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Inactivity in Childhood and Adolescence: A Modern Lifestyle Associated with Adverse Health Consequences

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The current era is characterized by kinetic limitation, both in children, and adolescents. Children today expend 400% less energy than did their counterparts of 40 years ago and are 40% less active than they were 30 years ago. Children and adolescents' today activity level is very low, while they spend their free time, mainly, in sedentary behaviours, such as tv viewing, and computer videogames playing. The average child or adolescent 2- to 18-years old spends on tv-videotapes watching or video games playing more than 5 hours per day. The lack of movement in children and adolescents' lives is one of the primary predisposing factors of increased morbidity, since many of the chronic diseases of adults are initiated in childhood. Approximately 40% of children aged 5 - 8 years old present increased risk factors for heart disease, such as obesity, hypertension and high total cholesterol, or for diabetes. These diseases are most often irreversible due to the continuous sedentary lifestyle that has been adopted by children. Moreover, significant relationships between inactivity and other adverse health practices, such as consumption of less-healthy foods or increased fat intake, as well as cigarette smoking that have been demonstrated in adolescents, predispose to cardiovascular disease. To sum up, inactivity represents a behaviour that is associated with adverse health consequences which initiate even though from childhood and follow children and adolescents throughout their lives.

Keywords: sedentary behaviours, lack of physical activity, tv-watching, children, adolescents, risk factor, obesity and chronic diseases

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Introduction

Today, both adults and children and adolescents are characterized by kinetic restriction. Many words have been used to describe the lack of physical activity. The word "sedentary", widely used in literature to describe the inactive living population that does not participate in any physical activity, derived from the Latin word "sedentarius", meaning "the person who makes a sedentary life" (ACSM, 2000). Nevertheless, "inactivity" is a more appropriate term to describe the time spent in sedentary behaviours. Inactivity can be defined as a state in which bodily movement is minimal. In terms of energy expenditure, inactivity represents a state or behaviour for which energy expenditure approximates resting metabolic rate (Ainsworth et al. 1993). Physical inactivity or a sedentary state may include some muscular activity and consequent changes in metabolic, regulatory and other functions that are too small, short-lived or infrequent to give sufficient stimulus for the various organs to maintain their normal structures, functions and regulations. This means that physical inactivity is a different state for different organs. It is lack of sufficiently strong contractions of the muscle to stimulate its rebuilding, lack of sufficiently increased metabolism to stimulate its various regulations, lack of sufficiently strong dynamic forces on the bone to cause a momentary microscopic change in its structure, lack of sufficient amount of skill-requiring movements to maintain the motor control of the muscles and so on (Vuori, 2004).

The study of inactivity as a behaviour rather than an account of the energy spent in sedentary pursuits may offer a richer assessment of factors that contribute to obesity or other diseases (Ainsworth et al., 1993). The lack of movement in children and adolescents' lives is one of the primary predisposing factors of chronic diseases, except obesity, such as heart disease, diabetes etc. These diseases are most often irreversible due to the continuous sedentary lifestyle that has been adopted by children, either necessarily in the classrooms and coaching schools desks, or for comfort and commuting in the car, either for recreation during television viewing and computer game playing or talking in person or on the telephone with friends or during eating (Ainsworth et al., 1993; Koutsis et al., 2008). However, regarding children and adolescents, inactivity is necessarily only for the obligations derived from school and lessons.

For these reasons the present review examines the published studies on the effects of children and adolescents inactivity on health, an issue that has received far less attention, due to the fact that inactivity has generally been viewed indirectly as part of a continuum of activity and not separately. The literature data was primarily collected through computer and manual searches of primary sources (e.g., journal articles, theses). For the computer search, online data bases

of Pub Med, Google Scholar and Sport Discus were used to retrieve available English language publications, entire articles and abstracts, related to inactivity, using keywords such as inactivity, sedentary behaviours, lack of physical activity, tv-watching, childhood, adolescence, risk factor, obesity and chronic diseases. The results of this literature study described in the present review, consists of the following parts: Inactivity vs Activity, TV – Computer: the most common sedentary behaviours in children, Effects and Consequences of Inactivity in Children and Adolescents, Inactivity and Obesity, TV viewing and Obesity. Finally, a conclusion is presented and recommendations are provided for further investigation.

