DM And Low Immunity Among Elderly Patients, Systemic Review In KSA

Arwa Amer Alsaiari[1], Hoor Khalid Ghandorah[2], Saad Mohammed Almasari[3], Ajfan Khalid Mogharbel[4], Noura Shawki Saati[5], Dalia Faisal Rowaihy[6], Arwa A Alomayrini[7], Taif Nasser Alharrani[8], Joza halban alotaibi[9] and Abeer eid almueahy[10]

[1] Family Medicine Consultant, Jeddah second health cluster,King Abdullah Medical Complex, Jeddah, KSA Dr.arwa2009@hotmail.com
[2] MD, Family medicine senior registrar, king fahad hospital, Jeddah, KSA
[3] Family Medicine Consultant , First health cluster, Riyadh, KSA Dr.masari13@gmail.com
[4] MBBS, Medical Doctor, Jeddah Second Health Cluster, King FahadHospital, Jeddah, KSA
ajfan.k.m@gmail.com
[5] MBBS , General physician, Mental health hospital, Jeddah, KSA
[6] MBBS, General physician, Albawadi 2- Medical center, Jeddah , KSA
[7] MBBS , General physician, King Fahd Specialist Hospital, Buraydah, KSA
[8] Pharma- D , Bachelors of Doctor of pharmacy, Abha, KSA
[9] Specialist Nurse, Public medical center in Qaryat al-Ulya, Eastern province, KSA
[10] Technician Nurse, Public medical center in Qaryat al-Ulya, Eastern province, KSA

Abstract

Actually there is currently no universally recognized age threshold to define the term "old people," the majority of developed nations have recognized and reported that the age of 65 is a definition of elderly people, primarily as a construct equivalent to the traditional retirement age. Furthermore, the notion of elder patients might be better defined by a person's active participation in society or other socially constructed markers rather than by age. Furthermore, a cut-off definition of 65 years and older was used in the majority of earlier research. This present study will evaluate the scenario in terms of life style related factors and trends of DM in elderly patients in KSA. Study will be based on previous studies conducted in the period of 2015 to 2024.

Keywords: Diabetes Mellitus, Elderly pateints, KSA.

Introduction

One of the major health problems facing people in the twenty-first century is diabetes mellitus (DM), and both industrialized and developing nations are seeing a steady rise in the number of patients worldwide. It's a chronic, non-infectious disease that arises when the body cannot correctly use the insulin that the pancreas produces, or when the organ is unable to create enough insulin. Menke et al (2015) Although there is no known treatment for this chronic, complex condition, it is largely preventable and treatable. Alqurashi et al (2011)

Diabetes that is not treated frequently results in hyperglycemia, or elevated blood sugar. Nerves and blood arteries are among the many bodily systems that it can seriously harm over time. This most prevalent chronic, non-communicable disease has a complex etiology that includes both environmental and genetic influences throughout its development. ADB (2020) Diabetes is a costly condition that affects the patient, his or her family, and the health authorities due to its chronic nature, the severity of its complications, and the control methods needed. Yang et al (2017)

The causes of this global DM epidemic include aging, population growth, affluent and sedentary lifestyles, and bad eating habits that lead to the fatal issues of obesity and physical inactivity. Chentli et al (2015) According to estimates from the International Diabetes Federation (IDF), there will be 366 million people with diabetes worldwide by 2030, up from 171 million in 2000. Regretfully, by 2011, 366 million people worldwide had diabetes mellitus. According to the IDF, 8.3% of the 382 million adults in the world have diabetes, and in less than 25 years, that number is predicted to rise to 592 million. Alsuwaidan et al (2021) The second big worry is that there are still an astounding 175 million undiagnosed instances of diabetes who are blissfully ignorant of the fact that they are developing consequences from the disease. Notably, a significant portion of the 382 million people with diabetes worldwide are between the ages of 40 and 59, and 80% of them reside in low- and middle-income nations. Recent IDF data serves as a stark warning about diabetes's potential to pose a serious danger to global development in the future. While type 1 diabetes mellitus (T1DM) is still a major societal concern, type 2 diabetes mellitus (T2DM) is more common. Since 70,000 new cases of T1DM are diagnosed each year, the condition is becoming more common in both developed and developing countries. Al Dawish et al (2016)

