ISSN: 0975-3583, 0976-2833 VOL 9, ISSUE 04, 2018

PREVALENCE OF METABOLIC SYNDROME PHENOTYPES USING WHO, NCEP ATP III, MODIFIED NCEP ATP III, IDF AND HARMONIZED CRITERIA: A SYSTEMATIC REVIEW WITH SPECIAL REFERENCE TO ASIAN INDIANS

Maitrayee Mitra[1], Arnab Ghosh[2]

[1]Ph.D. Scholar, [2]Faculty

Biomedical Research Laboratory, Department of Anthropology, Visva-Bharati (A Central University and an Institute of National Importance), Santiniketan, West Bengal, India

***Correspondence:** Arnab Ghosh Ph.D., Faculty, Biomedical Research Laboratory, Department of Anthropology, Visva-Bharati (A Central University and An Institution of National Importance) Santiniketan 731 235, West Bengal, India.
Mobile: +91-9433345326; Email: arnab_cu@rediffmail.com

Running Title: cut-offs in metabolic syndrome

Word Counts: 3099 (excluding References)

Tables: 03

Figure: 01

Disclosure Statements

Funding: Nil

Conflict of Interest: There is no conflict of interest so far as authorship and funding is concerned

Authorship: MM was responsible for preparation of the draft manuscript. AG was responsible for the study design, final version of the manuscript.

ISSN: 0975-3583, 0976-2833 VOL 9, ISSUE 04, 2018

ABSTRACT

Background: Metabolic syndrome is the accumulation of cardiovascular disease components in an individual which increases the risk of several non-communicable diseases. Several diagnostic criteria for determining MS have been proposed by different organizations but the disparities in outcomes using these criteria are well-evident in numerous literature. **Objective:** The present review aims to enlighten the hindrance in understanding the actual prevalence of MS globally using different cut-offs in a single study as well as the prevalence of MS phenotypes in Asian-Indians using hitherto available definitions along with Asian Indian specific Cut-offs. **Methodology:** Literature search was done from the peer-reviewed journals using the following keywords: 'Metabolic syndrome', 'Asian Indian', 'global population', 'NCEP ATP III', 'modified NCEP ATP III', 'IDF criteria', 'Harmonized criteria', 'WHO criteria' and 'Asian specific criteria'. 57 papers have been systematically reviewed out of which 30 papers were retrieved from Google Scholar, 11 papers from PubMed, 10 papers from Researchgate, and 6 papers by Google searching. **Conclusion:** There is an urgent need for using a uniform criterion for determining MS in any of the global population and as it also hinders in determining the diagnostic criteria for pediatric MS. Asian Specific criterion is a more significant way for defining MS in the Asian Indian population.

Keywords: metabolic syndrome, modified NCEP ATP III, IDF, WHO, Asian Indians

INTRODUCTION

Metabolic syndrome (MS) is the aggregation of cardiovascular disease (CVD) risk factors like dyslipidemia, hypertension, hyperglycemia/ insulin resistance (IR) and obesity, etc. It predisposes a person to fivefold risk of type 2 diabetes mellitus and doubled risk of CVD. Several definitions of MS have been proposed since decades amongst which the most commonly used criteria are of World Health Organization (WHO), National Cholesterol Education Programme-Adult Treatment Panel III (NCEP ATP III), Indian Diabetes Federation (IDF), modified NCEP ATP III and Harmonized criteria (Table 1) [1].

Apart from the above-mentioned criteria, rests are as the following [2]:

European Group for Study of Insulin Resistance (EIGR) considered MS as Insulin Resistance (IR) Syndrome and in the year 1999 proposed a modified version of WHO criteria. EIGR criteria considered plasma insulin of >75th percentile as a mandatory factor, replaced WHR by waist circumference (WC): ≥94 cm for males and ≥80 cm for females and added impaired fasting blood glucose (FBG) as another factor. Cut off of high BP, elevated TG and low HDLc were same as WHO. Along with plasma insulin of >75th percentile, any two of the rest factors defines MS as per EIGR criteria.

NCEP ATP III did not consider IR to be a mandatory criterion for MS but it is used broadly used by the researchers and health practitioners for its simplicity and clinical feasibility. But further in 2002, the American Association of Clinical Endocrinologists (AACE) referred MS as insulin resistance syndrome and considered impaired glucose tolerance, hypertension, obesity, elevated TG and low HDLc as the diagnostic criteria for MS but they did not mention any particular number of conditions to define MS.

In the year 2009, a revised guideline for obesity and MS specifically for the Asian Indians was formulated.[3] The Asian Indian specific guidelines mentioned WC cut off as >90cm for males and >80 cm for females and the rest of the criteria were the same as modified NCEP ATP III.

ISSN: 0975-3583, 0976-2833 VOL 9, ISSUE 04, 2018

We can find plentiful literature using different cut-offs to define MS among the global populations and Asian Indians. This obscures to understand the actual prevalence of MS in the population. The present review is a unique attempt to edify the disparities in the outcomes in the existing literature in diagnosing the MS and justify the significance of using the population-specific criteria with special reference to the South Asian Indian specific criteria among the Asian Indians.

1.1. Aim of the study

The present review aims to enlighten the hindrance in understanding the actual prevalence of MS globally using different criteria as well as the prevalence of MS phenotypes in Asian-Indians using hitherto available definitions along with South Asian Indian specific criteria with the hypothesis that prevalence of MS phenotypes in the same population do vary using available definitions of MS.

2. METHODOLOGY

We seek to find papers stepwise which compare the prevalence of MS using more than one criterion (**Figure 1**). In this review, 57 papers have been systematically selected and reviewed out of which 30 papers were retrieved from Google Scholar, 11 papers from PubMed, 10 papers from Researchgate, and 6 papers by manual searching in Google. Papers have been selected from the peer-reviewed journals. The keywords used for the literature search are 'Metabolic syndrome', 'Asian Indian', 'global population', 'NCEP ATP III', 'modified NCEP ATP III', 'IDF criteria', 'Harmonized criteria', 'WHO criteria' and 'Asian specific criteria'.

