

Prevalence of Diabetes among Adults and Risk Factors Associated With High Diabetes Prevalence in the United Arab Emirates: A Systematic Review

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Abstract: Introduction: The widespread presence or prevalence of diabetes mellitus type 2 is increasing rapidly in the United Arab Emirates. An individual person with diabetes mellitus may get greater exposure for the complications in later life. It is known as the non-communicable modern epidemic which has become a global threat. The aim is to understand the high prevalence of diabetes mellitus type 2 and the effect of its risk factors among adults in the United Arab Emirates.

Research design and methodology: We searched four electronic databases such as Medline Complete, PubMed, Web of Science, Scopus and suggested literature from experts also assessed. The searching keywords are prevalence, epidemiology, diabetes mellitus type 2, risk factors, modifiable risk factors, non-modifiable risk factors, population at risk, UAE, United Arab Emirates. One hundred fifty six articles found after primary search and eight articles were selected for the final review.

Results: This research results revealed the prevalence varied in different parts of the UAE such as in the Northern Emirates (19.1%-25.1%), in Dubai (12.4%-14.7%) and (19.0%-19.3%) among adult residents and citizens, in Al Ain the (18.8%-40.7%) among residents. The factors such as aging >35 years among citizens and (41-60, 61 plus) among residents, obesity (BMI >30 for Arabs and Europeans and >27 for Asians), central obesity (>102 cm in men and >88 cm in women for Arabs and Europeans, > 90 cm in men and >80 cm in women for Asians), positive family history of diabetes mellitus type 2, ethnicity, suffering from dyslipidemia and hypertension, less physical activity, duration of staying in the UAE more than 10 years, unhealthy diet, being single (widow, separated, divorced) and stress were positively associated with high prevalence.

Conclusion: The results considered planning for early screening, intervention, health resources allocation to pursue specific approaches to reduce high prevalence.

Keywords: Diabetes mellitus type 2, epidemiology, prevalence, population at risk, risk factors, Systematic review, United Arab Emirates.

1. INTRODUCTION

According to the World Health Organization, diabetes is a chronic metabolic disease which is characterized by elevated levels of blood glucose /blood sugar, leading to severe deterioration of heart, kidneys, eyes, blood vessels and nerves in addition to time. (1) Diabetes mellitus type 2 is more common in adults as a result of body cells become resistant to insulin or less production of insulin by pancreas.(1) In the year 2019, the global prevalence of diabetes mellitus above twenty was

463 millions which was the triple multiplied result in last two decades.(2)World Health Organization has focused the global mortality by diabetes in 2015 (eighth leading cause) might be (seventh leading cause) in 2030.(3)The countries are having highest diabetes rate are in the Middle East and North Africa region. People are more intended to adopt sedentary lifestyle, western food, less physical activity, accessing cars always along with development of socio economic condition, industrialization, city expansion soon after oil discovery in Middle East And North Africa Region leading to increase obesity and screening for diabetes at the age of 30 years in the UAE.(4)

According to the International Diabetes Federation, Middle East and North Africa is the second highest diabetes prevalence region in the world and in UAE, diabetes mellitus type 2 prevalence rate is 17.2%(20 to 79 years of age). (5)The population statistics 2022 in the UAE is projecting about residents population 88.52% and citizens population 11.48%.(6) In 1980, UAE population was 1.01 million and in 2023, UAE population growth reached to 10.17 million.(7) In the Middle East and North Africa region, along with nineteen countries UAE also has experienced rapid economic growth and increase diabetes prevalence parallel in the adult population along with complications.(4) In addition, age adjusted comparative prevalence of impaired glucose tolerance 18.3%, impaired fasting glucose 8.8% and diabetes related death 12.8%(20-79 years of age).Total health expenses related with diabetes in USD million 2,090.4 in the UAE.(5) This ongoing expansion of diabetes mellitus type 2 prevalence is a significant risk to health system, economy, society as it affects both individuals and respective families of them.

2. BACKGROUND

A review article showed higher diabetes prevalence among citizens in comparison to residents population (25% verses 13-19%) in the UAE, an association between gender and diabetes prevalence among UAE citizens population whereas global data reported about deviation in this association, limited evidence about higher rate of diabetes in men, increasing risk of diabetes in association with hypertension in white population living in UAE, a positive relationship in between family history of diabetes, physical activity, level of vitamin D level and diabetes prevalence.(8)About high prevalence and affected ethnic group the present scenario is different and few more related risk factors and unintentional events are responsible for this are not mentioned in this review.