Its fast population expansion and rising rate of disease-related early mortality demonstrate the burden that diabetes mellitus places on society. About half of all adult diabetes-related deaths in 2015 occurred among people under the age of sixty. In actuality, a death from diabetes occurs every six seconds, and in less developed areas, that percentage might reach 75%. In the past, diabetes was responsible for little over 800,000 deaths. Nevertheless, it is commonly recognized that the figures are significantly understated. A more accurate estimate would be approximately 4.6 million deaths per year among those aged 20 to 79. With an estimated rate of one death every seven seconds, this represents 8.2% of the global all-cause mortality for people in this age range. Furthermore, compared to the 2016 estimates, the number of deaths has increased by 13.3%. Gregg et al (2020)

The incidence of diabetes mellitus varies greatly by region due to variations in environmental and lifestyle risk factors. Thus, it's crucial to remember that 31 of 219 nations, or almost 17% of the total, have a very high prevalence of diabetes—more than 12%. These nations are primarily found in the Middle East, North Africa, and Western Pacific. With a population of over 20 million, the Kingdom of Saudi Arabia (KSA) is the largest country in the Middle East, covering an area of 2,150,000 km^3. Nowadays, DM is acknowledged as a prevalent yet quickly growing issue and a major contributor to illnesses and fatalities in Saudi Arabia. As such, it has emerged as one of the most significant social and economic health concerns in this area. The paucity of research on the occurrence, prevalence, and sociodemographic

characteristics of type 2 diabetes, particularly in relation to emerging nations, is concerning. From the published literature, we address a variety of topics pertaining to type 2 diabetes in Saudi Arabia in this review, specifically for elderly people. MoH, KSA (2020)

Although there is currently no universally recognized age threshold to define the term "old people," the majority of developed nations have recognized and reported that the age of 65 is a definition of elderly people, primarily as a construct equivalent to the traditional retirement age. Furthermore, the notion of elder patients might be better defined by a person's active participation in society or other socially constructed markers rather than by age. Furthermore, a cut-off definition of 65 years and older was used in the majority of earlier research. The world's population is aging, and according to the World Health Organization (WHO), there will be two billion people over the age of 60 by 2050, up from 900 million in 2017. Alsuwaidan et al (2019)

Poor glycemic control along with brittle diabetes, insulin resistance, recurrent diabetic ketoacidosis, insulin experience, and inadequate compliance and education are the worst outcomes for senior individuals with diabetes. The longer an aged patient has had diabetes, the greater their vulnerability to problems associated to the disease and their increased chance of acquiring geriatric syndromes. The goal of this study is to determine whether there is a chance to lower the death rate associated with diabetes mellitus in the elderly and to provide recommendations for improving the quality of care and lowering hospitalization rates for older adults with the disease. Veronese et al (2020)

Objective of the Study

The main objective of the study is to present all the components related to diabetes mellitus in Saudi, information about the same will be extracted from research studies published in and outside of KSA; although the focus will be on KSA.

Research Process

Premise: The study is based on the assessment of Diabetes mellitus in elderly patients in KSA, the period of 2015 to 2024; the researcher has mainly considered the effect of the same on elderly patients and even the state of immunity.

