Literature Review on Studying the Independent Association of Liver and Visceral Fat to Cardio Metabolic risk (CMR) among selected overweight and obese Type II Diabetic Indian patients

Cardio metabolic risk

Visceral/abdominal obesity along with elevated blood pressure, elevated plasma glucose, a low High Density Lipid (HDL) and elevated triglyceride levels are all contributory to cardio metabolic risk, otherwise known as insulin resistance syndrome or metabolic syndrome(Pereira, 2009). There has been reported many risk factors that are associated with cardio metabolic risk, such as physical inactivity, abdominal fat and Type II Diabetes Mellitus, besides which several ethnic and genetic factors have also known to come into play (Pereira, 2009)(Nazare, 2012). In sub-Saharan Africans, or individuals of African descent it has been found that though they have lesser visceral fat than Caucasian individuals, the correlation of Type II Diabetes Mellitus, abdominal fat and cardio metabolic risk as a result remain high. Several studies have in fact shown that the general measures of visceral fat are lower in Sub-Saharan Africans. A study conducted between Haitians of African descent and whites in Canada and a study in the European population both showed that individuals of the African descent exhibited lesser visceral fat than their counterparts. However, insulin resistivity was seen to be higher in the individuals of African descent as compared to the Caucasians(Sossa, Delisle, Agueh, Makoutodé, & Fayomi, 2012). In the sub-set of Indian population, though, the incidences of Type II Diabetes Mellitus is quite high along with secondary cardiovascular disease, thereby increasing the incidence rates of metabolic syndrome. The interesting area however lays in that the factors such as waist circumference and onset of diabetes. Even though, the waist circumference is reported to be lowest in the world, the incidence of metabolic syndrome is reported to be very high. The onset of diabetes and other cardiac health related factors appear at least a decade earlier in the south Asian population as opposed the rest of the world(Paper, 2007).

Overview of the risk factors associated with metabolic syndrome

Cardio metabolic risk (CMR), described by Reaven as Syndrome X in 1988, was defined by the collective effects of elevated plasma glucose, and triglycerides along with elevated visceral fat all contributory to increased rates of CMR the world over. The incidences of CMR seem to be fast increasing and also have been adding costs to the healthcare systems

worldwide due to its prevalence. There then emerges a need to understand in depth the workings of cardio metabolic risk(Pereira., 2009).

Below is discussed the associations of cardio metabolic risk with its contributory factors:

- CMR and obesity: obesity, especially of the visceral type more than any other has been found to be one the biggest precursors for elevated plasma glucose/Diabetes mellitus. The visceral fat or abdominal fat that is contributory to obesity goes hand in hand with Type II Diabetes Mellitus. It has been found that 4 out 5 people freshly diagnosed with Type II Diabetes mellitus are obese. The risk for getting diabetes as a result if obesity has been increasing. It is said that there is a 10-fold increase in the chance of getting diabetes in the severely obese than others. Besides this, the prevalence of diabetes is 2.9 times higher in the obese for both men and women(Sharma & Jain, 2009). This abdominal obesity in itself is a contributory factor to cardio metabolic risk, which may be measured by using the Body Mass Index (BMI). In South Asia, which encompasses the Indian sub-continent as a whole, the prevalence of CMR has been found to be more in women with a 50-75% difference. In India alone, prevalence amongst men is 29% whereas a whopping 46% in women. In comparison to the UK, the prevalence is 41% higher in men and 140% higher in women(Paper, 2007)(Pereira, 2009).
- CMR and physical inactivity: Physical activity has been known to reduce elevated levels of triglycerides and plasma glucose levels. The lack thereof, in turn increases the incidence of cardio metabolic risk. Exercise has also shown an increase in insulin sensitivity(Pereira, 2009). Lifestyle modifications such as inclusion of even a low grade form of exercise can go a long way in the prevention of CMR (Paper, 2007)
- CMR and diet control: Dietary control, patterns and habits play a very important role in developing cardio vascular risk. The lifestyle today is ever evolving in terms of food and evolving to suit our fast paced lives. This results in a poor quality food intake cycle with nil physical activity that defines our lifestyle, thereby increasing the chances of cardio metabolic risk. Foods rich in saturated fats and trans fats have

- been shown to increase insulin resistivity, whereas if such fats are replaced with monosaturated, polysaturated and unsaturated fats promote insulin sensitivity(Pereira, 2009). In the Indian subset, it has been found that HDL is relatively lesser with increased total cholesterol levels. A goal of <70mg/dl of Low Density Lipid (LDL) and <100mg/dl of total cholesterol (excluding HDL) has been recommended for patients with CAD/Type II diabetes Mellitus, by the American Association of Physicians of Indian origin. This goal has been set to curb the rising incidence of cardio metabolic risk in the Indian population(Paper, 2007). Furthermore, an intake of fresh fruits, simple carbohydrates, grains and pulses have been shown to increase insulin sensitivity that lowers plasma glucose level, thereby reducing the chance of a cardio metabolic risk. Although, dietary control is highly recommended, it is important to note that low fat diets have the converse effects and decreases the HDL while increasing the triglycerides(Paper, 2007)(Pereira, 2009).