Another review article showed diabetes mellitus type 2 prevalence among men in the middle east and the evidence of this review article reported diabetes prevalence among men in the United Arab Emirates 25.83%(3rd highest prevalence country) above 18 years of age. This review article ended up by giving suggestions to put more attention in educational and health promoting programs but not giving any information about diabetes mellitus type2 prevalence among female adults in the UAE and risk factors are associated with high prevalence.(9)

One more review article showed the relationship between increased diabetes mellitus type 2 prevalence and risk factors specially obesity, increased life expectancy resulting from population growth and aging, physical inactivity, unhealthy diet, genetic susceptibility but no evidence about which group of population are more affected in the UAE and why affected.(10) The research question is what are the risk factors associated with high prevalence of diabetes mellitus type2 among adults (citizens and residents) in the United Arab Emirates? This research paper aims to understand the high prevalence of diabetes mellitus type 2 and the effect of its risk factors among adults (citizens and residents) in the United Arab Emirate.

3. RESEARCH DESIGN AND METHODOLOGY

This systematic review protocol was prospectively registered on PROSPERO (International prospective register of systematic review),(34) registration number is CRD42023399728 and drew up by steps established on PRISMA (Preferred Reporting Items for Systematic Review and Meta-analysis).(11) Research question was developed by following PEO framework of research where P stands for population (adults in the UAE), E stands for exposure (exposed to risk factors), O stands for outcome (effect of risk factors).(21)The objectives are 1) critical appraisal, 2) to add required data for understanding research, 3) summarization about related risk factors associated with high prevalence.

Sources of data and search keywords in phrases

A systematic database search conducted to access documentation based results on diabetes mellitus type 2 prevalence and the effect of its risk factors in the United Arab Emirates using different electronic databases such as Medline Complete, PubMed, Science Direct, Scopus. These databases have played a vital role in the search and field of health. Suggested literature from experts also assessed. The included criteria were English language, free access and peer reviewed studies

conducted on UAE adult population. For the specific search strategy we used Me S H (Medical Subject Heading) term and keywords corresponding to the subjects such as “prevalence”, “epidemiology”, “diabetes mellitus type 2”, “risk factors”, “modifiable risk factors”, “non-modifiable risk factors”, “population at risk”, “UAE”, “United Arab Emirates”. To limit and define our search we used the Boolean operators (AND) (OR) such as “(Prevalence OR epidemiology) AND (diabetes mellitus type 2) AND (modifiable risk factors OR non-modifiable risk factors) AND (UAE OR United Arab Emirates)”, “(Prevalence OR epidemiology) AND (diabetes mellitus type 2) AND (risk factors OR population at risk) AND (UAE OR United Arab Emirates)”.

Procedure of selection eligible articles

After primary selection the next step was reviewing title/abstract for exclusion. The searching procedure was re-run before final selection. The last phase was full text review for final process (inclusion and exclusion). This systematic review had looked into articles from 2010 to 2021. The justification for not selecting articles before 2010 was the scenario of diabetes prevalence different than present. (8) This review included articles those adopted cross sectional study, conducted on adult population (>18 years), residents living in the UAE more than 4 years, adults having diabetes risk factors and diabetes mellitus type 2. There were restrictions on study design other than cross sectional, review articles, study conducted on animals, children, pregnant women. The exclusion criteria reduced the risk for an unfavorable outcome. The context was the United Arab Emirates and rural, urban were not the criteria of exclusion. To avoid the risk of bias of included individual study, one research expert and one of the authors reviewed the included studies by comparing keywords, inclusion and exclusion criteria. Identifying references, collection, organization, store in the computer done by Rayyan (reference management software). (33) When we conducted our first review work both of us selected blind on mode, after our review completed we turned on blind off mode and difference of opinion was solved by consensus. Critical appraisal of the articles (n=18) we did separately and discussed about the differences to solve the conflict and come to the same point to select final eligible articles.

Data extraction

Total one hundred fifty-six articles were obtained on diabetes mellitus type 2 prevalence/epidemiology in the United Arab Emirates. From Medline Complete fifteen articles, PubMed forty-eight articles, Scopus seventy articles, Web of Science seventeen articles and six articles from expert advice. After removal of duplicates (seventy), eighty-six articles were selected for title and abstract screening and eighteen articles were selected for full text assessment and critical appraisal. Finally eight articles were included in systematic review and ten articles were excluded due to not cross-sectional studies (n=2), not related to topic (n=4), couldn't obtain full text (n=1), review article (n=1) and not related to study population (n=2). The article's selection processes are shown in detail in figure 1.

Critical appraisal

Critical appraisal of the final elected articles (n=8) including the validity of the results (section A), worth of continuing appraisal, the results of the studies (section B) and local implication of the results (section C) and these characteristics are mentioned in table 1. The initial two are screening questions and we could proceed with the remaining questions only when the both questions answers of section A were yes. All the studies addressed a clearly focused issue and the cohort was recruited in an acceptable way. Two studies (16,18) mentioned some limitations about missing data and complex stratification. The exposure and outcome was measured accurately in seven studies only one study (15) about population they mentioned sample of UAE, didn't mention ethnicity. One study (14) did not include food intake and another study (16) did not record family history of diabetes, for the rest of the studies all important confounding factors have been identified clearly. Authors of all the eight studies taken account of the confounding factors in the design and analysis. The follow up information of the lost people absent in all the studies but the period of follow up of them was long enough in three studies. (13,16,18) The study results shown in (table 1), Confidence Interval done in five studies (13,14,17,19,20) out of eight and meta analysis not possible due to unable to calculate OR (odd ratio). The results of all studies fit with other available evidence and can be applied to the local population. Major implication of these studies in our practice to develop policy, improve early screening and diagnose individual at risk, health promoting and preventive strategy, to develop or adopt a validated tool to measure acculturation in the UAE, to improve primary and secondary intervention program, focusing particularly on modifiable risk factors and implication on health resources and cost.

