept (BMI at 33 years) and linear slope (change in BMI per year) to vary between individuals. Random effects for the quadratic age term were not significant. Second, to investigate the influence of television viewing on change in BMI, allowing the intercept (BMI at age 33) to vary by frequency of television viewing. A television viewing by age interaction term was added to test whether the slope of the BMI trajectory varied by television viewing. Adjustment for potential confounding factors (childhood BMI, mother's BMI, social class, puberty, concurrent physical activity, alcohol intake, smoking, adult diet) and their interaction terms by age were examined. We adjusted for changes in lifestyle factors over time by including each factor at two ages (16 and 23 years) in models of the BMI trajectory from 23 to 45 years. Researchers examined whether any of the lifestyle characteristics modified the influence of television viewing on the BMI trajectory.

We investigated that the effects of television viewing in childhood remained after adjusting for levels of adult television viewing. BMI transforming repeatedly tested by using a natural logarithm results was similar to those presented here, with one exception, described below. Relationships between television viewing (at 11, 16, 23 and 45 years; we selected the age mentioned to study the obesity in children and grownup stage, so the study became fruitful and showed the effect of BMI on average age of the participants) and waist–hip ratio at 45 years were investigated using linear regression. Unadjusted models were repeated using the (smaller) sample available for adjusted models and similar results were obtained. Regression models and other non-multilevel analyses were conducted using SPSS for Windows, version 13.0.1 (SPSS Inc., Chicago, IL, USA).

BMI and central adiposity

BMI at 11 and 16 years, heights and weights were measured. At 23 years, self-reports of weight and height were obtained. At 33 and 45 years, weight was measured with indoor clothing, without shoes, to the nearest 0.1 kg, and height was measured to the nearest centimeter at 33 years and nearest millimeter at 45 years. Central adiposity, indexed by waist and hip circumferences, was measured at 45 years. Both circumferences were measured to the nearest millimeter, waist circumference midway between the lower ribs and iliac crest in the mid-auxiliary line, and hip circumference at the widest part of the body below the waist. Key Parameters: (kg m-2), Inch, pound (0.454 kg).

Television watching

Data explore television-watching frequency at 11, 16 and 23 years, and daily duration at 45 years. At 11 and 16 years, categories were named as 'often', 'sometimes' or 'never or hardly ever'. Children watched television never/hardly ever (2 to 6%) and therefore the 'sometimes' and 'never/hardly ever' categories were combined. At 11 years, 'often' was defined as nearly every day, but was undefined at 16 years. At 23 years, frequency categories were as follows: _5**,** 3–4, 1–2 times per week, 2–3 times in the last 4 weeks, once in the last 4 weeks or not at all in the last 4 weeks. There are two categories: _5 and _4 times per week. At 45 years, participants reported how much television they had watched during the last year: greater than 4, 3–4, 2–3, 1–2 and less than 1 hour was starting day or none.

Other important mystifying factors to measure the obesity maternal BMI

In 1958, maternal height without shoes was measured. Pre-pregnant weight was self reported by mothers in categories of 1 stone (14 pounds or 6.35 kg), and the midpoint of their weight group was used for calculations of BMI (Lake et al., 1997).

Social class

Father's occupation was taken as a social class, according to the UK 1951 General Registrar's classification. We used two categories: Non-manual (professional, managerial and skilled non-manual) and manual (skilled, semi-skilled and unskilled manual, and those recorded as 'no male head of household') (Power et al., 2003).

Puberty

We used reports of age at menarche (girls) and age of voice breaking (boys) at 16 years.

Physical activity

Childhood obesity is adopted from parental obesity, eating behaviors, TV viewing and lack of physical activity (Burke et al., 2005; Jago et al., 2005). At 11 years, mothers reported how often their children used parks, recreation grounds, swimming pools and indoor play centers and the children were asked how often their played outdoor sport or took part in sport outside school hours. At 16 years, participants were asked how often they played outdoor and indoor games and sports, and went swimming and dancing. For each age, variables were combined into single variable (Parsons et al., 2005) and dichotomized; the most active and others. At 23 years, participants responded to a single question, about frequency of regular sports and exercise (Parsons et al., 2005). This was categorized here into two groups: Most active one, this is greater than 3 times per week; others, active less than 2 times per week.