Inactivity vs Activity

Nowadays not only children exercise less, but have fewer daily small activities, such as walking, running, chasing after, etc. More children are choosing to sit in front of a computer or a television set instead of participating in some form of physical activity (CAHPERD, 1998). From WH0 (2005) stated that over 85% of the population worldwide is not exercised enough. Today increasingly sedentary lifestyles and society's continued quest for new technology (that will make our lives "easier") have significantly eroded traditional activity levels. Children today expend 400% less energy than did their counterparts of 40 years ago (Fishburne, & Harper-Tarr, 1992) and are 40% less active than they were 30 years ago (Belfry, 2001).

In Canada only 9% of boys and 3% of girls between the ages of 10 and 19 participate in sports (Fishburne, & Harper-Tarr, 1992). In Greece, 55.8% of children aged 16-17 years participate in some form of physical activity, while 44.8% abstains from any form of activity outside school (Behtsi, 2009). In Denmark boys and girls (aged 7-15) are active on average for 36 minutes per day. In England, 61% of boys and 42% of girls (aged 7-18) participated in at least moderate intensity physical activity for an hour a day, while in Finland, the corresponding percentages were 40% for boys and 27% for girls (aged 12-18). In Ireland 62% of boys and 45% of girls exercise four times per week, while similar percentages have been observed in the Netherlands, that is 61% of boys and 35% of girls practise sport three times a week or more (European Heart Network, 2001). Thus, it is obvious that the percentages of the children who are not active are, unfortunately, big enough.

Actually, as inactive or sedentary is considered the person whose physical activity comprises less than 30 minutes of moderate-intensity activity each day (Chakravarthy & Booth, 2003). However, it is considered that there is a biological basis for the desire to be somebody inactive, i.e. not wish to exercise, and that

physical inactivity is an initiating factor in the molecular mechanisms of disease (Booth et al., 2002).

It has been observed that physical activity decreases as maturation proceeds during childhood, mainly during adolescence, while declines are greater in females than in males (Armstrong et al., 1990; Sallis, 1993). In a study in the United States it was found out that prepubescent children spent approximately 30 min/d in activities at or above 60% of heart-rate reserve, while pubescent and post-pubescent children spent less than 10 min/d with heart rates at the same level (Janz et al., 1992). In a study in Ireland, the levels of exercise decrease with age, from 63% of 9 to 11-year-olds and 58% of 12 to 14-year-olds to 40% of 15 to 17-year-olds. In Denmark participation drops with age from 90% sport participation at age 12 to only 46% at age 17 (European Heart Network, 2001). In the elementary and high schools in the U.S., student participation in daily sports lessons fell from 42% in 1991 to 25% in 1995. More specifically, only 19% of all students are physically active for 20 minutes or more every day in school physical education classes over a school week (A Report of Surgeon General, 1996).

As for sex, girls were less likely to participate in physical activity than were boys. About 75% of girls and 50% of boys reported no vigorous activity in the previous 3-week period. During the high-school years, no significant changes occurred in the activity levels of boys, and no significant differences were observed across ethnic groups. However, vigorous activity levels decreased significantly by grade for girls in all ethnic groups (Heath et al., 1994). In Belgium among 12-year-olds, 6.3% of boys were doing activity less than one hour/week, compared to 16.5% of girls. Among 17-year-olds 15.2% of boys did less than one hour per week compared to 19% of girls (European Heart Network, 2001).