Synthesis of data and statistical analysis

For data analysis and synthesis, information about title of the study, publication year, name of author/authors, country and design of conducted studies, the key findings of the study, statistical analysis, limitations of studies were collected and stored in the computer in supplement table 1. For critical appraisal CASP Cohort Study tool used, (12) this tool do not suggest any scoring system and it is designed to appraise systematically. The appraisal findings of 18 studies stored in computer in supplement table 2 and final summary of appraisal, data analysis and presentation of eight studies included in the review.

4. RESULTS

Description of the studies

This describes summary of the selected studies and the characteristics of included studies present in (table 2). Out of eight studies five studies were published before 2020 and three studies published in 2020. Different biochemical markers were used to diagnose diabetes mellitus type 2. Three studies used both fasting blood glucose and glycosylated hemoglobin to diagnose diabetes (13,14,20), one study showed the influence of obesity on diabetes mellitus type 2 induction was diagnosed through BMI calculation (15), rest of studies used glycosylated hemoglobin to diagnose diabetes (16,17,18,19). Oral glucose tolerance test didn't use as biochemical markers in any of those included studies. Fasting blood glucose level below 6.1mmol/l normal, more than 7.0mmol/l diabetes and HbA1C less than 6.5% normal, above 6.5% diabetes (diabetes diagnosis criteria). On diabetes induction, influence of obesity diagnosed through BMI calculation (overweight 25-30, above 30 obese). Both citizen and resident adult population participated in three studies, only residents in another three studies, only citizens in one study, sample in UAE (ethnicity not mentioned) in one study. Number of participants varied from 599 to 3203. Out of eight studies, one is stratified cross-sectional analysis observational study, three are cross-sectional national survey, two are cross sectional diabetes household survey (Dubai), rest two are cross sectional study. The adjusted prevalence of type 2 diabetes was in citizens (male 21% , female 23%) and in Asian residents (male 23%, female 20%) in national cross sectional survey, in Dubai prevalence of diabetes more in citizen (19%-19.3%) in comparison to residents (12.4%-14.7%), diabetes prevalence is positively associated with duration of residence (among female resident workers 40.7% >10 years of residence and among male resident workers 18.8% >10 years of residence). 59% of obese people were having diabetes type 2 in multicultural community people in the UAE.

Associated factors related to high prevalence

A summary of data analysis, associated factors related to high prevalence, presentation of the selected studies are mentioned in (table 3). Among selected studies sample analysis done twice in four studies. (13,14,18,20) The included studies reported different process of sample selection such as through community healthcare center (15), Preventive Medicine Department (13,14,20), Dubai House Hold (16,18), visa screening center (17,19). All participants are above eighteen and in most of studies they were stratified according to age, gender, family history of diabetes, history of self disease and medicine taking, level of physical activity, smoking history, marital status, education level, food and lifestyle habit, height, weight, waist hip circumference. Health related knowledge (13), history of acculturation (17,19) mentioned in those studies. History of acculturation measured as residency more than 10 years, 5-10 years, less than 5 years (19) and more than 10 years and less than 10 years (17). In one study gender, smoking, income, education are statistically not significant. (14) In other study use of medication, cigarette smoking, any type of disease was not statistically significant. (15) Blood samples collected for fasting glucose level, HbA1c and lipid profile. The studies also reported different software mentioned in the (table 3). Those analyzed data were described as mean, mean and standard deviation and statistical tests described were Chi-square test, Omnibus test, Cox and Snell R square, Nagelkerke, Hosmer and Lemeshow test, 95% level of significance, x Square test, Pearson Collection test, 95% confidence Interval, Crude Odd Ratio, t test.

