Effect of obesity on children

Chapter One: Introduction

Overweight and obesity have turn out to be the most serious health problem in children, adolescents and adults. " O *verweight in children and adolescents was defined as ≥ 85 th percentile according to BMI-for-age growth sex-specific charts, whereas obesity ≥ 95 th percentile of the BMI-for-age growth, sex-specific charts* "(Ogden et al., 2010). In the United States and Canada, 30% of adolescents were obese or overweight while the percentage doubled in adult (Anis et al., 2010). Obesity in adolescents' population tripled in the last 30 years at both countries (Ogden et al., 2002). Several chronic conditions such as cardiovascular disease, diabetes, and cancers were observed in obese adults (Panel, 1998). Adipose tissue is composed of subcutaneous and visceral adipocytes (Chowdhury et al., 1994). Visceral fat accounts for 20% of total body fat in men compared to only 6% in premenstrual women (Krotkiewski et al., 1983). The etiology of visceral tissue disposition in humans is still indistinct (Samaras et al., 1999, Batra and Siegmund, 2012).

In the last decade, blood pressure increased among children and adolescents (Muntner et al., 2004). Furthermore, children with high BMI are more probable to have elevated blood pressure and lipid profile (Freedman et al., 2007). Additionally, premature mortality is attributed to elevated blood pressure by increasing the incidence of cardiovascular disease (Stamler et al., 1993, Vasan et al., 2001). On the other hand, treatment of childhood obesity initiates reduction in blood pressure among adults which leads to cardiovascular disease prevention(Freedman et al., 1999). In 2008, Khader and colleagues estimated that 28. 1% of north Jordanian adult men were obese. Whereas, in 2009 the obesity rate, as regards to studies conducted on children in north Jordan, was 18. 8% of the targeted population(Khader et al., 2008, Khader et al., 2009). Comparing those studies, there is domination of obesity among adults rather than adolescents which leads to a prediction of escalating the obesity problem by age in north Jordan. This study aims to estimate abdominal and total fat among Jordanian adolescents and its relation to blood pressure. Many studies have shown that blood pressure is associated with being overweight in children and adolescents of Western countries (Genovesi et al., 2005, Ebbeling et al., 2002). Therefore, the aim of this study aims to estimate abdominal and total fat among Jordanian adolescents and its relation to blood pressure.

Chapter Two: Literature Review.

High body mass index is usually associated with elevated blood pressure (Cercato et al., 2004). Relation of trunk, waist circumferences and visceral fat with blood pressure were considered predictor indicators in children and adolescents for cardiovascular mortality (Welborn and Dhaliwal, 2007). The prevalence of hypertension among adolescents population has not been acknowledged as in adults. Adolescents with elevated blood pressure (BP) can develop several chronic diseases and body organ damage also they will increase risk of cardiovascular disease in adulthood. Therefore, prevention of obesity will help to limit the disease burden due to hypertension (Lande et al., 2006, Must et al., 1992).

In several studies conducted in Western countries, prevalence of high blood pressure among children ranged from 7 to 19% (Sorof et al., 2004, Paradis et al., 2004). However, few studies have been conducted in adolescence at developing countries (Mehdad et al., 2013, Abdulle et al., 2014, Abolfotouh et al., 2011).

Fat accumulation especially in abdominal region:

More than one third of obese children remained obese at adulthood (Serdula et al., 1993). A study showed that 77% of obese adults was related to overweight in childhood (Freedman et al., 2001). Another longitudinal study pointed that only1. 6% of adolescents’ in the transition to young adulthood shifted from obese to non-obese, while 9. 4% remained obese (Gordon-Larsen et al., 2004). Presence of abdominal fat was observed among non-obese children (Goran et al., 1995) and adolescents (Fox et al., 1993, De Ridder et al., 1992).