2.1. Findings

Continental variation in the prevalence of metabolic syndrome

The disparity in the outcomes in the same population by using different diagnostic criteria global/non-Asian Indian and Asian Indian population is shown in table 2 and 3, respectively. The findings from the different continental countries have been represented in the following paragraphs:

Prevalence of MS in African continental countries: A cross-sectional study from Ethiopia reported 38.9%, 4.5% and 10.2% higher prevalence of MS using NCEP ATP III criteria than WHO, modified NCEP ATP III and IDF criteria, respectively.[3] Another study from Nigeria reported 5% higher prevalence using modified NCEP ATP III criteria than the NCEP ATP III.[4] Again, from Ethiopia modified NCEP ATP III criteria 13.7% and ~50% more individuals with MS than WHO and NCEP ATP III, respectively.[5] From Sudan, 2.3% and ~1% more individuals with MS were detected by modified NCEP ATP III criteria than WHO and NCEP ATP III, respectively.[6] A hospital-based cross-sectional study 7.4% higher prevalence of using harmonized criteria than the NCEP ATP III.[7] The modified NCEP ATP III criteria again detected ~9% more individuals in Cameroon than the classical one.[8] Another study from Ghana diagnosed ~21% more patients of T2DM with MS using IDF criteria than NCEP ATP III.[9] Further a study detected 26.6% prevalence using the NCEP criteria and 22.7% using the IDF criteria.[10]

Prevalence of MS in North and South American continental countries: A study among the patients of Hemodialysis IDF criteria detected ~1% more individuals with MS of Brazil than the NCEP ATP III criteria.[11] A case-control study from Argentina diagnosed 5% more patients of rheumatoid arthritis using IDF criteria than the NCEP ATP III.[12] Again, a study from Brazil specifically among the climacteric females reported 15.1% more prevalence in general, 13% more among the pre-menopausal and 17.1% among the post-menopausal females using IDF

ISSN: 0975-3583, 0976-2833 VOL 9, ISSUE 04, 2018

criteria than the NCEP ATP III.[13] The harmonized criteria diagnosed 7.3% and 2.4% higher prevalence of MS than the NCEP ATP III and IDF, respectively from Brazil.[14] The harmonized criteria again diagnosed 1.4% higher prevalence of MS than the NCEP ATP III in Canada.[15] A study among the Asian Indian immigrants in the United States documented 11.3% and 5.5% higher prevalence of MS by IDF criteria than the classical and modified NCEP ATP III, respectively.[16]

Prevalence of MS in European continental countries: A cross-sectional study from Luthiana diagnosed 9% and 13% more individuals with MS using harmonized criteria than WHO and NCEP ATP III criteria.[17] In a study from Finland, IDF criteria detected 7.7% more prevalence of MS among the airline employees than the NCEP ATP III.[18] The IDF criteria again documented 4% more prevalence of MS among the menopausal females of the United States than the NCEP ATP III[19] however reverse finding was observed in another study among the adults, children, and adolescents of Canada.[20] A cross-sectional study among the pregnant mothers of Spain reported 7.4% higher prevalence of MS among the gestational diabetic mothers using NCEP ATP III criteria as compared to the WHO criteria but 15% higher MS prevalence was detected by WHO criteria among the hypertensive mothers in the same study.[21]

Prevalence of MS in Oceania continental countries: A longitudinal study documented a very high prevalence of MS among the patients of T2DM of Australia and New Zealand. In this study, the harmonized criteria diagnosed 5.7%, 9.3% and 7.1% more individuals with MS than the WHO, NCEP ATP III, and IDF criteria, respectively. However, few European individuals were also a part of this study.[22]

Prevalence of MS in Asian continental countries:

Eastern Asia: A comparative study from China reported 6.4% and 13.7% higher prevalence of MS using the IDF criteria than the classical and modified NCEP ATP III criteria, respectively.[23] Another population-based cross-sectional study from China again reported 7.2% and 4.3% higher prevalence of MS using the IDF criteria than the classical and modified NCEP ATP III criteria, respectively.[24] A 2.3% higher prevalence of MS in a Korean population was found by NCEP ATP III criteria than the IDF criteria.[25] Another study from Hong Kong reported ~4% higher prevalence by IDF criteria than NCEP ATP III.[26]

Western Asia: A case-control study from Turkey detected 2.6% more Vitiligo patients with MS using IDF criteria compared to the NCEP ATP III criteria.[27] A cross-sectional study from Arab detected 35.2% adults with MS using modified NCEP ATP III and IDF criteria; ~5% less prevalence was diagnosed by classical NCEP ATP III criteria.[28] Another cross-sectional study from Syria diagnosed ~2% more prevalence of MS among individuals with T2DM using modified NCEP ATP III criteria than the classical one.[29] Again, another study from Turkey reported 5% and 3% higher prevalence of MS in Type 1 DM patients by NCEP ATP III criteria than the WHO and IDF.[30] Further, NCEP ATP III criteria diagnosed ~20% and 16.5% more individuals with MS than IDF criteria in two studies from Palestine.[31,32]

Southern Asia: Two recent community-based cross-sectional studies from Iran reported ~3% more prevalence of MS using IDF criteria than NCEP ATP III criteria.[33,34] Another cross-sectional study from Iran among the arthritis patients reported 1.5% more prevalence of MS using modified NCEP ATP III criteria than the classical one.[35] Another study from Iran reported 6.25% and 3.45% higher prevalence using IDF criteria than modified and classical NCEP ATP III criteria, respectively.[36] A hospital-based study from Nepal detected 11% more patients of T2DM with MS using IDF criteria than NCEP ATP III criteria.[37] Again, a cross-

ISSN: 0975-3583, 0976-2833 VOL 9, ISSUE 04, 2018

sectional study showed 1.36% higher prevalence of MS among the Iranian patients with T2DM using IDF criteria than the NCEP ATP III criteria.[38] A very high prevalence of MS among the individuals with T2DM was found in a retrospective cohort study of Pakistan. The NCEP ATP III criteria diagnosed 10.4% and 5.2% higher MS prevalence than WHO and IDF criteria in the study.[39]

South-Eastern Asia: A prospective, community-based study from Malaysia diagnosed ~17% and 6% more individuals with MS using the harmonized criteria than the classical and modified NCEP ATP III criteria in Malaysia.[40] A very high prevalence of MS was reported among the T2DM patients in a hospital-based cross-sectional study of Malaysia. In this study again the harmonized detected 1.9%, 1.6%, and 13.2% more individuals compared to WHO, NCEP ATP III, and IDF criteria, respectively.[41] But in another Malaysian study, IDF detected 19.8% and 3.7% more individuals than WHO and NCEP ATP III criteria.[42]

Prevalence of MS in India (Asian-Indians): In a recent cross-sectional study from Gwalior, India detected ~2% higher percentage of individuals with MS using harmonized criteria than the NCEP ATP III and IDF criteria.[43] Another cross-sectional study from Kashmir reported ~5% higher percentage of individuals with MS using WHO criteria than the NCEP ATP III and IDF criteria.[44] Five studies from different parts of India detected 11.9%, 8.9% and 19.5% more individuals with MS using IDF criteria than NCEP ATP III criteria.[45,46,47,48,49] A hospital-based study diagnosed 2.4% and 7% higher prevalence of MS than IDF criteria among the schizophrenic and bipolar patients of North India using the modified NCEP ATP III criteria.[50] But a hospital-based study from Chandigarh again detected ~1% higher proportion of schizophrenic patients using the IDF criteria than the harmonized criteria.[51] Another study from Chandigarh reported 9.5% and 5.8% more individuals with MS using the modified NCEP ATP III criteria than the classical NCEP ATP III and IDF criteria.[52] A cross-sectional study from South India again reported 10.1% higher prevalence of MS using the modified NCEP ATP III criteria than the IDF criteria.[53]

DISCUSSION

From the above-mentioned findings, it is very difficult to determine which MS diagnostic criteria is most relevant and whether any uniform criteria can be effectively applied for the global population.

