

# Economic Cost of Diabetes Mellitus in the Middle East: A Systematic Review

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**Abstract:** Diabetic patients require expensive long-term therapy and care and the all-embracing implication of such disease negatively impacts society as a whole. Multiple indicators show that large number of diabetes mellitus-affected countries are located in the Middle East, which in some estimates reach around sixty percent of the global diabetes pandemic. It is already acknowledged that the incessant expansion of a non-transmittable illness in this region forces huge monetary expenses on families and nations. This systematic review analyzed the literature on the economic cost of diabetes in the Middle East and yielded 13 studies focusing on this issue. Results show that Middle-Eastern countries bare substantial economic cost, directly and indirectly, for treating and managing its diabetes population. From those nations, the Arabic-speaking countries share a higher portion of diabetes cost compared to other countries. While the Gulf states comprised the highest proportion of such cost. Although studies have been conducted on the cost of diabetes mellitus in the Middle East, yet very little has had significant impact on the awareness of the economic problem associated with it. The focus of this study shall be to encapsulate existing evidence on the expense of diabetes mellitus in the Middle East, survey the strategies used to work out costs, and explore regions for future implication.

**Keywords:** Economic Cost, Diabetes, Middle East

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## 1. Introduction

Diabetes seems to be one of the major risk factors for mortality, as per several studies and leading medical organizations. [1, 2] Several studies conducted in the Middle-East region reveal a pattern that is comparable to that seen throughout the world. According to a study by Abuyassin & Laher (2016) [3], diabetes has been one of the major reasons for mortality in the Middle-East in the early years of the last decade, which has arisen in numbers relative to the 20th century when the number was far below today's trends. In the last decade alone, diabetes has become the major source of health complications in major Middle-Eastern nations. Managing diabetes is very difficult, as it is now the fastest-growing factor of disordered life among the low and middle-income as well as affluent Middle-Eastern countries in the last decade. [3].

This is a study conducted on the pressure that is exerted over the economy in the Middle East region due to the expenditure that is incurred because of diabetes, and the health

issues arising from such conditions and how that negatively affects the economy as a whole. Such work can be carried out from different range of viewpoints. The patient's medical viewpoint, health institutions, the healthcare services' sector, the health system, and the community standpoint are all typical approaches. In this study, the perspective was economic cost of diabetes and its impact on society. The expenditure on healthcare facilities is rising tremendously in the Middle-East as a result of the declining health of the common people because of diabetes. Diabetes affects the Middle East in two-fold ways, the first is related to the expenditure on the illness and the second linked to the deteriorative health condition of the citizens.

This study aims to systematically review the scientific literature on the economic burden and cost of Type II diabetes mellitus (T2DM) across Middle-Eastern countries. Despite the fact that there are some studies that focus on such issue in the Middle-East, to our knowledge, very few to none have conducted a systematic review of those studies. Thus, attempting to do such thing may reveal significant trends or

variations relevant to this matter, and which could shed a light on ways to deal with this issue and improve future research.

### **1.1. Disease and Population**

Diabetes mellitus is a set of biochemical illnesses marked by high blood glucose levels caused by the abnormal release of the hormone insulin by the pancreas. This hormone is not produced enough by the body which results in low insulin levels which means the sugar in the bloodstream is elevated that can cause multiple health complications. The relevance of insulin as a catabolic enzyme causes biochemical irregularities in carbohydrates, triglycerides, and peptides. These biochemical irregularities are affected by the lack of insulin levels to obtain an effective response or insulin inhibition of target organs, mainly muscle tissue, fat cells, and to a smaller degree, liver, at the stage of receptor sites, signaling pathways mechanism, or extracellular enzymes or genetic makeup. [4] The type and presence of diabetes vary depending on the degree of seriousness of complications. Many individuals with diabetes, particularly those who have Type II diabetes in the initial phase of the condition, are undiagnosed; however, individuals with severe hyperglycemia, particularly children with severe insulin deficit, may develop excessive urination, fluid retention, increased hunger, decreased appetite, and vision problems. [4] Unchecked diabetes increases the risk of developing lethargy, unconsciousness, and fatality and when not managed can result in metabolic acidosis or diabetic nephropathy. [5] As per a study conducted in the last decade by the International Diabetes Federation (IDF), the worldwide incidence of diabetes in adults between the ages of 25 to 65 was almost 12% and the numbers of diabetic male patients are far more than that in women. Patients as early as the age of 30s are developing such conditions which are predicted by experts to rise by 15% at the end of the present decade. [6] There is a huge proportion of individuals living with prediabetes, while there are other groups who are diagnosed but still are untreated due to poor economic conditions. [6] During the gestation period, diabetes affects an average of 7-8% of women who suffer gestational diabetes. [7] The Middle East seems to have the most diabetes occurrence, with almost 6 out of 10 people have diabetes. Currently, countries in the Middle East including Kuwait, Qatar, Egypt, Saudi Arabia, the United Arab Emirates, Bahrain, Jordan, and Lebanon do have the fastest prevalence of overweight and diabetic patients. [3] These trends of diabetes prevalence in the Middle-East region are expected to rise by 96% from 2019 to 2045. [8].

