Metabolic Syndrome Literature Review

Contents

Literature review

Introduction

Metabolic syndrome (MetS) can be defined as the assemblage of conditions including high blood pressure, excessive body fat around the waistline, abnormal triglyceride or cholesterol and increased sugar level. This chapter has provided an overview of past literature regarding the risk factors which have promoted metabolic syndrome (MetS) among various health service users. This has been supported with relevant graphs, figures and cases in this chapter.

Prevalence of Metabolic Syndrome in Worldwide

As per the IDF reports, a quarter of the total world population is suffering from metabolic syndrome. In accordance with the study conducted by Grundy e al., almost in every country approximately, 20 to 30% of the grown-up population is suffering from the diseased condition. Further, as per various studies, the prevalence of diseased people is directly proportional to innumerable factors including age, gender, race and ethnicity. In 2000, around 30% of the United State adults had MetS and currently, it has risen to 35%. Berges et al. in 2011 had conducted a study with an aim to find out the prevalence of MetS in accordance to new World Health Organization recommendations. They had performed the cross-sectional study and selected the people aged 25 to 79 years old from Badajoz's health centre. Data were collected from the patients as per their history

of blood pressure, waist circumference and cardiovascular risk. The authors have concluded that Mets was significantly high (33%) in the male with age group of 50-55years (Ofori-Asenso et al., 2017).

Asenso et al had stated in 2017 that MetS is significantly prevalent in African countries and recurrent in urban dwellers and women. Ghanaians people are experiencing rapid transition such as nutrition and lifestyle changes due to urbanization and globalization which resultant into MetS. In accord with IDF criteria, 13 to 35% of the people are suffering from MetS. Moreover, as per the WHO, the prevalence rate is approximately 16%.

Risk Factors of Metabolic Syndrome

The strategic sign of MetS is central obesity, which is characterized by the accumulation of adipose tissue around the trunk and waist, increasing fat or adipose tissue resultant of insulin resistance condition. As already discussed that other signs are increased blood pressure, prediabetic condition, insulin resistance, impaired level of fasting glucose, increased triglyceride levels and decreased the level of serum HDL. The pathophysiology of the condition is complex. Further, it has been documented that most of the patients are obese, older and sedentary. Moreover, stress can be one of the contributing factors. Other important risk factors are diet, aging, little physical activity, and disturbed sleep pattern (Ranasinghe et al. 2017; de la Iglesia et al. 2016).

Low physical activity is the conjecturer of cardio-vascular disorder events and can be associated with high mortality. It can lead to increased fat tissue, decreased HDL cholesterol levels, increased glucose, triglyceride and blood pressure. Further,

increasing age can be the risk factor associated with MetS. The age reliance on the prevalence of MetS is seen in maximum population across the world. MetS quantify the risk of development of Diabetes mellitus (type II) (Wang *et al.* 2015). In an individual with compromised glucose tolerance, the presence of MetS increases the danger of developing diabetes mellitus (type2). Moreover, it has been documented that MetS also affect 50% of the people who have coronary artery disease with 37% prevalence rate amongst women (O'neill & O'driscoll, 2015; Bonomini, Rodella & Rezzani,2015).

The pathophysiology of MetS is a complex process. It has been documented that central obesity can lead to upsurge plasma TNF-alpha levels, moreover, increase the level of other substances such as adiponectin, PAI-1 and resistin. On the other hand, TNF-alpha activates cell signaling through TNF-alpha receptors that can cause insulin resistance. Moreover, an increase in fat tissue also upturns the immune cells number and contributes to the development of diabetes, atherosclerosis and hypertension. A pro-inflammatory state is characterized by increased levels of C- reactive protein. This stage is commonly associated with MetS because adipose cells produce inflammatory cytokines.It has been acknowledged that increased blood pressure associated with glucose intolerance and obesity, further, commonly associated with insulin –resistance individual. The MetScan be prompted by overeating with fructose or sugar along with high-fat food. This results in oversupplying of arachidonic acid and resultant in MetS (Scuteri et al., 2015).