In the topic of obesity, especially the android type of obesity , an observation of high mortality rate was recorded among the Danish population in a study with 27178 men and 29875 women. Mortality rate was 10% higher among 136 men than 130 women who were having increased waist circumferences. A similar observation was detected among smokers, overweight or obese participants (Bigaard et al., 2005). A study was in Morocco on 167 adolescents aged from 11- 17 years (123 girls and 44 boys) were, 42% overweight and/ or obese in addition to 58% were at normal weight. Significant relation between BMI and each of fat mass percent body fat in both genders. Waist circumferences could be predictor tool for fatness among adolescents (Neovius et al., 2004, Wang et al., 2007). In Kuwait, a study on adolescents 4, 219 participants aged from 11 to 19, Boys who had waist circumference ≥ 90th percentile account 8- 30. 3%, mean of waist circumference was higher in boys than it was in Kuwaiti girls. Also, increase in percentage of boys who had ≥ 90th percentile observed in boys unlike girls (Jackson et al., 2010). Peeters and colleagues (2003) detected a remarkable decrease in life expectancy by 7. 1 and 5. 7 years in nonsmoking males and females respectively at 40 years old. While, a lower life expectancy of 13. 3-13. 7 years identified in obese smoking females and males respectively (Peeters et al., 2003). Relation between smoking among adolescents and excessive fat in abdominal region young adults (men and women) has been investigated (Saarni et al., 2009). Intra-abdominal fat increases cardiovascular risks such as hypertension and dyslipidemia. Cardiovascular disease risks rise when accompanied with smoking which leads to modifications in the physiological functions of adipokines, endothelial, insulin and proatherogenic status (Ritchie and Connell, 2007). Other studies confirmed the association between abdominal obesity and smoking. Both abdominal fat and smoking were attributed to the same risk factors, which were unhealthy dietary behavior (Wingard et al., 1982, Keski-Rahkonen et al., 2003), low education (Pierce, 1989, Green et al., 2007) and low physical inactivity (Aarnio et al., 2002, Escobedo et al., 1993), the etiology of this causal link remained unclear. The reason could be related to the change in glucocorticoid metabolism and psychosocial stress that has been caused mainly by smoking (Cohen et al., 2006, Lahiri et al., 2007, Rohleder and Kirschbaum, 2006) may be in charge with abdominal fat (Björntorp and Rosmond, 2000, Björntorp, 2001).

Visceral tissue were more sensitive to lipolytic stimuli than other fatty tissue make fatty acid from triglycerides turnover increased in blood stream by portal vein, this led to, increasing hepatic fatty acid release make liver exposing to fatty acid also increased hepatic gluconeogenesis and secretion of LDLs moreover to inhibit hepatic role of insulin riddance to develop hyperinsulinemia and insulin resistance (Björntorp, 1992).

Studies showed that ischemic heart disease, independent lipid level changes (Després et al., 1996) and metabolic abnormalities were associated to patients with fasting hyperinsulinemia (Haffner et al., 1992). A hypothesis studied by Randle suggested a reduction in insulin resistance and glucose uptake because of reduce the need for glucose oxidation when fat oxidation increased (Randle et al., 1963).

Dietary effects on visceral fat, a study on white non-obese men, explains visceral and subcutaneous fat and dietary effect. Fat intake explained only 1. 4% of the variance in subcutaneous fat and no variance in visceral fat. On the other hand, 2% of the variance appear in total adiposity, which make dietary factors have a minor role in total adiposity and with no effect on visceral fat (Larson et al., 1996). In Bogalusa Heart Study, children and adolescents aged from 6-18 years demonstrate that high fat in truncal region associated with elevated LDL and VLDL cholesterol concentrations (Freedman, 1995). Total and visceral fat were inversely affected by dietary fibers intake; that effect was significantly observed among adolescent boys without a significant effect on girls in sample aged 14-18 years old in total participants of 559. Moreover, it linked between dietary fiber intake and inflammation markers include adiponectin and C-reactive protein (Parikh et al., 2012).

Aerobic exercise among adolescents for 8 weeks had significant effect on decreasing total fat 700 g by (0. 6 %); the majority of the lost fat was observed in abdominal region, but, no significant changes were noticed in subcutaneous fat to alteration in body compositions (Watts et al., 2004).

Risk for elevated blood pressure and it’s relation to total and abdominal fat:

Hypertension raised atherosclerotic cardiovascular disease outcomes by 2 to 3 folds. Moreover, Hypertension is the most influential accompaniment with cardiovascular disease that leads to death in a prospective longitudinal analysis (Kannel, 1996).