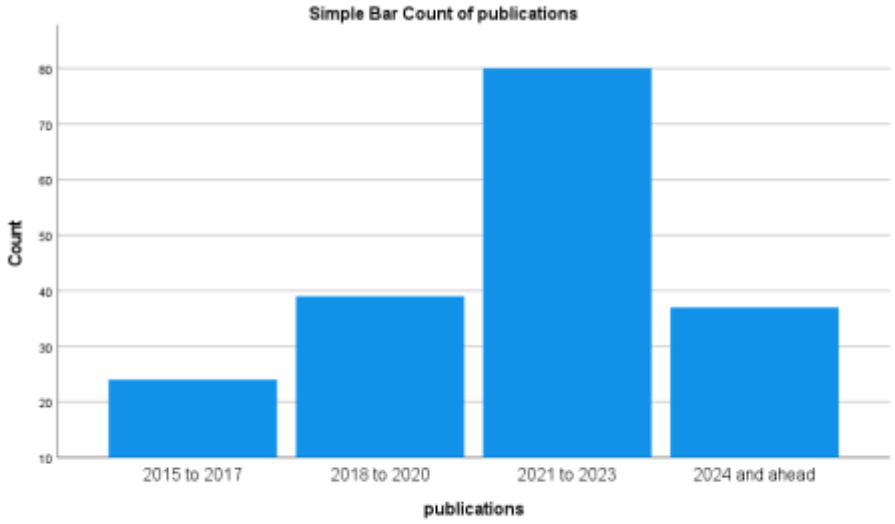
Research Design: This study is an exploratory study i.e. based on the studies conducted in the recent past; mainly in the above mentioned period. The data was collected from the studies published in Scopus, SCI, PubMed, etc. In general the socio-demographic features and comorbidities were considered.

Studies Included: This study touched around 215 previous studies based on the keywords like Diabetes mellitus, KSA, elderly patients, patients, Diabetes. Subsequent matches were made with the objective of the collected studies and research question of this present study. Any deviation in the premise of the same were excluded from the study. Finally 180 studies were selected for the study.

Evaluation: The collected qualitative information was evaluated, assessed and presented using SPSS Ver. 27.0.

Basic Statistics

In this section the researcher has tried to present the detailed view of the research studies carried out in the said study period. The evaluation includes all the 180 studies as assimilated in this present study. Most of the studies are having direct relation to the research question and and objective.



Source: Input Data in SPSS (Ver. 27.0) sheet

Figure 1: Publication Details of DM during the Study Period

As can be seen from the above figure 1, maximum of the studies were conducted in the period of 2021 to 2023, this is because of the reason that after the attack of COVID 19 many of the elderly people reached hospitals for general checkups and at that time the presence of DM was detected, this motivated the researchers to work of the issue and give their inputs as and where required.

Source: Input Data in SPSS (Ver. 27.0) sheet

Figure 2: State of Authors Within and Outside KSA

In this present study most of the authors were included from KSA only and some of the foreign authors were included to present the data of DM (elderly people) in resent of the world.

Discussion

According to the most recent IDF studies, the incidence and prevalence of DM are on the rise in the Arab world, which appears to be greater than the average growth in DM worldwide. About 170,000 adult deaths in Saudi Arabia are ascribed to diabetes, accounting for more than 10% of all fatalities in the nation. More concerning than mortality, though, are the short-term and long-term impairments brought on by diabetes-related illnesses such as blindness, amputations, kidney failure, psychological discomfort, and cardiovascular disorders. Benbow et al (2021) The high incidence of non-communicable diseases like diabetes mellitus has not yet been sufficiently prioritized by Arab governments, particularly when it comes to resolving policy disparities within nations. As a result, diabetes has a significant financial impact because of lost productivity as well as treatment costs. According to the IDF, treating diabetes in the Arab world would cost USD 8.7 billion in 2011. Additionally, it revealed that six of the ten nations with the highest prevalence rates of diabetes worldwide—Kuwait, Lebanon, Qatar, Bahrain, the United Arab Emirates, and Saudi Arabia—are located in the Gulf region. According to the current data, there are 20 Arab countries where around 20.5 million individuals have diabetes and 13.7 million more have impaired glucose tolerance (IGT), a condition that precedes diabetes. Diabetes prevalence has risen from about 3% before 1980 to 5% to 16% currently, affecting over 10% of the adult population, according to data from Jordan, Libya, Morocco, and Oman. Diabetes was reported to be the primary cause of End-Stage Renal Disease (ESRD) in Jordan [29.2%], whilst the rate in the United Arab Emirates was 23.3%. Given that kidney disease affects 30% of diabetics, diabetic kidney disease is probably another significant health issue in the Arab world. Jolobe et al (2022)