	All participants	Women			Men		
		MS subjects (n = 3199)	Non-MS subjects (n = 10306)	p values	MS subjects (n = 1223)	Non-MS subjects (n = 5774)	p values
Age at interview (years, mean ± SD**)	54.2±0.1	57.4±0.2	51.9±0.1	<0.001	57.3±0.3	55.8±0.2	<0.001
Weight (kg, mean ± SD)	60.2±0.1	65.5±0.2	55.9±0.1	<0.001	74.9±0.3	62.0±0.1	<0.001
BMI (kg/m^2, mean ± SD)	23.7±0.0	26.8±0.1	23.0±0.0	<0.001	26.8±0.1	22.5±0.0	<0.001
Red meat (g/day, mean ± SD)	30.0±0.6	26.9±1.9	26.4±1.1	0.500	35.6±1.2	33.2±0.6	0.067
White meat (g/day, mean ± SD)	16.3±0.2	17.0±0.5	17.0±0.3	0.913	22.5±0.8	20.5±0.4	0.024
Fish (g/day, median ± IQR†)	22.1±34.1	20.4±26.6	20.4±30.6	<0.001	22.1±34.1	22.1±34.1	0.265
Vegetables (g/day, median ± IQR)	225.0±187.5	225.0±187.5	225.0±225.0	0.083	300.0±187.5	267.9±187.5	0.147
Fruits (g/day, median ± IQR)	17.5±41.5	13.7±43.6	17.5±41.5	<0.001	21.0±41.3	17.5±41.5	0.047
Soy food (g/day, mean ± SD)	62.5±0.8	57.6±2.1	62.8±1.2	0.032	69.9±3.3	63.2±1.5	0.064
Education (%)							
Primary school/under	59.7	64.6	63.7		40.8	54.2	
Middle school	27.9	25.6	26.7		35.7	29.5	
High school/above	12.4	9.8	9.6	0.969	23.5	16.3	<0.001
Marital status (%)							
Yes	90.0	90.8	90.1		92.8	89.3	
No‡	10.0	9.2	9.9	0.808	7.2	10.8	0.002
Income per person (%)							
≤500 Yuan	64.3	65.2	65.5		57.6	63.6	
501–1000 Yuan	29.1	28.5	29.2		30.4	28.7	
≥1001 Yuan	6.6	6.3	5.3	0.042	12.1	7.5	<0.001
Farmer (%)							
Yes	64.9	69.4	69.6		46.1	59.3	
No	35.1	30.7	30.4	0.413	53.9	40.7	<0.001
Ever smoker (%)							
Yes	18.8	3.6	4.0		45.8	46.1	
No	81.2	96.4	96.0	0.168	54.1	51.9	0.125
Tea consumption (%)							
Yes	15.2	12.7	9.7		36.7	21.4	
No	84.8	87.3	90.3	<0.001	63.4	78.6	<0.001
Alcohol consumption (%)							
Yes	25.6	9.2	12.0		52.6	53.9	
No	74.4	90.8	88.0	< 0.001	47.4	46.1	0.223

* Means or median, percentages, and their p values were adjusted for age at interview.

** SD: standard deviation.

† IQR: inter-quartile range (25-75th percentiles).

‡ Including widowed, divorced/separated, and single.

Table 1: Prevalence of Metabolic Syndrome in case of Rural China

(Source: As derived from Xiao *et al.* 2016, p.e0147062)

This has been supported by the research of Xiao *et al.* (2016) where it was revealed that the sedentary lifestyle of people has been a major risk factor of metabolic syndrome in case of rural China. As understood from the data given in the above table, it was

revealed that the sedentary lifestyle resulted in a risk of Metabolic Syndrome (MetS) by 21.6%. However, the very researchers argued that the risk of metabolic syndrome was higher in women as compared to males in the rural society. This had been found mainly due to lack of physical activity, proper nutrition and intake of fruits and vegetables among the women.

According to Micucci, Valli, Matacchione & Catalano (2016: 38963), presence of **hyperglycemia** puts an individual at a major risk of metabolic syndrome. This is mainly developed due to resistance to insulin in the body cells of the individual. The body of a normal human being produces insulin from the beta cells of the *Islet of Langerhans*, in the pancreas. This helps in glycogen synthesis and maintenance of glucose levels in the blood of the individual. However, in case of people with hyperglycemia, there is an increased level of circulating glucose level in the blood. This hyperglycemia often results due to resistance to insulin which further risks the individual to have metabolic syndrome. This presence of metabolic syndrome could be detrimental to the health of the individual leading to formation of tumors in the body.