Alcohol consumption

At 16 years, participants were asked how long they had since consumed an alcoholic drink and if within the past week how much they had consumed. Some drank greater than 5 U weeks ago; greater than 1 U in the last month; greater than 2 U in the last week. At 23 years, participants were asked how frequently they consumed alcoholic drinks. According to the consumption it was categorized into: most days, 1 to 2 times per week and less often.

Cigarette smoking

At 16 years, participants were asked how many cigarettes they smoked per week.

At 23 years, participants reported the following about smoking:

1. They had ever,
2. Currently,
3. Smoked regularly
4. Never smokers,
5. Ex-smokers,
6. Smoke 1 to 19 cigarettes per day
7. Smoke greater than 20 cigarettes per day (Jefferis et al., 2004a).

Diet

At 33 years, participants reported how often they ate fresh fruit in summer; salads or raw vegetables in winter, chips, fried food (excluding chips), sweets or chocolates and biscuits.

Five frequency categories

1. Greater than once per day,
2. Once per day,
3. 3 to 6 days per week,
4. 1 to 2 days per week,
5. Less than 1 day per week or never

We constructed a healthy eating score using frequency data for the six foods as described previously (Parsons et al., 2006b):

Healthy foods: Fruit and salad
Unhealthy foods: Chips, sweets, biscuits and fried food.

Effects of television viewing were largely unaffected by adjusting these factors, which were unsurprising given that they were generally only weakly related to television viewing. Although there are changes in physical activity, smoking, alcohol intake and diet over time, (Jefferis et al., 2003; Jefferis et al., 2004a; Jefferis et al., 2004b; Parsons et al., 2006b), effects of television viewing on the BMI trajectory were little affected by adjusting these changes, which may also be due to the weak associations between these factors and television viewing. Also there were no interactions between lifestyle factors (activity, smoking, alcohol and adult healthy eating) present, with one exception.

In non-smoking men at 16 years, those who watched television 'often' experienced faster gains in BMI (16 to 45 years; by 0.017 kg m-2 per year) than those who watched less often, whereas in smokers, the trajectory was similar irrespective of the level of television viewing. The reason for this difference is unclear; the proportion watching television often and less often in smokers and non-smokers was almost identical, and BMI at 16 years was similar. We were able to take into account television viewing in adulthood and found that in females, adjusting adolescent television viewing at 16 years for television viewing at 23 years abolished the effect of television viewing at 16 years on BMI gain, suggesting that continuities in television viewing from adolescence to adulthood may be responsible for this effect. However, effects of television viewing at 11 years appeared to be independent of television viewing in adulthood. Waist–hip ratio has been shown to be positively associated with BMI, but is also a stronger and often independent predictor for cardiovascular disease mortality (Welborn et al., 2003) and associated risk factors, diabetes and certain cancers (World Health Organization, 1998).

We found that television viewing in adolescence had little influence on waist–hip ratio at 45 years, but more frequent viewing behavior in early adulthood (greater than 5 times per week at 23 years) was associated with an increase in waist–hip ratio of 0.01, an effect that persisted after allowing for television viewing over 20 years later. By 45 years, those watching television for greater than 4 h per day-1 had a mean waist–hip ratio of about 0.04 higher than those watching television for less than 1 h per day-1. This difference has been found to correspond to an increase in blood pressure (2 to 4 mm Hg systolic or 1 to 3 mm Hg diastolic) (Canoy et al., 2004). An increase of 1 S.D. in waist–hip ratio (0.06) has been associated with a 1.5 to 2.0 increase in odds of developing type II diabetes (Snijder et al., 2003).

DISCUSSION

Short sleep duration has been shown to be a risk factor for obesity in children (Jago et al., 2005; Agras et al., 2004), through the modulation of hormones, such as leptin and ghrelin. Anthropometric measurements included body weight (nearest 0.1 kg) and height (0.1 cm), from which body mass index (BMI) (kg/m2) was calculated. In addition, waist and hip circumferences were measured according to a standardized protocol (Harrison et al., 1988). Urban children constituted 73% of the whole group, while the remaining children were from semi- urban areas (small towns). Fifty four percent (n = 324) of the children were male. The range of body weight was from 14 to 68 kg and the body mass index (BMI) ranged from 9.8 to 29.8 kg/m2. Their ages ranged from 6 to 16 years, and the children came from lower to middle socio economic status households. Based on their BMI (41), 6.4% (n = 38) of the children were overweight. The reduced levels of BMI can increase hunger and appetite and influence weight gain (Spiegel et al., 2004; Taheri et al., 2004).