Regarding free time activities, in a study of Koutsis et al. (2008) became clear that in Greece about half the children do not participate in sports in their free time. As for the children who participate in sports activities, the activities in the greater proportion (80%) were either low or moderate intensity. In addition, Strauss et al. (2001) in a sample of 92 children aged 10-16, found out that children in the U.S. spend 75% of their free time without any physical activity, ie sedentary, with an average of 5.2 hours a day TV watching and computer playing. In contrast, only 1.4% of free time during a day (ie. 12.6 minutes) was spent in intense type physical activity. There was found, also, significantly low level of physical activity especially among girls. In particular, prepubertal girls spent about 35% more time in low and intense energy expenditure activities compared with teenage girls (Fishburne, & Harper-Tarr, 1992).

Thus, participation in physical activity declines with age, and males are more active than females. Children today are spending a great deal more time on computers and playing video games, while play habits have become more passive with new technology (Belfry, 2001). It could be said that children and adolescents' today activity level is very low and that they spend their free time, mainly, in sedentary behaviours.

TV – Computer: the most common sedentary behaviours in children

Inactive behaviours include television viewing, reading, working at a computer, talking with friends in person or on the telephone, driving a car or commuting, meditation or eating (Ainsworth et al., 1993). However, as for children the most common sedentary behaviours are tv viewing, and computer videogames playing.

In 1982, children aged 6 to 11 years watched tv an average of 24 hours per week (Nielsen, 1983). Later on Mares (1998) reported that the average child or adolescent watches an average of nearly three hours of tv per day, while the time spent watching videotapes or playing video games was not included. However, when the various media combined it was found that 2 - to 18-year-old children of a large nationally representative sample in U.S. spend to them an average of 5 hours and 29 minutes per day (Roberts et al., 1999).

Furthermore, almost one third of the 10-15-year-old children and adolescents studied in the National Longitudinal Survey of Youth watched more than 5 h tv daily (Gortmaker et al., 1996). Moreover, according to the data of Mavrovouniotis et al. (2008) the children were spent plenty of their free time with tv and computer/video games. More specifically, the boys spent with tv and computer/video games 2 hours and 31 minutes per day, while the girls spent significantly less time in comparison with the boys, that is 2 hours and 4 minutes. This time is, by far bigger than the time spent to free, creative and active playing with friends.

Effects and Consequences of Inactivity in Children and Adolescents

Scientific evidence shows that physical inactivity can lead to a host of chronic, degenerative conditions and premature death (Chakravarthy, & Booth, 2003; De Moura et al., 2011; Fishburne & Harper-Tarr, 1992; Hahn et al., 1990; Hamdy et al., 2001; Lakka & Laaksonen, 2007). Physical activity's lack in children and adolescents leads to increased morbidity, since many of the chronic diseases of adults are initiated in childhood (Bouziotas et al., 2004; Sallis, & Owen, 1997).

Statistics from USA suggest that the absence of vigorous or moderate physical activity is responsible for the death of 250,000 people per year (Bouchard et al., 2007), while is estimated to cause 1.9 million deaths worldwide (WHO, 2003). Epidemiological data have shown that inactivity and increased sedentary habits contribute directly to the occurrence of at least twenty of the most dangerous chronic health disorders (Bijnen et al., 1994; Booth et al., 2002; Flegal, & Troiano, 2000; Gerhardsson et al., 1986; Leon, 1997; Ogden et al., 1999). Moreover, inactivity is one of the most important risk factors of coronary heart disease, hypertension, or hyperlipidemia, since is well within the top 10 causes of death (Antonakoudis, & Antonakoudis, 2003).

As for children, it was found out that approximately 40% of children aged 5 - 8 years old present increased risk factors for heart disease, such as obesity, hypertension and high total cholesterol (Biddle, & Armstrong, 1992). It appears, indeed, that atheromatosis, and the destruction of arteries endothelium begins at the age of 7 years (Berenson, & Srnivasan, 2005). Reduced physical activity, certainly, favors the occurrence of coronary arteries atherosclerosis, and generally promotes atherothrombosis (Sharkey, & Gaskill, 2007).