Soon after the fast industrialization that led to a notable improvement in living standards and a more "Westernized" way of life, the Kingdom of Saudi Arabia started to observe a sneaky rise in the incidence and prevalence of DM. Over 25% of adults in the nation now have diabetes, an alarming increase caused by poor eating habits and a decline in physical activity. By 2030, the rate is predicted to more than double. Corriere et al (2017); Alyami et al (2022)

The World Health Organization (WHO) reports that Saudi Arabia has the second-highest rate of diabetes in the Middle East and the seventh-highest rate globally. Perhaps more worrisome is the recent rise in diabetes prevalence, which has increased by almost 10 times in Saudi Arabia over the previous three decades. In fact, DM is now regarded as an epidemic in Saudi Arabia. Rockwood et al (2020) Furthermore, research since the late 1980s has shown that one in five Saudi people has diabetes mellitus, an increasing trend. Furthermore, according to a more recent study, the prevalence of diabetes has increased to 27.6% in women and 34.1% in men. According to the study, the average age at which diabetes first appeared in men and women was 57.5 and 53.4 years, respectively. According to another study, 23.7% of Saudi Arabians aged 30-70 had diabetes mellitus overall, with a higher prevalence of impaired fasting glucose in the central region (Riyadh). Additionally, they noted that the prevalence of diabetes was much greater in urban areas (25.5% compared to 19.5% in rural areas). Umemura et al (2019); Ishii et al (2019) More than half of Saudi Arabia's population aged 30 and over had either diabetes (25.4%)

or pre-diabetes (25.5%), according to a more recent survey. A startling 40.3% of diabetic patients were completely unaware that they had the condition. The prevalence rate is expected to reach over 50% of adults by 2030, therefore it is not surprising if current trends continue. There were, however, very few investigations on the epidemiology of T1DM in Saudi Arabia when it was taken into account alone. The available research papers indicated that the prevalence of type 1 diabetes among Saudi children and adolescents was 109.5 per 100,000, which is significantly higher than the rate in many developed nations, and that the incidence of the disease had been rising over the previous 30 years. Medina had the highest incidence of type 1 diabetes when compared to other large cities in the Middle East. Furthermore, it has been observed that the mean annual incidence of T1DM in Eastern Saudi Arabia has nearly doubled, rising from 19 in 1995–1999 to 35 in 2000–2010. Weinger et al (2022) These statistics demonstrate that unless a long-term, comprehensive epidemic control program is vigorously implemented, including the promotion of a healthy diet, an active lifestyle, exercise, and the control of obesity, the prevalence of diabetes in Saudi Arabia is going to skyrocket to catastrophic levels. Asiimwe et al (2020)

a. Lifestyle Patterns and Urbanization

Saudi Arabia has advanced economically and commercially during the past forty years, raising living standards and embracing "Westernized" lifestyles. This crisis has been brought on by poor dietary choices and decreased physical activity. Similar to this, the Saudi population's hereditary susceptibility to diabetes and the large percentage of consanguineous marriages, in addition to their abrupt shift to a sedentary lifestyle, are additional factors contributing to the rising trend of DM.

Pennbrant et al (2019)

One study found that diabetes was influenced by both urbanization and monthly income since, even among low- and middle-income groups, the prevalence of DM was much greater in urban regions. This was explained by the idea that a high income might counteract both the effects of global urbanization and urbanization itself, which has reduced the disparity between the lifestyles of rural and urban residents. Watcharanat et al (2021)

Compared to 20% of Saudi Arabia's rural population, 26% of its urban population has diabetes. There are regional variations as well; the Northern provinces have higher rates of DM prevalence (31%), while the Eastern provinces have higher rates (29%). This suggests that the Southern region has a more rural lifestyle and a population that is less likely to be obese than the Northern and Eastern provinces.Yang et al (2017)

Dietary Pattern

Unfortunately, Saudi Arabia lacks data on the impact of environmental risk factors for diabetes. The regular consumption of dates, baked goods, desserts, and rice and meat dishes that are high in fat and carbohydrates are examples of dietary choices that are native to Saudi Arabia. The association between dietary habits and the risk of diabetes mellitus (DM) was examined in a small population-based study, excluding the effects of age, gender, education, and family history of the disease.