In Bogalusa Heart Study, prevalence of adult patients with hypertension who were diagnosed clinically, they were significantly higher in those who had elevated blood pressure at childhood (Bao et al., 1995). In young boys, an increase in blood pressure from pubescence to 18 years was observed (Cornoni-Huntley et al., 1979). Relation between blood pressure and fat distribution had a marked variance upon sexual difference among adolescents. Boys had an elevated blood pressure associated to adiposity that was enhanced by visceral and peripheral fat, unlike girls where blood pressure was affected by peripheral adiposity but no significant effect by visceral adiposity (Pausova et al., 2012). Low averages at cognitive test scores were observed among 5077 children and adolescents from 6 to 16 years when systolic blood pressure were ≥90th percentile and diastolic ≥ 90th percentile (Lande et al., 2003). In adolescents, 9-17years old, cardiovascular risk factors associated with fat accumulation areas, which was analyzed by Dual-energy X-ray absorptiometry (DEXA) (Daniels et al., 1999). Android type of obesity and cardiovascular disease risk factors as blood pressure produced a powerful relation among African-American and Caucasian children (He et al., 2002). Abdominal fat distribution that was measured by DEXA and skinfold- thikness among 920 healthy children and adolescents (American, Asian, and Caucasian aged from 5 to 18 years) was predictor for blood pressure in boys but not in girls (He et al., 2002). Systolic and diastolic blood pressure relation to total fat and fat distribution by using DEXA on 127 adolescents aged from 9-17 years, systolic blood pressure have significant relation to total body fat and fat distribution but diastolic blood pressure was significant with total body fat but was not with fat distribution (Daniels et al., 1999).

Evidence approved that truncal fat was associated to high cardiovascular risks such as hypertension compared with peripheral fat (Kannel et al., 1991, Sardinha et al., 2000). Adolescents with left ventricular hypertrophy were associated with high rate of essential hypertension; those who developed severe hypertrophy and abnormal left ventricular geometry were in high degree of the risk to cardiovascular disease and increase in morbidity rate (Daniels, 1999).

Abdominal fat could be estimated by using waist circumferences as a better indicator for abdominal fat rather than waist to hip ratio among children and adolescent because waist to hip ratio reflected changes in fat amount less than bones and muscular changes when children and adolescent were growing (Kissebah and Krakower, 1994). Waist circumference had relevance to blood pressure adolescents of both sexes and showed, by a study applied on multivariate models instead of visceral fat, no association between blood pressure and visceral fat, which made waist circumference an inappropriate tool to evaluate visceral fat in adolescents (Pausova et al., 2012). Adults, who deposited fat viscerally, rather than elsewhere in the body, were at a higher risk for hypertension (Hayashi et al., 2003, Fox et al., 2007). This relationship was shown to be stronger in men than in women (Fox et al., 2007).

Insulin absence, resistance and hyperinsulinemia were associated to obesity chiefly in abdominal region. insulin was responsible to elevated blood pressure due to obesity. One of the mechanisms to protect body from gaining weight, hypothesized by Landsberg, was activating the sympathetic nervous system when consuming high calories which lead to increasing thermogenesis (LANDSBERG, 1986). Mikhail and Tuck. 2000 observed an alteration in artery structure include thickness and artery flexibility in hemodynamic effects of insulin. Abdominal obesity related to increased plasma renin activity is the possible key to blood pressure elevation (Licata et al., 1994). Strong evidence showed that management of hypertension was related to obesity by block renin-angiotensin system (RAS), which was active in obese subjects (Sharma, 2004). In mice, adipocyte differentiation and growth effect by adipocyte-derived angiotensinogen which secreted into the bloodstream, redounding blood pool of angiotensinogen (Massiéra et al., 2001).

It was recently found that mice have greater angiotensinogen gene expression in visceral fat at variance with other fat tissue when it was on high fat diet to induce obesity (Rahmouni et al., 2004). Patients who accumulated fat, especially visceral fat, were associated with elevated plasma aldosterone (Goodfriend and Calhoun, 2004). Elevated blood pressure could be induced by aldosterone by effect on mineralocorticoid receptors situated on tissue as in brain, kidney and vasculature to make Aldosterone have a significant relation on obesity-hypertension (Rahmouni et al., 2005). Aldosterone relation to obesity-hypertension, explained by De Paula, showed blocking mineralocorticoid receptors with the specific antagonist eplerenone. A remarkable blood pressure increase was inhibited without development of weight on dogs even on the high fat fed ones (de Paula et al., 2004).

Vasculature health preservation depended on endothelium status when nitric oxide was released which was characterized by antiatherogenic properties (Vita and Keaney, 2002). Exercise was one of interventions that could be applied to improve nitric oxide dilator function (Maiorana et al., 2000, Maiorana et al., 2001), considering cardio-protective factors. Normalizing in vascular function and alteration in body compositions by increasing muscular strength were results for exercise training to minimize cardiovascular disease in future. Detection and treatment of endothelial dysfunction for 19 obese subjects aged 14. 3 ± 1. 5 in early stages were known as primary strategy role to prevent to prevent adolescents who were susceptible from developing cardiovascular disease in adulthood (Watts et al., 2004).