Physical activity lack is linked directly proportional to the prevalence of obesity, which is a particular health problem in childhood. Overweight and inactivity often go hand in hand. Obesity in children and adolescents is evolving rapidly in a worldwide epidemic. According to the World Health Organization (2004), rates of childhood obesity have risen between 10% and 40% in most European countries during the last decade (Biddle, & Armstrong, 1992). Moreover the rate of increase of obesity was around 0.88% - 2.33% per year for boys and 0.5% -1.82% per year for the girls (Moreno et al., 2005).

Prospective studies in various age-groups have linked inactive behaviours with changes in body fatness, suggesting that low physical activity increased the risk of incident obesity, and that obesity may also contribute to low levels of physical activity (Ching et al., 1996; Williamson et al., 1993). Moreover, the inverse relationship observed between the energy spent on activity and the level of fatness in children indicates either that decreased energy expenditure precedes the development of obesity or accompanies it (Davies et al., 1995).

Activity and inactivity may have independent effects, at least on the prevalence of obesity. More specifically, inactivity may lead to increases in body fatness, whereas vigorous activity may enhance cardiovascular fitness and reduce cardiovascular disease, independent of the effects of vigorous activity on fatness (Dietz, 1996).

Among children and young adults, a similar relationship between activity and the risk of subsequent weight gain has been observed in Finland (Raitakari et al., 1994; Rissanen et al., 1991). In addition, inactivity may contribute to seasonal variations in fatness (Dietz, & Gortmaker, 1984) since it was found increased in the winter and decreased in the summer (Dannenberg et al., 1989).

Johnson et al. (2000) in a sample of 115 children, 72 white (55 girls and 17 boys) and 43 black (24 girls and 19 boys), found that initial fat mass was the main predictor of increasing adiposity. There was observed also a significant negative relationship between aerobic fitness and the rate of increasing adiposity. With every increase of 0.1 L/minute of fitness, there was a decrease of 0.081 kg fat per kg of lean mass gained (Johnson et al., 2000).

Both obesity and inactivity are modifiable risk factors of cardiovascular disease. Increasing participation in regular physical activity will consequently reduce the risk of this fatal disease. However, several modifiable risk factors for coronary heart disease such as obesity, increased blood lipid, hypertension and lack of exercise begin early in childhood. In fact, coronary heart disease typically develops slowly, as the risk factors increase and are combined (Leppo, 1993). Thus, four in ten Canadian children have at least one risk factor for heart disease due to an inactive lifestyle (CAHPERD, 1998). In addition the body mass index of Danish children aged 7–13 years proved to be a highly significant predictor of coronary events in adulthood (Ekelund et al., 2006).

In active subjects, the absorbed from the digestive tract fat is mostly oxidized in muscle with energy release, while in sedentary subjects adipose tissue takes the great preponderance of absorbed fat for storage. It can be seen that there is a close parallelism, between the responsible mechanisms for the control of the peripheral resistance, and the partitioning of absorbed fatty acids between oxidation and storage. This may explain the association of hypertension with obesity, since the activities of both nitric oxide synthase and lipoprotein lipase in skeletal muscle are similarly reduced by loss of functioning capillary endothelium during prolonged inactivity. In addition, the nowadays observed progressive, population - wide decline in habitual activity may be reflected in reduced capillary density and metabolic capacity of skeletal muscle in virtually all adults and children not engaged in specific programmes of physical training (Macnair, 2000).

Moreover, TV viewing, one of the most common sedentary habits, has been linked to metabolic-risk factors in youth. One popular theory is that TV viewing may affect obesity and other metabolic-risk factors by displacing PA. Instead of playing in the yard after school, the theory suggests, children laze about in front

of the TV (Ekelund et al., 2006). Hancox et al. (2004) found a linear increase of hours watching television, accompanied by high values of body mass index (BMI), low cardiorespiratory capacity and elevated cholesterol levels in children and adolescents 5-15 years old. In addition, a study in 2.547 children aged 5-17 years proved that children who watched television 2-5 hours daily, had five times the risk to become obese, two times the risk to have elevated cholesterol and three times the risk of high blood pressure (Ludwig, & Gortmaker, 2004).