5. DISCUSSION

This review study was conducted to discover the high prevalence of diabetes mellitus type 2 and the effect of its risk factors in the United Arab Emirates. Total 8178 people were studied in eight cross-sectional studies. The prevalence ranges from 12.4% to 40.7% on basis of the results of included studies (table 2). Prevalence varied in different parts of the UAE such as in the Northern Emirates the prevalence was 19.1%-25.1% and in Dubai (12.4%-14.7%) and (19.0%-19.3%) among adult residents and citizens. In Al Ain the prevalence was (18.8%-40.7%) among residents. The included studies represent a

prompt increase in type 2 diabetes prevalence in the UAE during the past few years. Obesity related percentage of diabetes was 59% among the sample in UAE. According to International Diabetes Federation(2019) in Saudi Arabia National Prevalence of diabetes(20-79 years) 18.3% and age adjusted (20-79 years) comparative prevalence 15.8%, in Bahrain 16.3% and 15.6%, in Oman 8.0% and 10.1%, in Qatar 15.5% and 15.6%, in Kuwait 22.0% and 12.2% which are corresponding to the prevalence showed in this review.(22)

The collected evidence of this review also specifies that aging >35 years among citizens and (41-60, 61 plus) among residents, obesity (BMI >30 for Arabs and Europeans and >27 for Asians), central obesity (>102 cm in men and >88 cm in women for Arabs and Europeans , > 90 cm in men and >80 cm in women for Asians), positive family history of diabetes mellitus type 2, ethnicity, suffering from dyslipidemia and hypertension, less physical activity, duration of staying in the UAE more than 10 years, unhealthy diet, being single(widow, separated, divorced), gender and stress were positively associated with high prevalence. Along with the other countries of Gulf region United Arab Emirates are having also higher level of diabetes type 2 risk factors.(23,24,25)

The study conducted by Sulaiman (13) showed 19.1% prevalence of diabetes in residents of Northern Emirates and his another study(14) showed 25.1% prevalence among citizens of same emirates but undiagnosed diabetes percentage (64.2%) was higher.(13) The important factors identified associated with higher prevalence among citizens are more than 35 years of age, positive family history of diabetes among first degree relatives, having hypertension, obese(BMI>30), waist to hip ratio(>0.85 for female and >0.90 for male) (14) whereas among residents including the mentioned factors (age >40 years) few more added factors are unqualified and jobless people 19.3% diabetes prevalence, low level of education (having primary education or no education at all)16.1%, stress and unhealthy diet related to less income 16.0%, abnormal blood lipid(low level of high density lipoprotein 18.7% and high level of total cholesterol 16.3%, triglyceride 20.8%), less physical activity 17.5%, snoring 25%, female gender 16.0% .(13) Though the above mentioned factors are causal factors for fast increase but ethnic variation in the development of insulin resistance, association between TCF7L2 gene and diabetes type 2, unfavorable intrauterine atmosphere could also present.(26,27,28,29) His other study(20) revealed the adjusted prevalence of type 2 diabetes was in citizens 44% (male 21% ,female 23%) and in Asian residents 43% (male 23%,female 20%) which was higher than narrated prevalence rate (17.3% by International Diabetes Federation) in 2017 for wholeover UAE population.(20) These studies confirmed that residents were mainly male, less history of diabetes among their family, more central obesity, lower level of HDL but higher level of total cholesterol and triglyceride comparison to citizens in Northern Emirates.

The study conducted by Shah SM (17) unveiled the prevalence was positively associated with duration of residence in UAE (40.7% was in >10 years of living and 12.8% was in <10 years of living) and the overall prevalence was 10.7% among female residents in Al Ain and his other study (19) exhibited the prevalence of type 2 diabetes was positively associated with the duration of staying in the UAE (18.8% was in >10 years of living, 8.2% was in 5-10 years of living, 2.7% was in <5 years of living) and overall prevalence was 8.3% among male residents in the same emirates. South Asian female had highest prevalence 16.7%, non Emirati Arab females had 12.2% and Filipinos had 1.7%.Diabetes prevalence was higher among more than 40 years women 42.4%, lower education level 27.8%, not working women 25.3%, South Asian females 30.3%, more than 10 years staying in the UAE 40.7%, having central obesity 24.5%, obese women 31.1%, positive family history of diabetes type 2 53.7%.Though in South Asia diabetes prevalence increased meaningfully over last two decades but prevalence among South Asian women (16.7% versus 6%) and Arab women(12.2% versus 4-8%) was higher than their country and in their country urbanization, aging, obesity, higher waist hip ratio, less physical activity associated with escalated diabetes prevalence.(30)Study conducted on South Asian male residents showed crude prevalence of existing diabetes was 8.0% and new diabetes 9.3%.Diabetes prevalence was higher among >45 years age 25.9%, more than 10 years of living in the UAE 18.8%, Indian male 12.2%, located in urban and semi urban area in their home country 10.1%, males other than professional 12.7%, higher income group 11.9%, former smoker 18.9%, central obesity 13.0%, overweight males 11.1%, no activity 10.4%, positive family history 18.5%. Prevalence of diabetes among female residents living more than 10 years was comparatively higher (40.7%) than male(18.8%) but these prevalence were corresponding with 25% prevalence among local adult Emirati in Abu Dhabi based on fasting glucose level or oral glucose tolerance test after two hours of meal. These studies confirmed that South Asian (due to higher level of insulin resistance throughout the life, central obesity), age, positive family history of diabetes, residence more than 10 years, unhealthy diet induced overweight and obesity were strong associated factors for female residents in Al Ain.