In the non-Asian Indian population, the highest prevalence of MS is found as 95.8%, 96.1%, 84.8% and 97.7% using WHO, NCEP ATP III, IDF and harmonized criteria, respectively, in a cross-sectional hospital-based study conducted among the with T2DM patients of Malaysia.[41] In this study, the WHO, NCEP ATP III, and IDF criteria failed to detect 1.9%, 1.6% and 12.9% individuals with MS as compared to the Harmonized criteria.

In the Asian-Indian population, the highest prevalence of MS is found as 84.5%, 79.5% and 78% using WHO, NCEP ATP III and IDF criteria, respectively, in a cross-sectional hospital-based study conducted among the Kashmiri population.[44] In this study, the NCEP ATP III, and IDF criteria failed to detect 5% and 6.5%, respectively as compared to the WHO criteria.

Hence, it is a matter of skepticism whether the Harmonized criteria is more relevant predictor or the WHO criteria from the global perspective.

The highest prevalence of MS among the non-Asian Indians is found in the age 55.7±9.2 years using WHO, classical NCEP ATP III, IDF and harmonized criteria, respectively[41]; and the modified NCEP ATP III revealed the highest prevalence in age 59±8 years.[29] Hence, the older

ISSN: 0975-3583, 0976-2833 VOL 9, ISSUE 04, 2018

individuals tend to have highest risk of MS. All these individuals are found diabetic which further suggests T2DM as a strong risk factor for the development of MS.

The NCEP ATP III criteria was modified and announced on year 2005 and it was mentioned not so different from the classical ATP III criteria 2001 except in the case of abdominal obesity cutoff for Asian and IFG cutoff.[54] However in the present study, notable differences in the diagnosis percentage could be observed which indicates the WC as a significant criterion for MS in the Asian population.

Among the Asian-Indians highest prevalence of MS among the non-Asian Indians is found in the age 57.6±11.43 years using WHO, classical NCEP ATP III and IDF criteria, respectively[44] while the harmonized criteria detected 52.9±10.97 years aged individuals with highest prevalence.[43] Hence, the older aged individuals are more prone to the MS.

Among the non-Asian Indians, the highest prevalence among males[22] was 82.6%, 90.3%, 92.5% and 94.7% and among the females was 85.7%[39], 95.9%[39], 85%[22] and 90.3%[39] detected by WHO, classical NCEP ATP III, IDF and harmonized criteria, respectively.

Among the Asian-Indians, the highest prevalence among males was 74%, 65.9% and 63.8% and among the females was 90.8%, 87.9% and 86.8% detected by WHO, classical NCEP ATP III and harmonized criteria, respectively.[44]

It is clear from the above-mentioned findings that majority of the findings suggests the females at the higher risk of developing MS. Thus, the preventive measures should be initiated shortly.

The disparity is often influenced by the ecological condition of habitat because of vast variation in lifestyle and food culture occurs due to ecological contrast. The ecological influence can somewhat be controlled by using the population-specific diagnostic criteria of any particular population.

Using the Asian Specific criteria for MS, a cross-sectional study among 312 adult individuals of Bolpur-Santiniketan reported 28.2% of individuals with MS; prevalence was higher among females than males (36.9% versus 23.9%).[55] Another community based cross-sectional study among 350 adults of Kolkata reported 31.4% individuals with MS and 3fold higher risk among females than males.[56] Another study from Lucknow reported 77% individuals have MS using the Asian Specific criteria.[57] In these studies, no extensive cultural and ecological differences can be drawn between the studied areas and the outcomes are more justified as those are based on the criteria specifically formulated for the studied population.

3. CONCLUSION

There is no remarkable difference in the prevalence of MS between the developed and developing countries (Ex- India). India is the second largest countries in the globe however; the number of studies is very scarce. The Asian-Indian population comprises a heterogeneous cultural tradition leading to enormous variation in daily lifestyle and food habits which are much different from the other population. Hence, the Asian-specific criteria specifically formulated for the population should be strictly followed for determining MS.

There is an urgent need for using a uniform criterion for determining MS in any of the global population because it hinders in determining the diagnostic criteria for pediatric MS as well.

4. LIMITATIONS

The scarcity of papers from Indian origin is notable in this review. We could find plentiful of recent papers from the global population but it lacks from the Indian origin.

ISSN: 0975-3583, 0976-2833 VOL 9, ISSUE 04, 2018

Population-specific criterion has been used very often by the researchers. There is an urgent need to give attention to the population-specific criterion for determining the actual prevalence of MS in any population because such criteria are proposed specifically based on the characteristics of that population. Hence, such criteria are the most accurate predictor of the MS condition in any of the global population.

Several studies included in this review have been conducted among the individuals associated with some diseases like diabetes mellitus type 1 and 2), schizophrenia, bipolar disorder, and arthritis, etc. Many studies are also found to be conducted among the adult population. But information is very scanty among the children, adolescents and geriatric population. Childhood obesity has become a global health burden in a few decades. Over and above, the geriatric population is also associated with different prolonged diseases. Hence, these two groups of individuals should be also provided urgent attention from the researchers.

No significant literature could be found among the obstetric population of India depicting the prevalence of MS. Dyslipidaemia, gestational diabetes, excessive gestational weight gain (MS factors) are the factors which are associated with the future health status of the neonates. Therefore, the expected mothers should be carefully followed up during pregnancy for earlier screening of different non-communicable diseases (ex- T2DM, CVDs, etc.) of the children in their future life.

Not a single significant study could be found from the northern and central Asian countries; these areas seem to be scorned by the researchers. Therefore, extensive works on these areas are highly anticipated in the forthcoming research works. A need for more community-based or population-based kinds of literature in the review is noticed for an explicit overview. Researchers should expand their view towards longitudinal large cohort studies in the general population also to prevent the growing burden of MS worldwide by earlier screening for the betterment of the health condition of the countries.

CONFLICT OF INTEREST

There is no conflict of interest so far as funding and authorship is concerned.