In addition, Ekelund et al. (2006) in the European Youth Heart Study examined the nature, strength, and interactions between personal, environmental, and lifestyle influences on risk of metabolic diseases (e.g., diabetes) and cardiovascular diseases in later life. For this purpose the researchers questioned 1.921 boys and girls 9- to 10-y-old and 15- to 16-y-old from three regions in Portugal, Estonia and Denmark on the hours of TV viewed and measured their activity over a 4 day period. They also measured six metabolic-risk factors [body fatness, blood pressure, fasting triglycerides, inverted high-density lipoprotein (HDL) cholesterol, glucose, and insulin levels] and calculated a metabolic risk score for each child based on these risk factors. There was found a positive association between TV viewing and adiposity (fatness), but not with the overall risk score. However, the physical activity of the children was independently and inversely associated with systolic and diastolic blood pressure, fasting glucose, insulin, triglycerides and with the overall risk score, independently of obesity and other factors (Ekelund et al., 2006). Thus, preventive action against metabolic risk in children may need to target TV viewing and physical activity separately (Baker et al., 2006)

Significant relationships between inactivity and other adverse health practices, such as consumption of less-healthy foods or increased fat intake have been demonstrated in adolescents (Lytle et al., 1995) and adults (Simoes et al., 1995). Inactive individuals tended to consume increased quantities of dietary fat, even after adjustment for age, ethnicity, education, and BMI. Interestingly, fat intake also increased with cigarette smoking. In both adolescents (Escobedo et al., 1993; Lytle et al., 1995) and adults (Dannenberg et al., 1989) inactivity has also been associated with increased rates of cigarette smoking. Among adolescents, the covariance of these behaviours increases with age (Lytle et al., 1995). The demonstration that sedentary activity predicted the initiation of smoking and increased consumption of saturated fatty acids (Raitakari et al., 1994) suggests that the covariance of inactivity with other behaviours predispose to cardiovascular disease.

These data suggest that inactivity tends to interact with other health behaviours that have an adverse effect on the quantity and location of body

fat deposition. Whether the cluster of these behaviours reflects physiological, behavioural, or environmental effects remains unclear. One possibility is that for individuals who play sports regularly, smoking and alcohol use may have an immediate and recognizable impact on performance that serves to discourage these behaviours. No such adverse effects may occur among sedentary individuals. However, because inactivity is associated with increased body fat (Schulz, & Schoeller, 1994), and because both smoking (Troisi et al., 1991) and alcohol (Haffner et al., 1986; Troisi et al., 1991) increase visceral fat deposition, the net effects of the covariance of inactivity with other behaviours is to increase the risk of the morbidity and mortality of obesity.

In addition, inactivity leads to a decrease in fitness that occurs with a decrease in muscle strength, endurance, joint flexibility and diminished cardio-respiratory adequacy (Deligiannis, 1992; Mokdad et al., 2003). Children compared with those of the '60s, during their development, become overweight and obese, a fact that leads to a decrease in physical strength, and muscle strength and endurance (Biddle, & Armstrong, 1992). The biological damage as a result of inactivity is not only limited to loss of muscle tissue, but extended to all physiological functions such as: biochemical processes, morphological characteristics, biological abilities, and psychological traits resulting in shock of human health and disorder of psychosomatic balance (Corbin et al., 2001).