The findings from Dubai household health survey in 2014 and 2017 conducted by Alawadi (18) combined revealed prevalence of type 2 diabetes among citizens 19% and for residents 14.7%, overall prevalence was 15.2% whereas the results from Dubai household survey 2019 by same author (16) showed prevalence among citizens 19.3% and among residents 12.4%, the total prevalence was 13.7%. The prevalence of diagnosed (9.0% and 3.8%) and undiagnosed (10.0% and 10.9%) diabetes for both citizens and residents in Dubai at the age 50-59 years and 60+, male gender, obesity, no physical activity, family history of having diabetes, hypertension, separated. Undiagnosed diabetes was higher among female residents. Known diabetes was higher among smoker citizens whereas undiagnosed diabetes was higher both non smoker citizens and residents. (18) 2019 household survey in Dubai showed less overall and residents prevalence. The survey data showed in from 50-59 years and 60+ people had higher prevalence for both diagnosed (16.1% and 10.5%) and new diabetes (3.2% and 1.9%) among citizens and residents which was as a result of other factors such as obesity (citizens 23.90%, residents 20.40%), no physical activity (citizens 20.20%, residents 10.10%), smoking (citizens 27.90%, residents 9.80%), hypertension (citizens 37.60%, residents 9.80%), separated due to divorce/spouse death (citizens 39.90%, residents 19.90%). Both type of diabetes prevalence was more among non educated citizens and primary educated residents. These studies confirmed that aging, obesity, being single and stressful life, hypertension, family history of diabetes were powerful associated factors for citizens in Dubai. The oil discovery in the UAE along with other GCC countries expedited significant changes of socioeconomy that mirrored on the lifestyle and made people adopt more sedentary life, consumption of junk food leads to increase obesity and diabetes type 2. (31)

Study conducted on multinational communities in the UAE to find out association of type 2 diabetes with obesity and other factors by Arafat (15) showed age 40-45+, female gender, middle eastern population, positive family history of diabetes, obesity and unhealthy food were associated with high percentage of diabetes. Use of medication, cigarette smoking, any type of disease was not statistically significant.

The main strength of this study is that we conducted full text review and critical appraisal before selecting final studies for this review to minimize the bias and local implication of the result. Less than 50% of diabetes mellitus type 2 patients in the UAE meet their glycemic targets level (32), this review results will help to diagnose individual at risk by early screening, develop or adopt tool to measure acculturation, suggestion about consideration of prospective cohort study, policy development to meet health needs for residents and citizens, the necessity of preventive and screening measure nationally, promotion of healthy lifestyle and implication of health cost, can inspire to conduct study on residents staying in the UAE <10 years.

6. LIMITATIONS

This review article has confirmed some limitations although we followed a comprehensive methodology. First, we included only English language publications, leading to under-representation of studies in other languages and we did not search gray literature. Second, we included only cross sectional studies findings which naturally don't explain the relationship between cause and effect. So, factors are related with high prevalence rate we can mention as associated factors and should prospective cohort studies be considered? Third, the focus of this review was on the UAE, then to apply our findings to other world regions with the same characteristics further studies will be needed on the high prevalence rate and associated factors. Fourth, we couldn't conduct meta-analysis due to the inability to utilize odd ratios as confidence intervals done in 5 studies out of 8 and 2 articles reported missing data which we couldn't solve by sending an email to the author.

7. CONCLUSION

Diabetes prevalence was highest among citizens living in Northern Emirates and based on the most significant related factors the intervention process for identification and prevention of diabetes type 2 required early. Female residents living in Al Ain had the highest diabetes prevalence and health care providers should be more concerned about South Asian female residents who are >40 years and living in the UAE more than 10 years. In Dubai, though prevalence among citizens increased but prevalence among residents decreased in 2019 survey. Diabetes prevalence and its associated factors varied in different emirates. Residents specially South Asians were having less family history of diabetes but more central obesity due to sedentary life and unhealthy diet when their year of residence increased. Collected evidence also informed about less physical activity due to hot, humid climate and community barriers. As cross sectional studies are not suitable to comment about risk factors, should prospective cohort studies be considered? This review article presents evidence of the increasing and high prevalence of diabetes type 2 in adults in the UAE. Though this is the ultimatum for the health care providers, the

programs for health promotion, prevention and control of diabetes can be implemented against associated factors which are modifiable and commonly known.

CONFLICT OF INTEREST

This article did not report any potential conflict of interest.