Children with television sets in their rooms spent less time in bed on weekdays and reported higher overall levels of being tired (Davison et al., 2006; Dennison et al., 2002; Van den, 2004) distribution of TV viewing in its tertiles was 34, 45 and 21% in children who slept less than 8.5 h known as lowest tertile of sleep. Hence, there was no significant clustering observed in the present study. It has also been recommended that the children's total media time (TV, video and video games) to be limited to no more than 1 to 2 h of quality programming per day (American Academy of Pediatrics, 2001).

However, it seems that even within this recommend-dation, there may be potential for a graded response towards weight gain with increasing duration of television viewing. Our over all review suggests that gain in BMI over nearly 30 years of adult life is influenced by frequency of television viewing in adolescence and early adulthood, more consistently in females than males. Generally consistent effect of television viewing at age 16 years was found on change in BMI over time, with excess gains of between 0.011 and 0.013 kg m^{-2} per year for those watching the TV most frequently. These effects may not be evident in very young children (3 to 6 years), and possibly emerge around 6 to 7 years (Jago et al., 2005), and interestingly, several studies report stronger relationships in females (Horn et al., 2001; Berkey et al., 2003; Hancox et al., 2006).

Our study has several repeated measures of BMI over an extensive period, during a life stage in which BMI is typically increasing, and it therefore adds important information about changes in BMI through to mid adulthood. Information on central adiposity at 45 years is a further strength to the study.

The measure of television viewing changed over time. Although some suggest that relationships between body fatness and television viewing reported in the literature are generally weak and perhaps unimportant (Marshall SJ et al, 2004), others counter-argue that television viewing is at least comparable to, and may be a better predictor of body fatness, than other frequently considered causal predictors, such as dietary intake or physical activity (Berkey et al., 2000; Hancox et al., 2006). Our analyses of physical activity and television viewing at 23 years reported here and elsewhere (Parsons et al., 2006b) suggest effects of similar magnitude on BMI through to 45 years.

Conclusion

Our findings suggest that watching television more frequently in adolescence or early adulthood is related to a faster BMI gain through to mid-adult life, particularly in females, and that more frequent television viewing in early adult life increases waist–hip ratio some years later. At 45 years, the cross-sectional relationship between television viewing and BMI mirrored the longitudinal relationship, being stronger in women than in men. In contrast, the relationship between waist–hip ratio and television viewing at 45 years was stronger in men. The reasons for gender differences in our study and elsewhere in the literature are unclear; we found that continuities in television viewing between one age and the next were similar for males and females. Possible gender differences in the underlying mechanisms by which television influences adiposity, for example in dietary or compensatory behaviour, might explain the differences in the relationship and require further exploration. Television viewing is one factor among several that impacts on subsequent body fatness and weight gain (Parsons et al., 1999), and as such, reducing television viewing may be a useful component in strategies for limiting BMI gain and increases in central adiposity. And suggestions from recent reviewers that duration of sleep, television viewing and consumption of fried foods may be significant factors that contribute to overweight. Further longitudinal studies are needed to confirm these findings.

Reducing procedures

How reduced television watching lowers the risk of obesity or central adiposity, and whether it might be acting via increased activity, or changes in dietary intake, is uncertain. Cross-sectional studies generally show weak or no association between television viewing and physical activity (Kronenberg et al., 2000), particularly in children (Parsons et al., 2005), although associations are possibly more consistent and stronger in adults (Salmon et al., 2000). Irrespective of an association, both television viewing and physical activity are generally found to have independent effects on obesity (Berkey et al., 2000; Salmon et al., 2000; Jakes et al., 2003; Parsons et al., 2005). Our results are consistent with this general pattern; effects of television viewing on the rate of BMI gain were independent of physical activity. A second possible explanation is that effects of television are mediated through dietary habits. In children, television viewing has been found to be positively related to snacking between meals (Marshall et al., 2004) and consumption of energy-dense snacks (Parsons et al., 1999), although whether snacking habits or energy density is related to adiposity is less clear (Guillaume et al.,1998; Phillips et al., 2004; Bell et al., 2005). While we lack dietary data concurrent with our measures of television viewing, the relationship between television viewing and BMI gain was not influenced by a healthy eating score in adulthood. We cannot, however, exclude the possibility that television viewing affects BMI gain or waist–hip ratio through dietary habits. Television viewing is a complex exposure, and further work is needed to determine how it affects obesity risk.

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