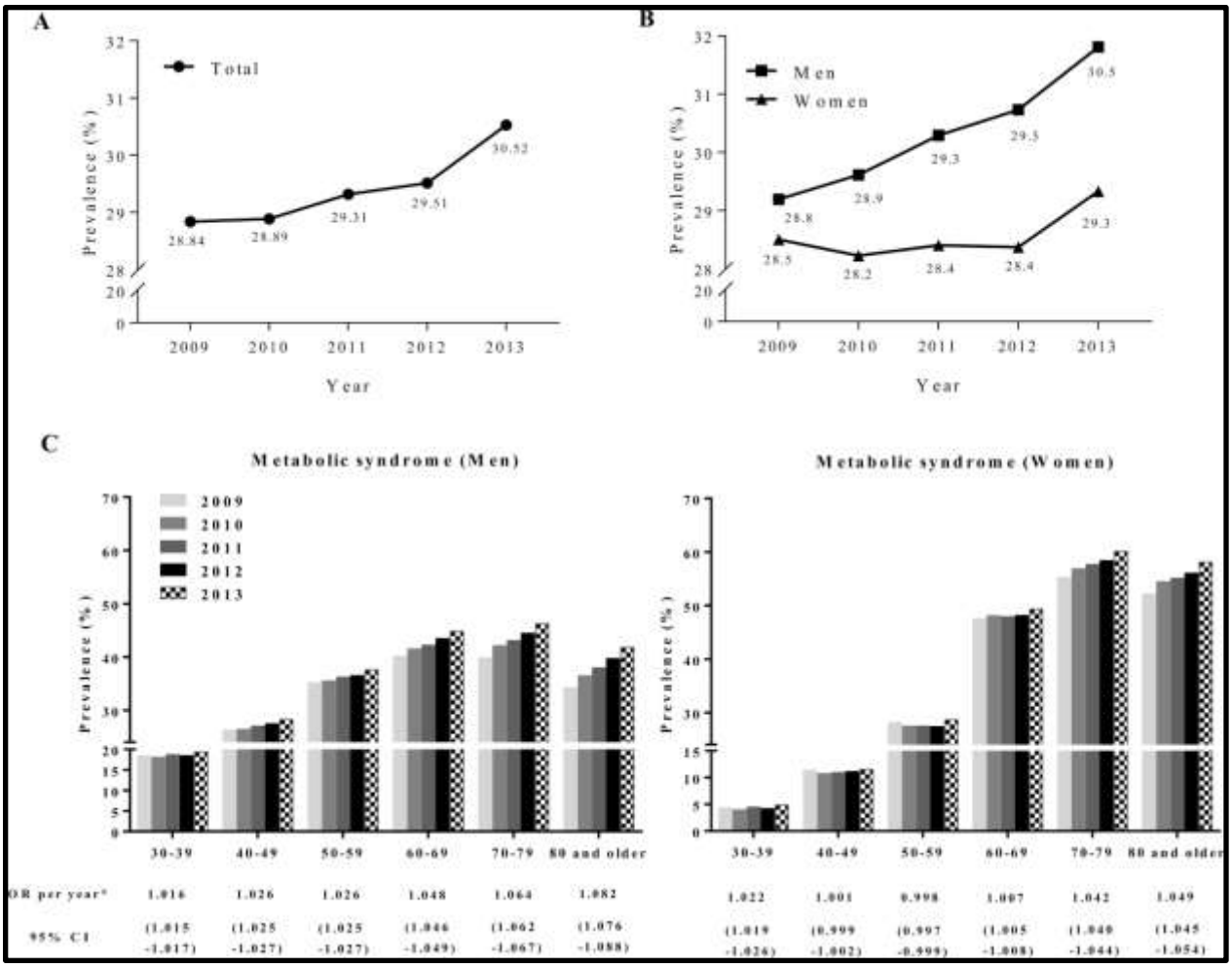

Figure 1: Trends in Metabolic Syndrome among Men and Women with diabetes type 2 in South Korea

(Source: As derived from Lee, Han, Kang, Kim, Cho, Ko ... & Koh, 2018, p. e0194490)

However, Lee *et al*. (2018: e0194490) argued that **type 2 diabetes** is the reason behind rise in trends of metabolic Syndrome. The researchers had conducted their study on the population of South Korea, whereby it was noted that, women were at more risk of metabolic syndrome as compared to men suffering from type 2 Diabetes. This has been supported by results in figure 1, whereby researchers conducted research on hyperglycemic diabetic patients.