ETHICAL STATEMENTS

This study was approved by the University Research Board.

ISSN: 0975-3583, 0976-2833 VOL 9, ISSUE 04, 2018

Highlights:

Following a uniform criterion for determining metabolic syndrome is urgently needed for a better understanding of its actual prevalence

Waist circumference is a significant criterion for MS in the Asian population

The Asian-specific criteria specifically formulated for the population should strictly be followed for determining metabolic syndrome

ISSN: 0975-3583, 0976-2833 VOL 9, ISSUE 04, 2018

REFERENCES

1. Ghosh A. The metabolic syndrome: a definition dilemma. Cardiovasc J Afr. 2011; 22:295-296.
2. Misra A, Chowbey P, Vikram N, Wasir J, Chadha D, Joshi SR, et al. Consensus Statement for Diagnosis of Obesity, Abdominal Obesity and the Metabolic Syndrome for Asian Indians and Recommendations for Physical Activity, Medical and Surgical Management. J Assoc Physicians India. 2009;57:8.
3. Bizuayehu Wube T, Mohammed Nuru M, Tesfaye Anbese A. A comparative prevalence of metabolic syndrome among type 2 diabetes mellitus patients in Hawassa university comprehensive specialized hospital using four different diagnostic criteria. Diabetes Metab Syndr Obes. 2019;12:1877–87.
4. Kingsley A, Godwin O, Onyenekwe C, Ayomabi FS, Adebayo AO. Prevalence of metabolic syndrome among students of faculty of health science and technology in Ebonyi state university, Abakaliki, Nigeria. AJAS. 2019;7(6):717-726.
5. Birarra MK, Gelayee DA. Metabolic syndrome among type 2 diabetic patients in Ethiopia: a cross-sectional study. BMC Cardiovasc Disord. 2018;18:149.
6. Sabir FM, Hassan DA, Elamin MI. Prevalence of metabolic syndrome among young Sudanese university students using three different criteria of WHO, IDF and NCEP-ATP III. Peadiatr Neonatal Nurs Open Access. 2016; 2(2).
7. dos Prazeres Tavares H, dos Santos DCDM, Abbade JF, Negrato CA, de Campos PA, Calderon IMP, et al. Prevalence of metabolic syndrome in non-diabetic, pregnant Angolan women according to four diagnostic criteria and its effects on adverse perinatal outcomes. Diabetol Metab Syndr. 2016;8(1):27.
8. Kengne AP, Limen SN, Sobngwi E, Djouogo CF, Nouedoui C. Metabolic syndrome in type 2 diabetes: comparative prevalence according to two sets of diagnostic criteria in sub-Saharan Africans. Diabetol Metab Syndr. 2012;4:22.
9. Gyakobo M, Amoah AG, Martey-Marbell D-A, Snow RC. Prevalence of the metabolic syndrome in a rural population in Ghana. BMC Endocr Disord. 2012;12(1):25.
10. Awotedu K, Ekpebegh C, Longo-Mbenza B, Iputo J. Prevalence of metabolic syndrome assessed by IDF and NCEP ATP 111 criteria and determinants of insulin resistance among HIV patients in the Eastern Cape Province of South Africa. Diabetes Metab Syndr Clin Res Rev. 2010;4(4):210–4.
11. Kubrusly M, Oliveira CMC de, Simões PSF, Lima R de O, Galdino PNR, Sousa P de AF, et al. Prevalence of Metabolic Syndrome according to NCEP-ATP III and IDF criteria in Patients on Hemodialysis. Jornal Brasileiro de Nefrologia. 2015;37(1).
12. Salinas MJH, Bertoli AM, Lema L, Saucedo C, Rosa J, Quintana R, et al. Prevalence and Correlates of Metabolic Syndrome in Patients With Rheumatoid Arthritis in Argentina. J. Clin. Rheumatol. 2013;19(8):439–43.
13. Neto JAF, Figuerêdo ED, Barbosa JF, Barbosa FF, Costa JRC, Nina VJS, et al. Metabolic syndrome and menopause: cross-sectional study in gynecology clinic. Arq. Bras. Cardiol. 2010;95(3).
14. Alencastro PR, Wolff FH, Oliveira RR, Ikeda MLR, Barcellos NT, Brandão ABM, et al. Metabolic syndrome and population attributable risk among HIV/AIDS patients: comparison between NCEP-ATPIII, IDF and AHA/NHLBI definitions. AIDS Res Ther. 2012;9:29.

ISSN: 0975-3583, 0976-2833 VOL 9, ISSUE 04, 2018

15. Reidger ND, Clara I. Prevalence of metabolic syndrome in the Canadian adult population. CMAJ. 2019;183(15): E1127-34.
16. Misra R, Patel T, Kotha P, Raji A, Ganda O, Banerji M, et al. Prevalence of diabetes, metabolic syndrome, and cardiovascular risk factors in US Asian Indians: results from a national study. J Diabetes Complicat. 2010;24(3):145–53.
17. Butnoriene J, Bunevicius A, Norkus A, Bunevicius R. Depression but not anxiety is associated with metabolic syndrome in primary care based community sample. Psychoneuroendocrinology. 2014;40:269–76.
18. Puttonen S, Viitasalo K, Harma M. The relationship between current and former shift work and the metabolic syndrome. Scand J Work Environ Health. 2012;38(4):343-348.
19. Brown TM, Vaidya D, Rogers WJ, Waters DD, Howard BV, Tardif J-C, et al. Does Prevalence of the Metabolic Syndrome in Women with Coronary Artery Disease Differ by the ATP III and IDF Criteria? J Womens Health (Larchmt). 2008;17(5):841–7.
20. Kaler SN, Ralph-Campbell K, Pohar S, King M, Laboucan CR, Toth E. High rates of the metabolic syndrome in a First Nations Community in western Canada: prevalence and determinants in adults and children. Int. J. Circumpolar Health. 2006;65(5):389–402.
21. Bartha JL, González-Bugatto F, Fernández-Macías R, González-González NL, Comino-Delgado R, Hervías-Vivancos B. Metabolic syndrome in normal and complicated pregnancies. Eur. J. Obstet. Gynecol.Reprod. Biol. 2008;137(2):178–84.
22. Scott R, Donoghoe M, Watts GF, O'Brien R, Pardy C, Taskinen M, et al. Impact of metabolic syndrome and its components on cardiovascular disease event rates in 4900 patients with type 2 diabetes assigned to placebo in the field randomised trial. Cardiovasc Diabetol. 2011; 10:102.
23. Woo KS, Hu YJ, Chook P, Wei AN, Chan R, Yin YH, et al. A Tale of Three Gorges in the Yangtze River: Comparing the Prevalence of Metabolic Syndrome According to ATPIII, WHO, and IDF Criteria and the Association with Vascular Health in Modernizing China. Metab Syndr Relat Disord. 2019;17(3):137–42.
24. Zhao Y, Yan H, Yang R, Li Q, Dang S, Wang Y. Prevalence and Determinants of Metabolic Syndrome among Adults in a Rural Area of Northwest China. PLoS One. 2014;9(3).
25. Min K-B, Min J-Y, Paek D, Cho S-I. The Impact of the Components of Metabolic Syndrome on Heart Rate Variability: Using the NCEP-ATP III and IDF Definitions. Pacing Clin Electro. 2008;31(5):584–91.
26. Luk AOY, Ma RCW, So W-Y, Yang X-L, Kong APS, Ozaki R, et al. The NCEP-ATPIII but not the IDF criteria for the metabolic syndrome identify Type 2 diabetic patients at increased risk of chronic kidney disease. Diabet Med. 2008;25(12):1419–25.
27. Tanacan E, Atakan N. Higher incidence of metabolic syndrome components in vitiligo patients: a prospective cross-sectional study. An Bras Dermatol. 2020;95(2):165-72.
28. Zidi W, Zayani Y, Abbes A, Hammami B, Haj-Tayeb S, Sanhaji H, et al. Which obesity index is more compatible in predicting metabolic syndrome? A population based study? Arch. Cardiovasc. Dis. 2020;12(1):160-1.
29. Bakir MA, Hammad K, Bagdadi K. Prevalence of metabolic syndrome and its components among type 2 diabetic mellitus Syrian patients according to NCEP-ATP III and IDF diagnostic criteria. Anthropol. Rev. 2019;82(1):1-14.