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Identification of studies via databases and other methods

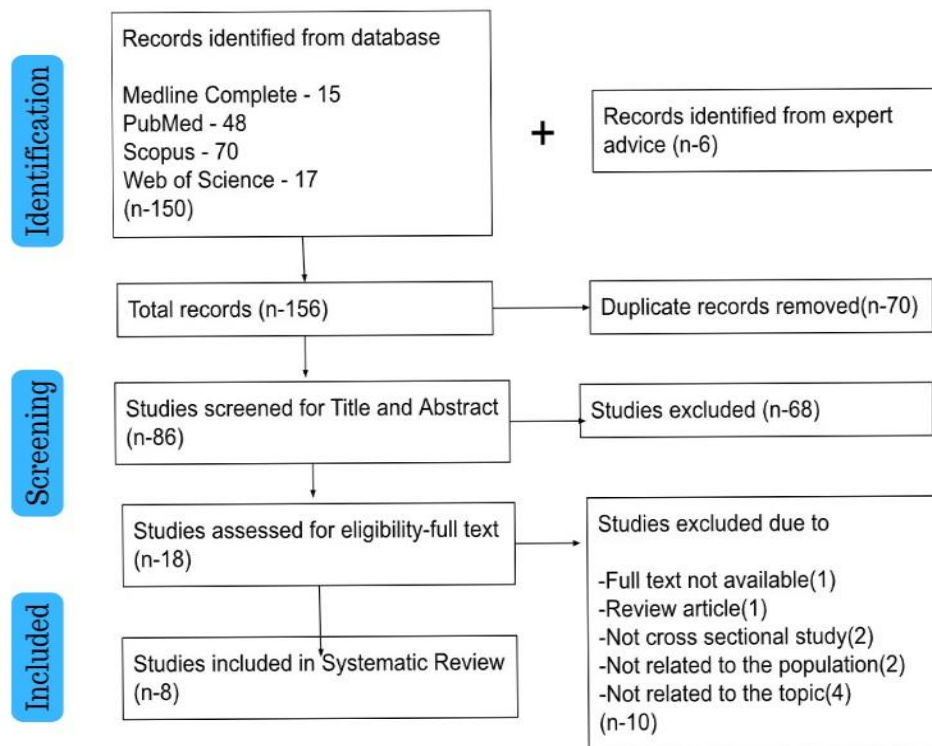


Figure 1 Flow Diagram: PRISMA (Preferred Reporting Items for Systematic Review and Meta - analysis) figure for illustrating the screening process of the articles for the systematic review.

Fig. 1

Table 1: (Critical appraisal of the selected studies)

Articles	Section A: Are the results of the study valid?		Is it worth continuing?						Section B: What are the results?			Section C: Will the results help locally?		
	Did the study address a clearly focused issue?	Was the cohort recruited in an acceptable way?	Was the exposure accurately measured to minimize bias?	Was the outcome accurately measured to minimize bias?	a. Have the authors identified all important confounding factors?	b. Have they taken account of the confounding factors in the design and/or analysis?	(a) Was the follow up of the subjects complete enough?	(b) Was the follow up of subjects long enough?	What are the results of this study?	How precise are the results?	Do you believe the results?	Can the results be applied to the local population?	Do the results of this study fit with other available evidence?	What are the implications of this study for practice?
Sulaiman et al.2018	Yes	Yes	Yes	Yes	Yes	Yes	Not mentioned	Yes	The highest prevalence was in Asians (16.4%) and non-Emirati Arabs (15.2%) and lowest in Africans and Europeans (11.9%). It increased with age: 6.3% in 18-30 years and 39.7% in 51 to 60 year	Confidence Interval done	yes	yes	yes	The urgent need for better preventive and screening measures nationally. To develop a policy for meeting the health needs of migrants in the UAE.
Sulaiman et al.2018	Yes	Yes	Yes	Yes	Comment: food intake was not included	Yes	Not mentioned	Not mentioned	high prevalence of diabetes among UAE citizens who live in the Northern Emirates (25.1%)	Confidence Interval done	Yes	Yes	Yes	Can implement to diagnose individual at risk.
Sulaiman et al.2019	Yes	Yes	Yes	Yes	Yes	Yes	Not mentioned	(residents) but can't tell about citizens because its not mentioned	The adjusted prevalence of type 2 diabetes was in citizens 44%(male 21%, female 23%) and in Asian residents 43%(male 23%,female 20%)	Confidence Interval done	Yes	Yes	Yes	On basis of these informations can improve early screening system
Shah SM et al.2020	Yes	Yes	Yes	Yes	Yes	Yes	Not mentioned	Not mentioned	The overall prevalence of type 2 diabetes was positively associated with duration of staying in the UAE(18.8% was in >10 years of living, 8.2% was in 5-10 years of living and 2.7% was in <5 years of living workers)	Confidence Interval done	Yes	Yes	Yes	Helpful in policy making, preventive and health promoting strategies, implication of cost of health system
Shah SM et al.2017	Yes	Yes	Yes	Yes	Yes	Yes	Not mentioned	Not mentioned	The overall prevalence was 10.7% and positively associated with duration of residence in UAE(40.7% was in >10 years of living and 12.8% was in <10 years of living female workers)	Confidence Interval done	Yes	Yes	Yes	Can inspire to develop tool in the UAE to measure accuration or to adopt and validate a tool