Chen, Lee, Chien, Su, Lin, Cheng ... & Yeh (2018: 9) argued that it was the presence of hyperglycemia and **dyslipidemia** which posed a risk to metabolic syndrome in people. The researchers supported their research by putting forward the case of elderly patient in Taiwan, whereby evidence-based diagnosis and treatment was used to bring in lifestyle changes to enable the patient's body to bring in changes in blood lipid levels, thereby reducing the risk of metabolic syndrome. However, dyslipidemic patients who had not brought any or much changes in their lifestyle were found to be at high risk of metabolic syndrome.

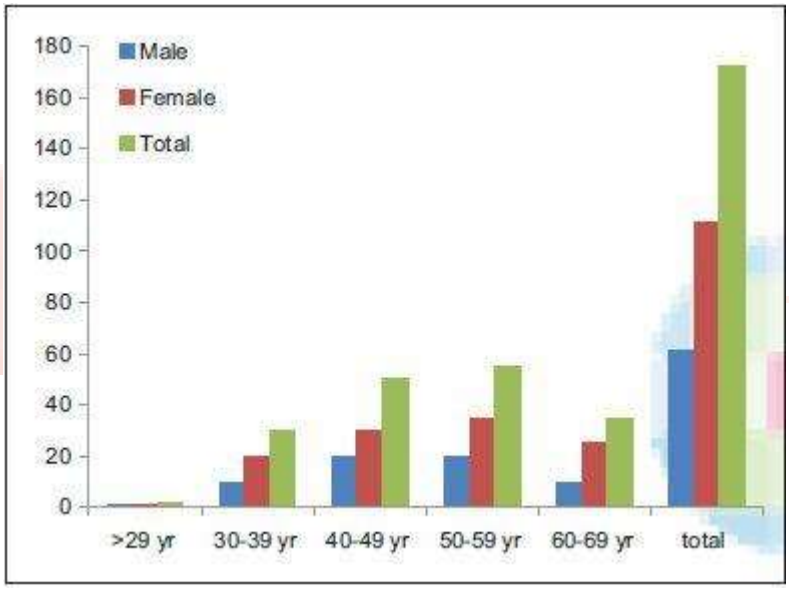

Figure 2: Prevalence of Metabolic Syndrome in Northern India

(Source: As derived from Khan *et al.* 2018, p.120)

It has been argued by Khan *et al.* (2018) that the prevalence of metabolic syndrome has crossed 40% in Northern India itself. As understood from figure 2, the prevalence of such cases has been found in the middle age criteria (40-59 years). The research further pointed out that more than 40% of such cases were found in Gwalior region

itself. The major risk factor in such case was **central obesity** along **with sedentary lifestyle** pattern in the population of the said region (Sharma *et al.* 2016). This resulted in presence of hyperglycemia and abnormal blood pressure levels, especially among the females of the population (Khan *et al.* 2018). However, the researchers even pointed that the **poor food habits** have led to increasing in cases of fatty liver risking metabolic syndrome among people below the age of 40 years, raising the concern of several medical and health specialists in the nation.

According to Banerji, Lam & Chaiken (2017: 2), **insulin resistance** among people posed a high risk of metabolic disorders in individuals. The resistance to insulin since childhood led to a high level of blood lipids and fluctuation of blood glucose level in the body. This high level of blood lipids, further posed the risk of dyslipidemia among individuals leading to metabolic syndrome disorder in people. However, Ofori-Asenso, Agyeman & Laar (2017: 6) stated that central obesity was higher in case of postmenopausal Ghanaian women. This led to a higher prevalence of metabolic syndrome among postmenopausal Ghanaian females by 43% as compared to premenopausal women (18.9%).