Furthermore, many research concentrated on particular dietary patterns that contribute to the increase in the prevalence of diabetes mellitus in Saudi Arabia. Due to the prevalence of meals like French fries, baked goods, and kabsa (mixed rice dish) in Saudi Arabia, the study found that these foods were the main causes of diabetes mellitus among Saudi citizens.Alyami et al (2021)

Physical Activity

It is becoming increasingly clear that declining levels of activity are linked to the global DM epidemic. Dynamic, regular exercise is essential for managing diabetes, regardless of age, as it enhances the advantages of both physical and mental health. The majority of Saudis are generally not physically active enough to benefit from physical exercise, according to earlier research on the physical activity profile of Saudi adults. Therefore, encouraging physical activity must be a top priority in order to prevent and treat diabetes mellitus, and type 2 diabetes in particular. An astounding 99.5% of adult females from the Asir region reported not exercising at all, regardless of intensity, while an alarming 81% of Saudi adult males in the capital of Riyadh are inactive. Almedlej et al (2019) When compared to the United States, the United Kingdom, and other developed nations, Saudi Arabia's high prevalence of physical inactivity poses a significant public health cost. Also, the incidence of diabetes in Saudi society will only increase to epidemic levels in the near future due to the high prevalence of other risk factors, such as coronary heart disease. Maggi et al (2020)

Obesity

Obese persons have a seven-fold increased chance of developing diabetes, and overweight people have a three-fold increased risk of developing diabetes compared to those who are at ideal weight. Much of the increased prevalence of DM has been apparent as a result of a shift in lifestyle toward more sedentary lifestyles coupled with high-fat diets that lead to obesity. Because they are so common, both of these traits are accepted as normal in Saudi Arabia, even though they are both avoidable and reversible. Inadequate data currently exists regarding the association between lifestyle choices and the prevalence of diabetes in Saudi Arabia. But some research on Saudi Arabia's economic growth and westernization over the last forty years has made incredibly drastic dietary shifts more common. Dates, fresh vegetables, fruit milk, whole wheat bread, and fish were consumed in large quantities. However, these days, people frequently eat foods high in saturated fats and refined carbohydrates, along with little dietary fiber. A significant increase in the prevalence of diabetes mellitus and obesity in Saudi Arabia is linked to these dietary modifications. Walsh et al (2021)

An obesity research conducted in Saudi Arabia's Eastern Province found that obesity has reached epidemic levels among women, primarily those over 40. In this age group, 78.4% of women were overnourished, whereas up to 30–40% of women in younger groups were overweight or obese. It is not unexpected that disorders like diabetes are prevalent in people with obesity given these concerning facts. Khin et al (2022)

Related Components

Individuals with diabetes mellitus are more susceptible to many short- and long-term consequences, many of which result in early death. Due to the prevalence of this kind of DM, its modest onset, and its late detection, patients with DM have a tendency to have greater rates of morbidity and mortality. Additionally, a number of studies have demonstrated that diabetes mellitus is one of the top 10 worldwide causes of disability and a significant risk factor for heart disease and stroke. Diabetes that is poorly managed or goes undiagnosed can cause blindness, renal problems, and even lower limb amputation. Rooparinesingh et al (2017)

Major infectious diseases including malaria, HIV/AIDS, and tuberculosis can also be made worse by diabetes mellitus. The World Health Organization projects that NCDs, including diabetes mellitus, will soon overtake all other causes of morbidity and death in Saudi Arabia. It is still unknown how common micro and macrovascular problems are in Saudi Arabian DM patients. Such findings are unquestionably essential, given vascular complications are responsible for over 55% of all deaths among DM patients in affluent nations. Algharbi et al (2022)