Alawadi et al.2020	Yes	Yes Comment: They mentioned some limitations about missing data and complex stratification	Yes	Yes	Yes	Yes	No	Yes	In 2014,the dubai household survey and in 2017 samples combinedly showed that the prevalence of type 2 diabetes among citizens 19% and for residents 14.7%.Overall prevalence was 15.2%.The rate of undiagnosed diabetes was almost equal to known diabetes in Dubai UAE nationals and was much higher in Dubai residents.Undiagnosed diabetes was much higher in Dubai residents in comparison to nationals with an exception being among smokers.	Confidence Interval not done.The data were tested at a 95% level of significance and P-value was <0.05	Yes	Yes	Yes	Focusing particularly on modifiable risk factors and to perform robust screening on those who are having risk factors.
Alawadi et al.2020	Yes	Yes Comment: They mentioned some limitations about missing data and complex stratification	Yes	Yes	Family history of diabetes did not record	Yes	No	Yes	Diabetes type 2 prevalence among citizens 19.3% and among residents 12.4%.The total prevalence was 13.7%.Correlation of age and prevalence of diabetes in Dubai,UAE (nationals and residents)	Confidence Interval not done.They did Chi square test and Pearson correlation(P-value was 0.03 or less)was considered statistically significant	Yes	Yes	Yes	To improve the collective measure to reduce diabetes and to improve health department services
Arafat et al.2014	Yes	Yes Comment: They mentioned sample of study but didn't mention nationality	Can't tell.	Yes	Yes	Yes	Not mentioned	Not mentioned	Most significant factor related to type 2 diabetes was obesity (59%)diabetic of obese people.Diabetic cases were within the age (40 to 45+) 75%,within the age (29 to 39) 23%.Female,middle eastern,who consume unhealthy food more prone to develop diabetes.Family history was very significant difference on being diabetic among study population(P<0.001)	Confidence Interval not done.They did Chi square test(P value of 0.05 or 1 was less statistically significant)	Can't tell	Yes	Yes	Provide important informations about primary and secondary interventions program to manage diabetes type 2.Develop and implement strategy for promotion of health and lifestyle

Table 2: (Summary of the studies included in the review)

Title of the study	Author and year	Population and country	Study Design	Study Findings	Validated tools	Limitations
High prevalence of diabetes among migrants in the United Arab Emirates using a cross-sectional survey	Sulaiman et al.2018	Resident population living in the UAE (in the Northern Emirates) more than 4 years (n-2406)	Cross-sectional	Highest prevalence rate of type 2 diabetes was in Asians (16.4%),Non emirati arabs(15.2%) and lowest in Africans,Europeans(11.9%).The overall prevalence among migrants was 19.1%	FPG,HbA1c,BMI,waist circumference,waist to hip ratio,BP,TG,HDL,LDL	1.Convince people to fast more than 8 hours 2.Who came at the last minute to renew their visa for them was very difficult to adjust to another 30-45 minutes extra time. 3.Due to the above reasons response rate was 68%
Diabetes risk score in the United Arab Emirates:a screening tool for the early detection of type 2 diabetes mellitus	Sulaiman et al.2018	Citizen population living in the Northern Emirates of UAE (n-797)	Cross-sectional	The overall prevalence of diabetes type 2 was in the citizen of Northern Emirates(25.1%)	HbA1c,BMI,waist circumference,waist to hip ratio,BP	The subjects might not represent the whole population in UAE,food intake was not included,data from the population in other emirates was not collected.
Prevalence and diabetes risk factors comparison between ethnic groups in the United Arab Emirate	Sulaiman et al.2019	Citizen and resident population living in the Northern Emirates of UAE (n-3203)	Cross-sectional	The adjusted prevalence of type 2 diabetes was in citizens 44%(male 21% ,female 23%) and in Asian residents 43%(male 23%,female 20%).	FPG,HbA1c,BMI,waist circumference,waist to hip ratio,BP,HDL,LDL,TG	Not mentioned
Association between duration of residence and prevalence of type 2 diabetes among male South Asian expatriate workers in the United Arab Emirates:A cross-sectional study	Shah SM et al.2020	Male South Asian expatriate workers in Al Ain ,UAE (n-1375)	Cross-sectional	The overall prevalence of type 2 diabetes was 8.3% and positively associated was duration of staying in the UAE(18.8% was in >10 years of living,8.2% was in 5-10 years of living and 2.7% was in <5 years of living workers)	HbA1c,BP,BMI,physical activity measurement,waist and hip circumference,years of living in UAE	Migrant workers from Nepal,Sri Lanka were not included,cross-sectional study not sufficient to comment on relationship in between duration of staying and diabetes prevalence,no validated tool in UAE to measure acculturation
Prevalence of Diabetes among Migrant Women And Duration Of Residence In the United Arab Emirates: A Cross Sectional Study	Shah SM et al.2017	Migrant women aged 18 years and over in Al Ain,UAE (n-599)	Cross-sectional	The overall prevalence was 10.7% and positively associated with duration of residence in UAE(40.7% was in >10 years of living and 12.8% was in <10 years of living female workers)	HbA1c,BP,BMI,physical activity measurement,waist and hip circumference,years of living in UAE	Cross-sectional study not sufficient to comment on relationship in between duration of staying and diabetes prevalence,no validated tool in UAE to measure acculturation
The Prevalence of Diabetes and Pre-Diabetes among the Dubai Population: Findings from Dubai Household Health Surveys, 2014 and 2017	Alawadi et al.2020	Citizens and residents of Dubai (n-600)	Cross-sectional	In 2014,the dubai household survey and in 2017 samples combinedly showed that the prevalence of type 2 diabetes among citizens 19% and for residents 14.7%.Overall prevalence was 15.2%	HbA1c,BP,BMI,physical activity measurement	Missing data,complex stratification of data
Prevalence of Diabetes and Associated Health Risk Factors among Adults in Dubai, United Arab Emirates: Results from Dubai Household Survey 2019	Alawadi et al.2020	Citizens and residents of Dubai (n-1799)	Cross-sectional	Diabetes type 2 prevalence among citizens 19.3% and among residents 12.4%.The total prevalence was 13.7%	HbA1c,BP,BMI,physical activity measurement	Missing data,complex stratification and didn't record family history of diabetes
The association of type 2 diabetes and with obesity and other factors:In multinational community	Arafat et al.2014	Sample in UAE .Ethnicity not mentioned(n-602)	Cross-sectional	Most significant factor related to type 2 diabetes was obesity (59%) diabetic of obese people)	BMI	Not mentioned