ISSN: 0975-3583, 0976-2833 VOL 9, ISSUE 04, 2018

30. Yayici Köken Ö, Kara C, Can Yilmaz G, Aydin HM. Prevalence of Obesity and Metabolic Syndrome in Children with Type 1 Diabetes: A comparative assessment based on criteria established by WHO, IDF and NCEP. J Clin Res Pediatr E. 2019; DOI: 10.4274/jcrpe.galenos.2019.2019.0048
31. Damiri B, Abualsoud MS, Samara AM, Salameh SK. Metabolic syndrome among overweight and obese adults in Palestinian refugee camps. Diabetol Metab Syndr. 2018;10(1):34.
32. Sirdah MM, Abu Ghali AS, Al Laham NA. The reliability of the National Cholesterol Education Program's Adult Treatment Panel III (NCEP/ATP III) and the International Diabetes Federation (IDF) definitions in diagnosing metabolic syndrome (MetS) among Gaza Strip Palestinians. Diabetes Metab Syndr Clin Res Rev. 2012;6(1):4–8.
33. Bahar A, Kashi Z, Kheradmand M, Hedayatizadeh-Omran A, Moradinazar M, Ramezani F, et al. Prevalence of metabolic syndrome using international diabetes federation, National Cholesterol Education Panel- Adult Treatment Panel III and Iranian criteria: results of Tabari cohort study. J Diabetes Metab Disord. 2020; DOI: http://link.springer.com/10.1007/s40200-020-00492-6
34. Nikbhakt H, Rezaianzedeh A, Seif M, Ghaem H.Prevalence of metabolic syndrome and its components among a population-based study in south of Iran, PERSIAN Kharameh cohort study. Clin Epidemiol Glob Health. 2020;8(3):678-83.
35. Mobini M, Niksolat F, Bahar A, Mohammadpour R, Karimi M. Metabolic Syndrome and its Components in Patients with Rheumatoid Arthritis, and their Association with Disease Activity and Duration. J Clin. Diagn. Res. 2020;14(2):OC05-09
36. Ebrahimi H, Emamian MH, Khosravi A, Hashemi H, Fotouhi A. Comparison of the accuracy of three diagnostic criteria and estimating the prevalence of metabolic syndrome: a latent class analysis. J Res Med Sci. 2019;24:108.
37. Bhattarai S, Kohli S, Sapkota S. Prevalence of metabolic syndrome in type 2 diabetes mellitus patients using NCEP/ATP III and IDF criteria in Nepal. Nep J Med Sci. 2012;1(2):79–83.
38. Marjani A, Shirafkan A. The metabolic syndrome in type 2 diabetic patients in Gorgan: According to NCEP ATPIII and IDF definitions. Diabetes Metab Syndr Clin Res Rev. 2011;5(4):207–10.
39. Ahmed A, Khan TE, Yasmeen T, Awan S, Islam N. Metabolic syndrome in type 2 diabetes: comparison of WHO, modified ATPIII & IDF criteria. J Pak Med Assoc. 2012;62:569.
40. Ramli AS, Daher AM, Noor Khan Nor-Ashikin M, Mat-Nasir N, Keat Ng K, Miskan M, et al. JIS Definition Identified More Malaysian Adults with Metabolic Syndrome Compared to the NCEP-ATP III and IDF Criteria. BioMed Res. Int. 2013;2013:1–10.
41. Tan MC, Ng OC, Wong TW, Joseph A, Chan YM, Hejar AR. Prevalence of metabolic syndrome in type 2 diabetic patients: a comperative study using WHO, NCEP ATP III, IDF and harmonized definitions. Sci Res.2013;5(10):1689-1696.
42. Zainuddin LRM, Isa N, Muda WMW, Mohamed HJ. The prevalence of metabolic syndrome according to various definitions and hyperglyceridemic-waist in Malaysian adults. Int J Prev Med. 2011;2(4):229-237.
43. Subramani SK, Mahajan S, Chauhan P, Yadav D, Mishra M, Pakkirisamy U, et al. Prevalence of metabolic syndrome in Gwalior region of Central India: A comparative