A recent study conducted in Saudi Arabia's Al Ahsa province found that diabetes individuals had a significant prevalence of chronic problems. Among the important comorbidity variables are the high prevalence of obesity, hypertension, and dyslipidemia. In total, 70% of research participants experienced at least one diabetes mellitus-related problem. Of these, 31% experienced just one issue, 25% experienced two, and 15% experienced more than two. Additionally, the study found that women had a considerably greater overall prevalence of complications than men. MacKnight et al (2020) A recent study based on the Saudi National Diabetes Registry revealed that the total prevalence of diabetic nephropathy in Saudi Arabia was 10.8%, with 1.2% of cases being micro-albuminuria, 8.1% being macroalbuminuria, and 1.5% being end-stage renal disease. Additionally, the prevalence of diabetic nephropathy was found to be strongly influenced by age and the length of diabetes, with rates ranging from 3.7% in patients aged 25–44 with a duration of >5 years to 21% in patients aged 65 and with a diabetes course of 15 years. Diabetes duration, retinopathy, neuropathy, hypertension, age over 45, hyperlipidemia, smoking, male sex, and poor glycemic control over time all suggest a markedly elevated risk of diabetic nephropathy.

In Saudi Arabia, the number of diabetic patients receiving renal replacement therapy increased dramatically from 4% in the early 1980s to 14.8% in the mid-1990s, primarily due to diabetic nephropathy. The late 1990s saw an even greater increase, reaching 40%. DM patients account for 59% of the majority of mortality among dialysis patients.

62% of diabetes individuals in Saudi Arabia develop peripheral arterial disease, and around 35–40% have a stroke.

Retinopathy is present in 31% of Saudi patients who have had diabetes for at least ten years, whereas neuropathy is present in almost 80% of diabetic patients in the Western region of Saudi Arabia, according to statistics. With another 55% asymptomatic, this is among the highest rates in the world. 20% of people had diabetic retinopathy overall, according to another study, with 10% having non-proliferative retinopathy, 12% having proliferative retinopathy, and 7% having

retinal edema. According to the aforementioned study, age and the length of diabetes are the two biggest risk factors for diabetic retinopathy. The risk of diabetic retinopathy is also considerably increased by nephropathy, neuropathy, insulin use, poor glycemic control, hypertension, and male sex. It has been observed that among Saudi Arabian type 2 diabetics, smoking, hyperlipidemia, and obesity dramatically lower the incidence of diabetic retinopathy.

Conclusion

The prevalence of diabetes mellitus in Saudi Arabia is skyrocketing for the elderly people, endangering the advantages of economic recovery and modernization. Numerous nutritional, behavioral, and socioeconomic factors are associated with diabetes mellitus in elderly people as far as Saudi Arabia is concerned. It is urgently necessary to conduct thorough research on these determinants' roles and how they affect the incidence of DM in elderly people. The majority of the studies are cross-sectional and have small sample sizes, typically encompassing only a few areas of the nation. It is very likely that healthy behaviors related to DM management and prevention can be readily adopted in a way that does not go against Saudi Arabian cultural norms. In Saudi Arabia, diabetes is a very common condition that poses a significant clinical and public health concern for elderly people. In order to prevent type 2 diabetes, it is advised that all Saudis over 30 be evaluated for both the disease and pre-diabetes, based on earlier Saudi studies. It is also necessary to launch a nationwide prevention program that can detect diabetes and address community-level modifiable risk factors, with a particular emphasis on high-risk populations, as soon as feasible.