FPG(fasting plasma glucose), HbA1c(glycosylated hemoglobin), BP(blood pressure), BMI(body mass index), TG(triglyceride),LDL(low density lipoprotein), HDL(high density lipoprotein).

Table 3: (Study of data analysis and presentation of the selected studies)

Articles	Sample Analysis	Software Use	Statistical test	Risk factors	Mean And SD
Sulaiman et al.2018	1+1	Statistical Package for Social Sciences,version 22(IBM corp,New York)	Chi-square test, P-value,Omnibus test, Cox and Siedl R square,Nagelkerke,Hosmer and Lemeshow test,Odd ratio of 95% CI	Ethnicity (Asians,nou-emirati arabs),aging(>40 years),gender(female),obesity,family history of diabetes,dyslipidemia,stress and hypertension,low income,low education,watching tv less than one hour per day,snoring	done
Sulaiman et al.2018	1+1	Statistical Package for Social Sciences (SPSS) version 22 (IBM,New York,USA)	P-value,Omnibus test,multiple logistic regression analysis, Odd ratio of 95% CI	Aging (>35 years),family history diabetes,hypertension,increased waist hip circumference.BMI(>30),Gender,smoking,income,education are statistically not significant	done
Sulaiman et al.2019	1+1	Statistical Package for Social Sciences (SPSS) version 24(IBM,New York,USA)	Student t test,x square test,P-value,logistic regression of independent factors	Ethnicity,aging(>35 years for citizens,>40 years for residents),gender(female citizens and male residents),larger waist circumference(residents>citizens),increased triglyceride(residents>citizens),family history of diabetes(citizens>residents),snoring(citizens>residents),obesity(citizens>residents),less physical activity,increase systolic blood pressure	done
Shah SM et al.2020	1	Stata V.11.0 (StataCorp,College Station,Texas)	95% CI,x square test,P-value,crude Odd ratio	Duration of staying in UAE(>10 years,5-10 years,<5 years),aging(>45 years),ethnicity(Indian males),family history of diabetes,income and occupation,physical activity level,smoking ,obesity ,increased waist hip circumference	done
Shah SM et al.2017	1	Stata V.14.0 (StataCorp LP,College Station,Texas)	Odds Ratio and 95%CI, crude prevalence of diabetes by nationality and duration of staying,P-value	Duration of staying in UAE(>10 years and <10 years), aging(>40 years),ethnicity(Asian),family history of diabetes,income and occupation,physical activity level,obesity,increased waist hip circumference	done
Alawadi et al.2020	1+1	Statistical Package for Social Sciences Program	95% level of significance,P-value	Gender(male),age (50-59 and 60+),obesity,less physical activity,hypertension,marital status(widow ,divorced,separated),family history,lower level of education	Not done
Alawadi et al.2020	1	Statistical Package for Social Sciences V.21(IBM,Armonk,New York,USA) and Stata 12(STATACorp,College Station,Texas,USA)	X square test,Pearson collection test,P-value	Gender(male),age (50-59 and 60+),ethnicity(citizens>residents),obesity,less physical activity,smoking,hypertension,marital status(widow,divorced,separated),lower level of education	Not done
Arafat et al.2014	Not mentioned	Not mentioned	Chi-square test,P-value	Age(40-45),female gender,middle eastern,unhealthy diet,obesity,family history of diabetes,Use of medication,cigarette smoking,any type of disease was not statistically significant	Not done