ISSN: 0975-3583, 0976-2833 VOL 9, ISSUE 04, 2018

study using NCEP ATP III, IDF and Harmonized criteria. Diabetes Metab Syndr Clin Res Rev. 2019;13(1):816–21.
44. Lone S, Lone K, Khan S, Pampori RA. Assessment of metabolic syndrome in Kashmiri population with type 2 diabetes employing the standard criteria's given by WHO, NCEPATP III and IDF. JEGH. 2017;7(4):235.
45. Manjunath D, Uthappa CK, Kattula SR, Allam RR, Chava N, Oruganti G. Metabolic Syndrome Among Urban Indian Young Adults: Prevalence and Associated Risk Factors. Metab Syndr Relat D. 2014;12(7):381–9.
46. Yadav D, Mahajan S, Subramanian SK, Bisen PS, Chung CH, Prasad G. Prevalence of Metabolic Syndrome in Type 2 Diabetes Mellitus Using NCEP-ATPIII, IDF and WHO Definition and Its Agreement in Gwalior Chambal Region of Central India. Glob J Health Sci. 2013;5(6):142–55.
47. Mangat C, Goel N, Walia DK, Agarwal N, Sharma MK, Kaur J, et al. Metabolic Syndrome: a challenging health Issue in highly urbanized Union Territory of north India. Diabetol Metab Syndr. 2010;2:19.
48. Pandey S, Srinivas M, Agashe S, Joshi J, Galvankar P, Prakasam CP, et al. Menopause and metabolic syndrome: a study of 498 urban women from Western India. J Midlife Health. 2010;1(2):63-69.
49. Deepa M, Farooq S, Datta M, Deepa R, Mohan V. Prevalence of metabolic syndrome using WHO, ATPIII and IDF definitions in Asian Indians: the Chennai Urban Rural Epidemiology Study (CURES-34). Diabetes Metab Res Rev. 2007;23(2):127–34.
50. Grover S, Nebhinani N, Chakrabarti S, Avasthi A, Kulhara P, Basu D, et al. Comparative study of prevalence of metabolic syndrome in bipolar disorder and schizophrenia from North India. Nordic J Psychiatry. 2014;68(1):72–7.
51. Grover S, Aggarwal M, Dutt A, Chakrabarti S, Avasthi A, Kulhara P, et al. Prevalence of metabolic syndrome in patients with schizophrenia in India. Psychiatry Res. 2012;200(2–3):1035–7.
52. Ravikiran M, Bhansali A, RaviKumar P, Bhansali S, Dutta P, Thakur JS, et al. Prevalence and risk factors of metabolic syndrome among Asian Indians: A community survey. Diabetes Res Clin Pract. 2010;89(2):181–8.
53. Kaur P, Radhakrishnan E, Rao SR, Sankarasubbaiyan S, Rao TV, Gupte MD. The Metabolic Syndrome and Associated Risk Factors in an Urban Industrial Male Population in South India. J Assoc Physicians India. 2010;58:4.
54. Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. Executive Summary of the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). JAMA: J Am Med Assoc. 2001;285(19):2486–97.
55. Nag T, Ghosh A. Prevalence of metabolic syndrome in rural elderly of Asian Indian origin: Metabolic Syndrome in Rural Elderly. Am J Hum Biol. 2015; 27(5):724–7.
56. Das M, Pal S, Ghosh A. Association of metabolic syndrome with obesity measures, metabolic profiles, and intake of dietary fatty acids in people of Asian Indian origin. J Cardiovasc Dis Res. 2010;1(3):130–5.
57. Khanna R, Kapoor A, Kumar S, Tewari S, Garg N, Goel PK. Metabolic syndrome & Framingham Risk Score: Observations. Indian J Med Res. 2013;7.

ISSN: 0975-3583, 0976-2833 VOL 9, ISSUE 04, 2018

ISSN: 0975-3583, 0976-2833 VOL 9, ISSUE 04, 2018

Table 1: Diagnostic criterion to determining MS.

WHO criteria(1998)	NCEP ATP III criteria(2001)	Modified NCEP ATP III criteria (2005)	IDF criteria (2006)	Harmonized criteria(2009)
Diabetes mellitus and/or insulin resistance along with any two or more of the following: i. High blood pressure (BP): ≥140/90 mm Hg, ii. elevated plasma triglycerides (TG): ≥150 mg/dl and/or high density lipoprotein cholesterol (HDLc): <35 mg/dl in males and<39 mg/dl in females, iii. waist-hip ratio (WHR): >0.9 in males and >0.85 in females and/or Body Mass Index (BMI) >30 kg/m^2 and iv.microalbuminuria: urinary albumin excretion ≥20 µgm/min or albumin creatine ratio ≥300 µgm/mg.	Any three from the following: i. WC: ≥120 cm in males and ≥88 cm in females, ii. high BP: >130/85 mmHg, iii. impaired FBG: >110 mg/dl, iv. elevated TG: ≥150 mg/dl and v. elevated HDLc: <40 mg/dl in males and <50 mg/dl in females.	Any three of the following: i. high BP: >130/85 mmHg and/or under antihypertensive drug treatmalest, ii. WC: >90 cm for Asian American Indians, iii. elevated TG: ≥150 mg/dl and/or under treatmalest for this abnormality, iv. reduced HDLc: <40 mg/dl in males and <50 mg/dl in females and/or under treatmalest for this abnormality and v. impaired FBG: >100 mg/dl and/or under treatmalest for this abnormality.	A slightly modified diagnostic criteria of MS in which the measure of WC were defined with ethnicity specific values and rest of the criteria is same as modified NCEP ATP III.	WC cut off was mentioned as ≥90 cm for males and ≥80 cm for females. Rest of the criteria is same as of modified NCEP ATP III.

ISSN: 0975-3583, 0976-2833 VOL 9, ISSUE 04, 2018

Table 2: Prevalence of MS globally using different *cut-offs*

Authors	Year	Area	Nature of Study	Studied Population	WHO criteria	NCEP ATP III criteria	Modified NCEP ATP III criteria	IDF criteria	Harmonized Criteria
Bahar et al.[33]	2020	Iran	Cross-sectional	10,255 adult individuals of 50.23±9.37 years		41.10%		44.60%	
Tanacan et al.[27]	2020	Turkey	Cross-sectional case-control	230 adults; 155 vitiligo patients of 37.04±12.07 years and 155 control of 37.37±12.60 years		37.4% and 19.4%, respectively		40% and 26.5%, respectively	
Zidi et al.[28]	2020	Great Tunis, Arab	Cross-sectional Community based	2708 adult individuals of 18-64 years		30.4%	35.2%	35.2%	
Mobini et al.[35]	2020	Iran	Cross-sectional	200 females of 50.29±6.2 years with rheumatoid arthritis(RA)		54.5%	56%		
Ghaem et al.[34]	2020	Iran	Cross-sectional Population based	10663 adult individuals of 51.94±8.27 years		33.82%		37%	