References

- Menke A, Casagrande S, Geiss L, Cowie CC (2015) Prevalence of and trends in diabetes among adults in the United States, 1988-2012. JAMA 314: 1021-1029.
- Alqurashi KA, Aljabri KS, Bokhari SA (2011) Prevalence of diabetes mellitus in a Saudi community. Ann Saudi Med 31: 19-23.
- American Diabetes Association (2020) Standards of Medical Care in Diabetes-2020 Abridged for Primary Care Providers. Clin Diabetes 38: 10-38.
- Yang W, Li Y, Tian T, Wang L, Lee P, et al. (2017) Serum vaspin concentration in elderly patients with type 2 diabetes mellitus and macrovascular complications. BMC Endocr Disord 17: 67.
- Chentli F, Azzoug S, Mahgoun S (2015) Diabetes mellitus in elderly. Indian J Endocrinol Metab 19: 744-752.
- Alsuwaidan S, Algharbi A, Alyami S, Almukhlifi N (2021) Prevalence of Comorbidity Among Elderly. Glob J Aging Geriatr Res 1: 2021.
- Al Dawish MA, Robert AA, Braham R, Al Hayek AA, Al Saeed A, et al. (2016) Diabetes mellitus in Saudi Arabia: a review of the recent literature. Curr Diabetes Rev 12: 359-368.
- Gregg EW, Engelgau MM, Narayan V (2002) Complications of diabetes in elderly people: Underappreciated problems include cognitive decline and physical disability. BMJ 325: 916-917.
- Ministry of health Saudi Arabia (2020) Elderly Health. Ministry Of Health, Saudi Arabia.

- Alsuwaidan A, Almedlej N, Alsabti S, Daftardar O, Al Deaji F, et al. (2019) A comprehensive overview of polypharmacy in elderly patients in Saudi Arabia. Geriatrics (Basel) 4: 36.
- Veronese N, Kolk H, Maggi S (2020) Epidemiology of fragility fractures and social impact. In: Falaschi P, Marsh D (eds.). Orthogeriatrics: The Management of Older Patients with Fragility Fractures (2ndedn) Springer, Berlin, Germany.
- Benbow SJ, Walsh A, Gill GV (2021) Brittle diabetes in the elderly. J R Soc Med 94: 578-580.
- Jolobe OMP, Khin N (2022) Brittle diabetes in the elderly. J R Soc Med 95: 58.
- Mather HM (1994) Diabetes in elderly Asians. Journal of the Royal Society of Medicine 87: 615.
- Corriere M, Rooparinesingh N, Kalyani RR (2017) Epidemiology of diabetes and diabetes complications in the elderly: An emerging public health burden. Curr Diab Rep 13: 805-813.
- Alyami SS, Algharbi A, Alsuwaidan S (2022) Characteristics of Associated Diseases in Older Patients with Cardiovascular Disease. Advances in Aging Research 11: 151-161.
- Rockwood K, Awalt E, MacKnight C, McDowell I (2020) Incidence and outcomes of diabetes mellitus in elderly people: Report from the Canadian Study of Health and Aging. CMAJ 162: 769-772.
- Umemura T, Kawamura T, Umegaki H, Kawano N, Mashita S, et al. (2019) Association of chronic kidney disease and cerebral small vessel disease with cognitive impairment in elderly patients with type 2 diabetes. Dement Geriatr Cogn Dis Extra 3: 212-222.
- Ishii M, Yamaguchi Y, Hamaya H, Ogawa S, Imura M, et al. (2019) Characteristics of factors for decreased lung function in elderly patients with type 2 diabetes. Sci Rep 9: 20206.
- Weinger K, Beverly EA, Smaldone A (2022) Diabetes self-care and the older adult. West J Nurs Res 36: 1272-1298.
- Asiimwe D, Mauti GO, Kiconco R (2020) Prevalence and risk factors associated with type 2 diabetes in elderly patients aged 45-80 years at Kanungu District. Journal of diabetes research 2020.
- Pennbrant S, Berg A, Johansson LF (2019) Self-care experiences of older patients with diabetes mellitus: A qualitative systematic literature review. Nordic Journal of Nursing Research 40: 64-72.
- Watcharanat P, Khuancheree K, Lee B (2021) Factors Associated with Self-Care Behavior of Elderly Patients with Type 2 Diabetes in Thailand. The Open Public Health Journal 14: 494-497.