Regarding the lack or non-lack of physical activity, Dwyer, and Gibbons (1994), who examined students 7-15 years old in Australia, found a significant negative correlation between children's fitness and systolic blood pressure. Additionally, Sallis et al. (1988) observed significant negative correlations between fitness and blood pressure, as well as BMI. In agreement, Fraser et al. (1983), Harshfield et al., (1990), and Gutin et al. (1990), also, demonstrated significant negative correlations between fitness and blood pressure in children. These findings demonstrate that whatever applies to adults, also applies to children. That is, risk factors for coronary disease such as lipids, lipoproteins, blood pressure and obesity are related to the individual level of physical activity or otherwise of fitness (Epstein, & Wing, 1980; Haskell, 1984; Siscovick et al., 1985). Moreover, Hu et al. (2004) suggest that physical inactivity is an important lifestyle determinant of insulin resistance in hypertensive patients. Thus, the sedentary hypertensive patients found to be more insulin resistant than the non-sedentary hypertensive. In fact, the influences of smoking and alcohol intake on insulin resistance are less significant than physical inactivity in hypertensive subjects. Moreover, Koutsis et al. (2008) showed an upward trend in blood pressure, as the non-exercisers elementary students presented increased blood pressure (pre-hypertension and hypertension) at a rate of 29.8%.

In contrast, regular physical activity has been shown to contribute in reducing the risk of cardiovascular disease and mortality (Blair et al., 1989; Leon, 1997; U.S. Department of Health and Human Services, 1996). Indeed, "there is no pill" that holds as much promise for sustained health as a lifetime program of regular physical activity (Fishburne, & Harper-Tarr, 1992).

Inactivity and Obesity

Whether the relationship between inactivity and the development of obesity is a consequence of a reduced level of energy expenditure, or whether inactivity is a marker for other behaviours that lead to obesity remains unclear. However, obesity is a very important problem for children and adolescents, as big percentages of overweight or/and obesity have been found worldwide in these age groups, too.

Nevertheless, obesity does not occur alone, but the role of inactivity is very important. Thus, important potential contributors to the rise in childhood obesity are considered factors such as: a reduction in physical education classes and after-school athletic programs, an increase in the availability of sodas and snacks in public schools, the growth in the number of fast-food outlets, the increasing number of highly processed high-calorie and high-fat grocery products (The Henry, J. Kaiser Family Foundation, 2004). It could be said that these factors are all influenced by tv, computer games, as well as various media combined.

Researches have been shown a positive association between from one side the children's BMI and body mass and from the other side the time spent on TV watching and online games (Crespo et al., 2001; Dietz, & Gortmaker, 1985; Grund et al., 2001; Janssen et al., 2005; Proctor et al., 2003). Indeed, it is important the fact that tv watching replaces engaging in physical activities. Thus, it appeared that non-exercisers students watch TV significantly more hours daily, spend more time on video games, and of course, are more overweight and/or obese in relation to students who participate in sports activities (Koutsis et al., 2008; Malkogeorgos et al., 2010).

In addition, epidemiological study in South Carolina, USA, pointed out that obese children spent less time in moderate and vigorous physical activity than non-obese children (Trost et al., 2001). Besides, it is well known that many people reduce their physical activity and range of movements with increasing weight, because they don't want to attract attention due to their body size (Sharkey & Gaskill, 2007). Thus, it could be said that inactive daily behaviours are, mainly, responsible for obesity occurrence.

TV viewing and Obesity

The amount of time children and adolescents watch tv is not just some hours of the day, but unfortunately it has been shown consistently to be directly related to the prevalence of overweight (Andersen et al., 1998; Dietz, & Gortmaker, 1985; Durant et al., 1994; Gortmaker, et al., 1996; Grund, et al., 2001; Hernandez et al., 1999). Comparison of the relationship between television viewing and the prevalence of obesity in 12-17-year-old adolescents studied in 1967 (Dietz, & Gortmaker, 1984) with the relationship among 10-15-year-old children studied in 1990 (Gortmaker et al., 1996), suggests that the strength of the relationship has increased considerably.

A study in 137593 students aged 10-16 years from 34 countries showed that in countries where physical activity is low and in combination, the hours of TV watching are many, obesity appears increased (Janssen et al., 2005). This fact shows the linear correlation between childhood obesity, WC, HC, and WHR, with the hours of TV watching (American Academy of Pediatrics, 2001; Andersen et al., 1998; Mavrovouniotis et al., 2008; Ogden et al., 2002).