Tools used to determine fat measures among overweight and obese subjects with Type II Diabetes Mellitus

Typically fat measures especially around the abdomen may be done with the use of Body Mass Index (BMI), Waist Circumference (WC) and Waist Hip Ratio (WHR) otherwise known as anthropometric measures(Hassan Lotfi, 2014).

Biochemical markers like, High Density Lipids (HDL), Triglycerides (TY), plasma glucose, and insulin are used(Nazare, 2012). Another interesting measure is the use of post prandial glucose measurements in which the levels for both glucose as well as triglycerides may be elevated which is indicative of the higher chance of cardio metabolic risk in Type II Diabetes Mellitus patients(Tushuizen, Diamant, & Heine, 2005).

Non-invasive measures may be used as a tool for determination and these include, CT scanned images of Visceral Adipose Tissue (VAT), Superficial Subcutaneous Adipose Tissue (SSAT), Deep Subcutaneous Adipose Tissue (DSAT) and liver fat. A CT scan may also be taken of T12-L1(Nazare et al., 2012).

Finally, the cut offs of the various measures are to be taken into consideration to find the correlation in itself(Dobbelsteyn, Joffres, MacLean, & Flowerdew, 2001).

Below is discussed all the tools that may be used for determination of fat measures:

1. Anthropometric measures: These measures may be used to determine the amount of fat present specific to one area such as the abdomen by employing measurements such as the BMI, WC and WHR. They are used in lieu of or as proxies to such measures as visceral adipose tissue etc. Anthropometry may be used as tools to also determine body mass, its distribution, concentration and effects on the above on health in general. Besides the standard measures such as BMI etc., a relatively new anthropometric measure known as the Body Adipose Index (BAI) has been introduced. This employs the use of the Hip Circumference (HC) as opposed to the WC and height. Although, it is being used there has been no comparison with the standard measures as yet(Barreira, 2012). Of the above mentioned measures, none has so far been claimed as the gold standard; however, the use of WC has been deemed a more accurate measure to determine the correlation between abdominal obesity and cardio metabolic risk(Dobbelsteyn, 2001). Some studies have also indicated that all three in conjunction can indicate more accurately(Hassan Lotfi, 2014). A value of 95 cm of WC in both men and women and a WHR of 0.94 and 0.88 for men and women respectively have been accepted as standard. Hence, if the values exceed the said limit, then the subject is deemed at a cardio metabolic risk and is advised management (Dobbelsteyn, 2001). Some studies have also shown that the use of the anthropometric parameters in conjunction with other measures have the most efficiency in determining cardio metabolic risk(Després, 2006). In the Asian population however, the standard cut offs have been deemed unusable as the body types and other physical measurements differ vastly from the Caucasian or African type and hence a revised consensus has been reached with regard to these values(Misra et al., 2009).

A study conducted in Iran(Hassan Lotfi, 2014), has demonstrated that these anthropometric tools are effective of which the WC parameter gave the most accurate association to cardio metabolic risk and that it may be used exclusively in further studies. Another study(Roopakala et al., 2009) proved the same WC as an adequate predictor for cardio metabolic risk., while (Anjana., 2004) showed that WC in conjunction with SAD marker is an effective parameter for determination of the fat measure.

2. Biochemical markers: The use of blood and plasma as a form of determining cardio metabolic risk has been deemed the best method thus far. This employs the measures of plasma glucose, insulin, triglycerides, HDL, Total Cholesterol etc. (Upadhyay, 2015). Besides this, C-reactive protein and inflammatory markers may be used for cardio metabolic risk determination in women(Ridker, Hennekens, Buring, & Rifai, 2000). The above studies have demonstrated that the use if the biochemical markers are a very effective tool.

3. Non- Invasive techniques: Besides the usual techniques such as MRI, CT scans etc. (Nazare et al., 2012), Dual Energy Absorptiometry (DXA) for determining abdominal fat is being used. The drawback with this method is that it cannot differentiate visceral and subcutaneous fat but can give an appropriate determination on Cardio metabolic risk. The advantage however remains that it is a non-invasive technique, simple procedure with no radiation(Kaul et al., 2012).

4. Cut off ranges for the major tools: Receiver Operating Characteristic (ROC), is the curve that compares the anthropometric measures and gives the said cut offs for both men and women(Dobbelsteyn et al., 2001).

   The recommended cut offs for the various parameters are as below:
   BMI- Normal 18.5-24.9 kg/m^2
   Overweight- 25-29.9 kg/m^2
   Obese - >30 kg/m^2

For WC the recommended is currently under review due to the heterogeneity of the population. However for all the above said, the study (Misra et al., 2009)a consensus statement was much required to conquer to some extent this heterogeneity.

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