ISSN: 0975-3583, 0976-2833 VOL 9, ISSUE 04, 2018

Woo et al.[23]	2019	China	Cross-sectional Comparative	182 individuals of 49.7±9 years; 95 ex-farmers, 87 farmers		36.8% and 13.8%, respectively	29.5% and 11.5%, respectively	43.2% and 17.2%, respectively
Bakir et al.[29]	2019	Syria	Cross-sectional	424 adults with T2DM of 59±8 years; 209 males and 25 females			67%	69.3%
Yayici et al.[30]	2019	Turkey	Cross-sectional Descriptive	200 individuals with T1DM of 13.8±2.8 years	8.5%	13.5%		10.5%
Wube et al.[3]	2019	Ethiopia	Cross-sectional	314 individuals of 49.8±9.8 years	31.2%	70.1%	65.6%	59.9%
Fotouhi et al.[36]	2019	Iran	Cross-sectional	4737 adults; 1946 males of 56.5±6.2 years and 2791 females of 55.4±6.2 years		53.75%	56.55%	60%
Ayomabi et al.[4]	2019	Nigeria	Cross-sectional	80 university students of	2.5%			7.5%

ISSN: 0975-3583, 0976-2833 VOL 9, ISSUE 04, 2018

Birarra et al.[5]	2018	Ethiopia	Cross-sectional	24.4±5.87 years; 28 male and 52 females 256 adults with T2DM of ≥20 years; 113 males and 143 females	43.3%	7.03%	57%
Damiri et al.[31]	2018	Palestine	Cross-sectional	689 adult refugees of 18-65 years; 329 males and 360 females		51.9% and 52.2% overweight and obese males and females, respectively	71.8% and 67.6% overweight and obese males and females, respectively
Elamin et al.[6]	2016	Khartoum, Sudan	Cross-sectional	1012 university students of 20±1.94 years; 332 males and 680 females	6.1%	7.5%	8.4%
Tavares et al.[7]	2016	Angola	Cross-sectional Hospital-	675 pregnant mothers of 24.7±6.7		29.2%	36.6%

ISSN: 0975-3583, 0976-2833 VOL 9, ISSUE 04, 2018

			based	years					
Oliveira et al.[11]	2015	Brazil	Cross-sectional Observational	115 patients on Hemodialysis of 50.2±14.7 years		41.7%		42.6%	
Yan et al.[24]	2014	North-west China	Cross-sectional Population-based	2990 adult individuals of 50.6±1.0 years; 1035 males and 1955 females		7.9%	10.8%	15.1%	
Ramli et al.[40]	2013	Malaysia	Prospective, Community-based cohort	8836 adults of 53.21±10.6 years; 3766 males and 5070 females		26.5%		37.4%	43.4%
Butnoriene et al.[17]	2013	Raseiniai, Luthiana	Cross-sectional	1115 adults of 62.0±9.6 years; 562 males and 553 females	34%	30%			43%
Ng et al.[41]	2013	Malaysia	Cross-sectional Hospital-based	313 adult T2DM patients of 55.7±9.2 years; 150	95.8%	96.1%		84.8%	97.7%

ISSN: 0975-3583, 0976-2833 VOL 9, ISSUE 04, 2018

				males and 163 females			
Saurit et al.[12]	2013	Argentina	Cross-sectional Case-control	1033 adults; 409 RA patients of 55.5±13.2and 624 controls of 57.3±13.1 years	30% RA patients and 39% controls	35% RA patients and 40% controls	
Kengne et al.[8]	2012	Cameroon, Sub-Saharan Africa	Cross-sectional	308 T2DM patients of 55.8±10.5 years; 157 males and 151 females	Overalll 60.4%; 43.1% males and 68.1% females	Overall 71.7%; 55.7% males and 72.1% females	
Gyakobo et al.[9]	2012	Ghana	Cross-sectional	228 rural adults of 44.4±6.9 years; 102 males and 104 females	Overall 15%; 5.9% males and 24% females		Overall 35.9%; 15.7% males and 55.8% females
Bhattarai et al.[37]	2012	Nepal	Cross-sectional Hospital-based	66 adult T2DM patients; 44 males of mean age 55 years and 22 females of mean age 56 years	Overall 71%; 72% males and 91% females		Overall 82%; 80% males and 95% females

ISSN: 0975-3583, 0976-2833 VOL 9, ISSUE 04, 2018

Sirdah et al.[32]	2012	Palestine	Cross-sectional	230 Gaza strip adults of 20-64 years; 116 males and 114 females		Overall 23%; 18.1% males and 28.1% females		Overall 39.5%; 45.7% males and 33.3% females
Ahmed et al.[39]	2012	Karachi, Pakistan	Cross-sectional Restrospective cohort	210 T2DM patients of 53.67±11.17 years; 112 males and 98 females	Overall 81.4%; 77.7% males and 85.7% females	Overall 91.9%; 88.4% males and 95.9% females		Overall 86.7%; 78.6% males and 95.9% females
Puttonen et al.[18]	2012	Finland	Cross-sectional	1811 airline employees of 43.3±8.9 years; 1009 males and 802 females		20.8%		28.5%
Fuchs et al.[14]	2012	Brazil	Cross-sectional Hospital-based	1868 HIV infected patients of 38.6±10.1 years; 1240 males and 628 females		Overall 17.2%; 15.2% males and 19.2% females	Overall 22.1%; 20.7% males and 23.5% females	Overall 24.5%; 24.6% males and 24.8% females

ISSN: 0975-3583, 0976-2833 VOL 9, ISSUE 04, 2018

Marjani et al.[38]	2011	Iran	Cross-sectional	293 T2DM patients of 53.11±10.15 years; 170 males and 123 females		Overall 75.43%; 62.60% males and 84.70% females	Overall 76.79%; 60.97% males and 88.23% females	
Mohamed et al.[42]	2011	Malaysia	Cross-sectional	298 adults; 124 males of 49.82±11.74 and 175 females of 48.58±11.67 years	12.4%	28.5%	32.2%	
Riediger et al.[15]	2011	Canada	Cross-sectional	1800 adult individuals of 18-79 years		Overall 17.7%; 15.9% males and 19.5% females		Overall 19.1%; 17.8% males and 20.5% females
Scott et al.[22]	2011	Australia, New Zealand and Finland	Longitudinal	9795 adult patients with T2DM of 50-75 years; 3067 males and 1833 females	Overall 81.9%; 82.6% males and 80.7% females	Overall 78.3%; 90.3% males and 82.8% females	Overall 80.5%; 92.5% males and 85% females	Overall 87.6%; 94.7% males and 90.3% females

ISSN: 0975-3583, 0976-2833 VOL 9, ISSUE 04, 2018

Neto et al.[13]	2010	Brazil	Cross-sectional	323 climacteric females of mean age 49.7 years	Overall 34.7%; 24% pre-malesopausal and 44.4% post-malesopausal females		Overall 49.8%; 37% pre-malesopausal and 61.5% post-malesopausal females
Ekpebegh et al.[10]	2010	South Africa	Cross-sectional Case-control	231 adults; 86 HIV patients of 37.7±9.2 years with anteretroviral therapy and 125 controls of 36.3±13.7 years	26.6%, 15.7% and 21.9% for respective groups		22.7%, 23.2% and 19.3% for respective groups
Misra et al.[16]	2010	United States	Cross-sectional	1038 Adult Asian Indian immigrants of 45.7±12.8 years	26.9%	32.7%	38.2%
Cho et al.[25]	2008	Korea	Cross-sectional	1071 adult individuals of mean age 53.3 years; 1035 males and 1955 females	26.6%		24.3%