Epidemiological study in Canada on a sample of 7.217 children aged 7-11 years showed that TV watching and using computer games contributed to increasing the risk of becoming overweight from 17 to 44%, and the risk of obesity from 10 to 61% (Tremblay, & Wills, 2003). Moreover, Mavrovouniotis et al. (2008) found out that the children with central obesity spent significantly more time a day to tv and computer/video games than the children with normal abdominal fat quantity. In accordance, other researchers found significant associations between the amount of time children spent watching tv and the prevalence of obesity, indicating that tv watching is a risk factor for increase in body fat and is positively associated with obesity (Crespo et al., 2001; Dietz, & Gortmaker, 1985; Grund et al., 2001; Proctor et al., 2003). Estimating the attributable risk it is worth to be said that more than 60% of overweight incidence in children, 10- to 15-year-olds, can be linked to excess tv viewing time (Gortmaker et al., 1996).

The hours the children spend on tv viewing per day play a very important role to the development of obesity. It has been observed that as long as the hours of tv viewing are increased, so much the children's weight, BMI, WC, and HC are increased. Thus, the children who spent less than 2 hours per day on tv and computer/video games had significantly smaller weight, BMI, WC, and HC than those who spent 2-4 hours per day. In reverse those who spent more than 4 hours per day on tv and computer/video games had significantly bigger values on the measured variables in comparison with the other children (Mavrovouniotis

et al., 2008). In agreement, Andersen et al. (1998) who analyzed the 1988-1994 NHANES data, found that children 8- to 16-year-olds who watched many hours a day tv had more body fat and greater BMI than those who watched less than 2 hours. After adjustment for overweight at baseline, gender, poverty, and mother's ethnicity, education, marital status, and employment, the relative risk of overweight was 5.3 times greater for children 10-15-year-old who watched more than 5 h of television daily compared with those who watched 0-2 h (Gortmaker et al., 1996). Thus, watching tv more than 2 hours a day is related to overweight and obesity (Lowry et al., 2002). Furthermore, Dietz, and Gortmaker (1985) found that, among 12- to 17-year-olds, the prevalence of obesity increased by 2% for each additional hour of tv viewing.

Moreover, Hancox et al. (2004) analyzed prospective cohort data from New Zealand to assess whether the long-term effects of childhood television viewing on BMI is mediated by adult TV-viewing. Subjects were enrolled at age three years and followed through age 26 years. In this study it was found out that the average weeknight TV viewing between ages 5 to 15 years was associated with significantly higher BMI at age 26 years. Approximately 17% (95% CI 7 to 25) of overweight in 26-year olds could be attributed to watching TV for more than two hours per day. The authors concluded that increased television viewing during childhood and adulthood is significantly associated with increased risk of obesity among adults.

But how the media contribute to childhood obesity? Pediatricians, child development experts, and media researchers have theorized that media may contribute to childhood obesity in one or more of the following ways:

1. The time children spend using media displaces time they could spend in physical activities. Robinson et al. (1993) observed that the number of hours that girls of 6th- and 7th-grade spent watching tv after school was negatively associated with their level of physical activity. It could, also, be said that the time spent on tv is associated with being sedentary (Lowry et al., 2002). The excessive tv watching, as well as children's immobilization in front of the computer/video games, results to decreased activity, especially during the day, when the children are usually more active (Corbin et al., 2001).

2. The food advertisements children are exposed to on tv influence them to snack excessively while using media and to buy and eat more high-calorie and unhealthy foods. Kotz, and Story in their study (1994) documented approximately 11 food commercials per hour during children's Saturday morning television programming, estimating that the average child viewer

may be exposed to one food commercial every 5 minutes. So the tv viewing expose the children to foods with consistently low nutritional value, as fast foods, candy, soft drinks, and snack chips in 7 out of 10 commercial breaks (Brand, & Greenberg, 1994), and, of course, not to fruit or vegetables (Kunkel, & Gantz, 1992). Thus, the children aged 4 years, who watch TV 2.4 hours a day, consume 1600 calories a day, while those who watch TV 1.1 hours a day, consume 1486 calories a day. That is, the, more riveted to the TV, children will weigh 5-6 kg more in one year than those who watch TV less hours (Jordan, & Robinson, 2008).