However, Aguirre, Ita, Garza & Castilla-Cortazar (2016: 3) supported the research of Banerjee, Lam & Chaiken (2017: 2), by showing the link between insulin resistance in the human body and presence of metabolic syndrome in patients. According to the researchers, **central obesity** and insulin resistance preceded any metabolic bodily changes, leading 75-82% patients to be at risk of metabolic syndrome. This was supported by the researchers by portraying cases of Dutch females and population of the Indian and UK Gujrati community. It was revealed that lack of insulin in the body

among Dutch females led to insulin resistance, posing risk of metabolic syndrome. Further, lack in manipulation of dietary energy and insulin resistance was responsible for prevalence of metabolic syndrome among Indian rural Gujaratis as compared the U.K. Gujaratis by 40%.

According to Yeboah *et al.* (2018), lifestyle in the family along with **genetic inheritance** from parents has been found to be two major risk factors of metabolic syndrome in young adults of Ghana. The researchers revealed that parents were found to engage in active and passive smoking which often impacted the growing fetuses in the country of Ghana (Vaughan, 2018). This led the infants to be born with high blood pressure and low insulin resistance in the body, thereby increasing chances of diabetes among the children. This posed a major risk of metabolic syndrome in the young adults of Ghana, along with neighboring areas (Yeboah *et al.* 2018).

Strokes have been found to be another risk factor of metabolic syndrome in patients. According to the research of Satoh-Asahara *et al.* (2015), in a sample of 300 Japanese patients, 7 cases were that of stroke leading to metabolic syndrome in the health service users. The high scores of the cardiovascular index (CAVI) in patients was found to be a significant factor of metabolic disorders in the patients. This was supported by research of Nyström *et al.* (2015), in which, it was revealed that strokes suffered by obese people often resulted in an increase in chances of metabolic syndrome, raising chances of mortality in patients. This was found in 24% in Italian females and 74% among the Finnish women. However, Muyanja *et al.* (2016) argued that it was not only strokes but even HIV which resulted in high rates of mortality due to metabolic syndrome among 58% of the patients in Uganda.

Complication of Metabolic Syndrome

MetS are the danger factor for various neurological disorders. Various metabolomics studies documented that excessive organic acids, essential amino and fatty acids, and lipid oxidation byproducts in the blood of affected individuals can be found. It can be acknowledged that waist circumference, blood pressure, cholesterol levels, fasting blood triglycerides and glucose levels can be indicative of MetS. The complication associated with the MetS is usually long term and serious. The complications include atherosclerosis, diabetes, heart attack, stroke, kidney disease, cardiovascular disease and fatty liver disease. Further, diabetes mellitus can cause additional complications, including neuropathy, retinopathy, limb amputation and kidney disease (Gardner-Sood et al., 2015).

According to various studies, Mets can be managed by medication and diet modification. An individual disorder can be treated accordingly and separately. ACE inhibitors and diuretics can be given for hypertension. Moreover, cholesterol drugs can be prescribed for triglycerides, HDL and LDL cholesterol abnormality. Additionally, diet and lifestyle modification is also beneficial. Dietary sugar reduction can be advantageous in maintaining serum glucose level. Improved physical activity along with dietary changes is the possibly beneficial measure to prevent Mets. Physical activity helps in the reduction of cholesterol levels, blood sugar and blood pressure. Moreover, a healthy diet includes whole grains, vegetables and fruits (Grundy, 2016; van den Driessche, Plat & Mensink, 2018). It can be concluded that MetS is a collection of conditions including high blood pressure, central obesity, abnormal triglyceride or cholesterol and increased blood sugar level. Further, male with an age range of 50 to 55

% is more prone to develop MetS. Additionally, low physical activity, poor lifestyle, improper diet, age and genetic factors can be contributing factors. Various complications associated with the syndrome conditions are a heart attack, stroke, cardiovascular disease, renal disease, atherosclerosis, retinopathy and fatty liver.

Conclusion

It was concluded from the above chapter that, metabolic syndrome is a major ailment which is on the rise. It is highly prevalent among the female population as compared to males. This difference in prevalence of metabolic syndrome is present in all parts of the globe. Further, the researcher has deduced that diabetes type 2, family history, smoking on behalf of parents, strokes, poor dietary habits, hyperglycemia, dyslipidemia, and central obesity pose a major risk to people when it comes to metabolic syndrome in people. However, this risk factor has been found to vary in cases of different regions all over the world.

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