ISSN: 0975-3583, 0976-2833 VOL 9, ISSUE 04, 2018

Tong et al.[26]	2008	Hong Kong	Cross-sectional	6350 adults of 55.1±13.3 years		50.5%	54.2%
Brown et al.[19]	2008	United States	Cross-sectional	372 post-malesopausal females of 65.3±8.4 years		70%	74%
Bartha et al.[21]	2008	Spain	Cross-sectional Cohort	90 pregnant mothers of 23-35 years	3.3% gestational diabetic mothers, 35% gestational hypertensive mothers and 30% pre-eclamptic group	10% gestational diabetic mothers, 20% gestational hypertensive mothers and 30% pre-eclamptic group	
Kaler et al.[20]	2006	Canada	Cross-sectional	176 adults of 39.4±13.3 years		52.3%	50%

ISSN: 0975-3583, 0976-2833 VOL 9, ISSUE 04, 2018

Table 3: Prevalence of MS in Asian-Indian population using different criterion.

Authors	Year	Area	Nature of Study	Studied Population	WHO criteria	NCEP ATP III criteria	Modified NCEP ATP III criteria	IDF criteria	Harmonized criteria
Prasad et al.[43]	2019	Gwalior	Cross-sectional Clinic-based	1190 adults of 52.9±10.97 years; 819 males and 371 females		50.2%		53.9%	72.7%
Lone et al.[44]	2017	Kashmir	Cross-sectional Hospital-based	1000 adult patients of 57.6±11.43 years age; 385 males and 615 females	Overall 84.5%; 74% males and 90.8% females	Overall 79.5%; 65.9% males and 87.9% females		Overall 78%; 63.8% males and 86.8% females	
Manjunath et al.[45]	2014	Hyderabad, Andhrapradesh	Cross-sectional	473 young adults of 20±2 years; 322 males and 151 females		Overall 3.6%; 4.7% males and 1.3% females		Overall 6.6%; 8.4% males and 2.6% females	
Grover et al.[50]	2014	North India	Cross-sectional Hospital-based	248 individuals of ≥15 years; 126 with Schezophrenia			36.5% Schizophrenic patients and 62.5% bipolar patients	34.1% Schizophrenic patients and 55.5% bipolar patients	

ISSN: 0975-3583, 0976-2833 VOL 9, ISSUE 04, 2018

				of 30.69±10.73 years, 72 with bipolar disorders of 37.79±13.10 years and 50 healthy controls of 37.74±13.32 years			
Yadav et al.[46]	2013	Madhyapradesh	Cross-sectional	700 adults of 28-87 years with T2DM individuals; 504 males of 55±9.5 years and 196 females of 53±10 years	Overall 45.8%; 41% males and 58.1% females		Overall 57.7%; 52.7% males and 70.4% females
Grover et al.[51]	2012	Chandigarh	Cross-sectional Hospital-based	227 patients with Schezophrenia of 34.67±12.84 years		44.5%	43.6%
Mangat et al.[47]	2010	Chandigarh	Community-based cross-sectional	605 adults of 44.99±14.74 years; 290 males and 315	Overall 38.5%; 39.5% males		Overall 47.4%; 40.4% males and 59.6%

ISSN: 0975-3583, 0976-2833 VOL 9, ISSUE 04, 2018

				females	and 44.8% females		females	
Kaur et al.[53]	2010	South India	Cross-sectional	1077 male industrial workers of 37.7±8.83 years		51.4%	41.3%	
Bhansali et al.[52]	2010	Chandigarh	Population-based cross-sectional	2225 adults of 42.74±16.61 years; 1068 males and 1157 females	35.8%	45.3%	39.5%	
Vaidya et al.[48]	2010	Western India	Cross-sectional	498 adult females of 49.8±8.49 years			45% pre-menopausal and 55% post-menopausal women	44% pre-menopausal and 56% post-menopausal women
Deepa et al.[49]	2007	Chennai	Epidemiological Cross-sectional	26001 individuals of 40±13 years	18.3%		37.8%	

ISSN: 0975-3583, 0976-2833 VOL 9, ISSUE 04, 2018

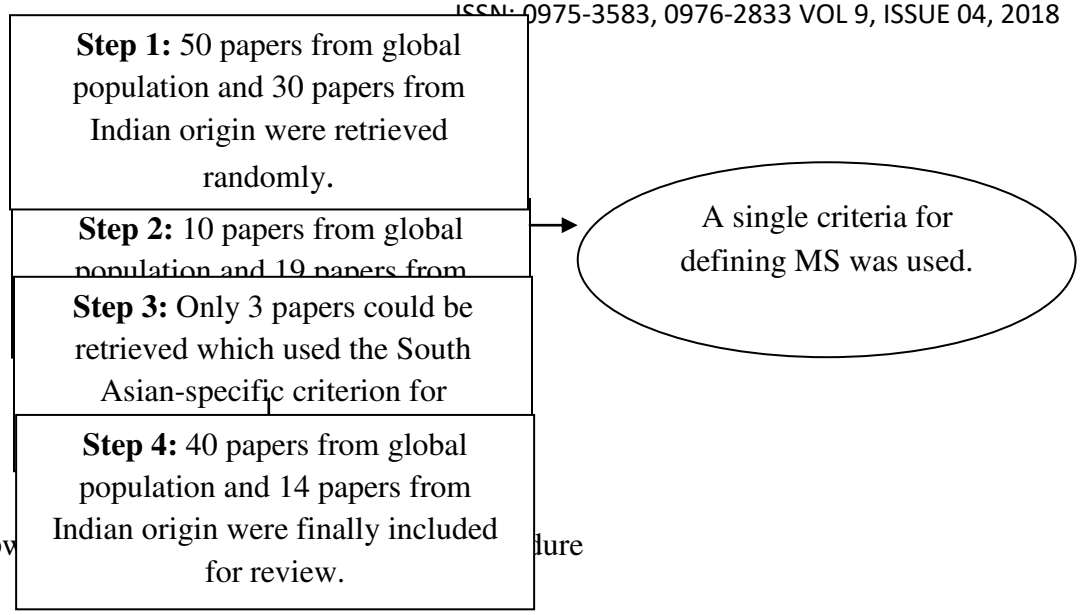

Figure 1: Stepw lure