3. Another possibility is that the act of watching tv and videos itself actually reduces children's metabolic rate even more than resting or sleeping, contributing to weight gain. Parents commonly report that television exerts a hypnotic effect on children, akin to a trance-like state, a state that might be associated with a lower metabolic rate (Klesges et al., 1993). However, Dietz et al. (1994) failed to demonstrate a significant difference in metabolic rate among pre-adolescent girls measured when they were reading, watching television, or sitting quietly in a chair doing nothing. As for video games, it could be said that they are commonly considered a prevalent form of inactivity. However, 02 consumption, while playing a video game, indicated that the level of energy expenditure was 80% greater than resting metabolic rate (Segal, & Dietz, 1991). In addition, the energy expended in other sedentary behaviours, such as working at a computer, has not been examined, but is probably similar (Dietz, 1996). However, future research is needed to fully understand the relationship of various media on children's weight status.

From the other side, reductions in tv and video viewing, as well as in computer/video games playing time appear to be effective strategies to treat and prevent overweight. Dietz, and Gortmaker (1993) noted that 29% of the cases of obesity could be prevented by reducing tv watching to 0-1 hour per week. In agreement, Hernandez et al. (1999) found that the risk of obesity in 712 children aged 9-16 years in Mexico, of which 24% were obese and watched tv 4.1±2.2 h/d, increased by 12% for each additional hour watching television per day, but declined by 10% for every hour of involvement with moderate-to-vigorous sport activities a day.

One school-based study demonstrated a 2% decrease in the prevalence of overweight over the course of two school years as a result of a curriculum that focused on reduced tv viewing time to 2 hours per day (Gortmaker et al., 1999). A second school-based study demonstrated significant reductions in BMI, triceps skinfold thickness, WC and WHR in children who reduced tv time, as a result

of a curriculum that focused on limited tv viewing time to 7 hours per week, as well as learning media literacy skills to teach selective viewing (Robinson, 1999).

In addition, a weight-control program (Epstein et al., 2000), in which families with obese children 8- to 12-year-olds were assigned to, indicated that significant decreases in percent of overweight and body fat were associated with decreasing sedentary behaviors such as watching tv or videos, or playing video or computer games. It is worth to be mentioning that decreasing sedentary behaviors such as screen media use is a viable alternative to increasing physical activity in treating childhood obesity.

Conclusion

Inactivity represents a behaviour that is associated with adverse health consequences which initiate even though from childhood and follow children and adolescents throughout their lives. However, because the most trials for lifestyle modification during adulthood are, usually, unsuccessful, or very difficult to be performed, inactivity prevention from the early childhood seems to be the more useful strategy for obesity and the other adverse health disorders control during both childhood and adulthood. Thus, the phenomenon of inactivity should be prevented from the early childhood that considered the most appropriate period for positive lifestyle adoption with respect to motor behaviour. In fact, successful reductions in inactivity or else increases in physical activity may provide the most cost-effective approach to the treatment of obesity, and the prevention of cardiovascular disease and other adverse health disorders in adulthood. Consequently, the states via school should provide to the children curriculums focused on the negative effects of inactivity and on the positive effects of participation in physical activity on children, as well as on adults lives. Besides, it is worth mentioning that children who have a positive perception and knowledge about the beneficial effects of physical activity are more likely to adopt a non-sedentary lifestyle, where the physical activity will be the key component in everyday life. In concluding, future research is needed in order to establish all the factors, behavioural, family, environmental, educational etc., that reinforce inactivity or else that account for the rapid declines in activity in childhood and adolescence, and propose ways so as to overcome the inactivity phenomenon.

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