### **1.2. Epidemiological Approaches**

Diabetes is now a severe and widespread global health problem around the world. The Middle East has recorded the highest incidence of diabetes around the world in the last decade, reaching 3 out of every 20 people showing symptoms of diabetes accompanying incidence and death. [3] Excessive weight gains, lack of physical activity, industrialization, and unhealthy eating, with a combination of hereditary susceptibility in the demography, have all contributed to the

region's high incidence of diabetes and hyperglycemia. [8] Such determinants have manifested untimely symptoms of juvenile diabetes in children and young adults, limiting the productive seasons and wellbeing of these younger generations. [9] Moreover, civil unrest and military action in several economies in the area, including the impact of the coronavirus disease in 2019, have hampered and confounded efforts to manage the rising prevalence of diabetes and associated complications. [10] Very few countries in the Middle East show that the percentages of diabetic patients are male but most of the diabetic-infected population are women. There are various reasons for such an occurrence, such as urban lifestyle and the restricted movement associated with it, the consumption of junk food and ready-made meals, and the lack of physical activities and the options for women to exercise. However, in many regions in central Iran, the prevalence of diabetes in men is higher than that in women. [11] The rural population has the lowest numbers of diabetes patients as they are generally active and their lifestyle is less sedentary. There are incidences of prediabetes which account for about 5% more than the diagnosed cases. [12] Genetic is a prime player in this field, there have been incidences where despite a healthy lifestyle, individuals as young as 25 years developed diabetes. Children develop juvenile diabetes which in turn affects their education, health and therefore the future of the country's economy. It puts pressure on the cost of the treatment as they avail themselves of the medical facilities from a very early stage of their lives. As the prevalence of diabetes is the highest in the Middle East, other health complications like kidney problems, heart and liver diseases, arise for which again accompanying treatment costs arise increasing the economic burden in such countries. [13].

Studies have been conducted on the cost-effectiveness of diabetes mellitus in different countries, yet very little work available to encapsulate existing evidence on the expense of diabetes mellitus in the Middle East. Therefore, this study mainly focuses on the economic cost of diabetes mellitus in the Middle-East.

## **2. Methods**

The study approached cost and immediate medical expenses of diabetes as the emphasis on researching the scientific literature. A collection process was employed using multiple sources and databases to highlight essential statistics and data related to the economic impact of developing and treating Type II diabetes mellitus. This includes clinical information, diabetes pervasiveness as well as other clinical findings, hospital costs, and economic indicators. The study focuses on population of the Middle East. The study considered economic burden, financial expenditures, and indirect expenses which comprised reduced efficiency owing to acute and chronic impairments, along with wasted manpower caused by early death.

Secondary research work was conducted, we searched various articles from Pubmed, Medline, Embase, Science Direct, and Google Scholar. The accompanying qualification

measures were utilized: old relevant articles of more than a decade ago as well as the most recent articles until 2021 have been included, peer evaluated English articles from years ranging from 2003 to 2021 are included, articles that revealed unique examination discoveries on the expense of diabetes disease, and papers that included at least one country from the middle east. Repetitive studies have not been included and very early studies have also been excluded to improve the focused objective of this study. Data has been extracted from multiple sources as highlighted and subsequently tabulated as

and when required to improve its presentation efficacy.

This systematic literature review, with a focused approach towards a dedicated region-specific cohort, has been commanded by the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines. [14] The underlined principle of this tool provides a minimum/optimal number of shortlisted research outcomes with a narrowed list towards higher quality of systematic syntheses and narrative reviews. The PRISMA flow diagram has been depicted in Figure 1.

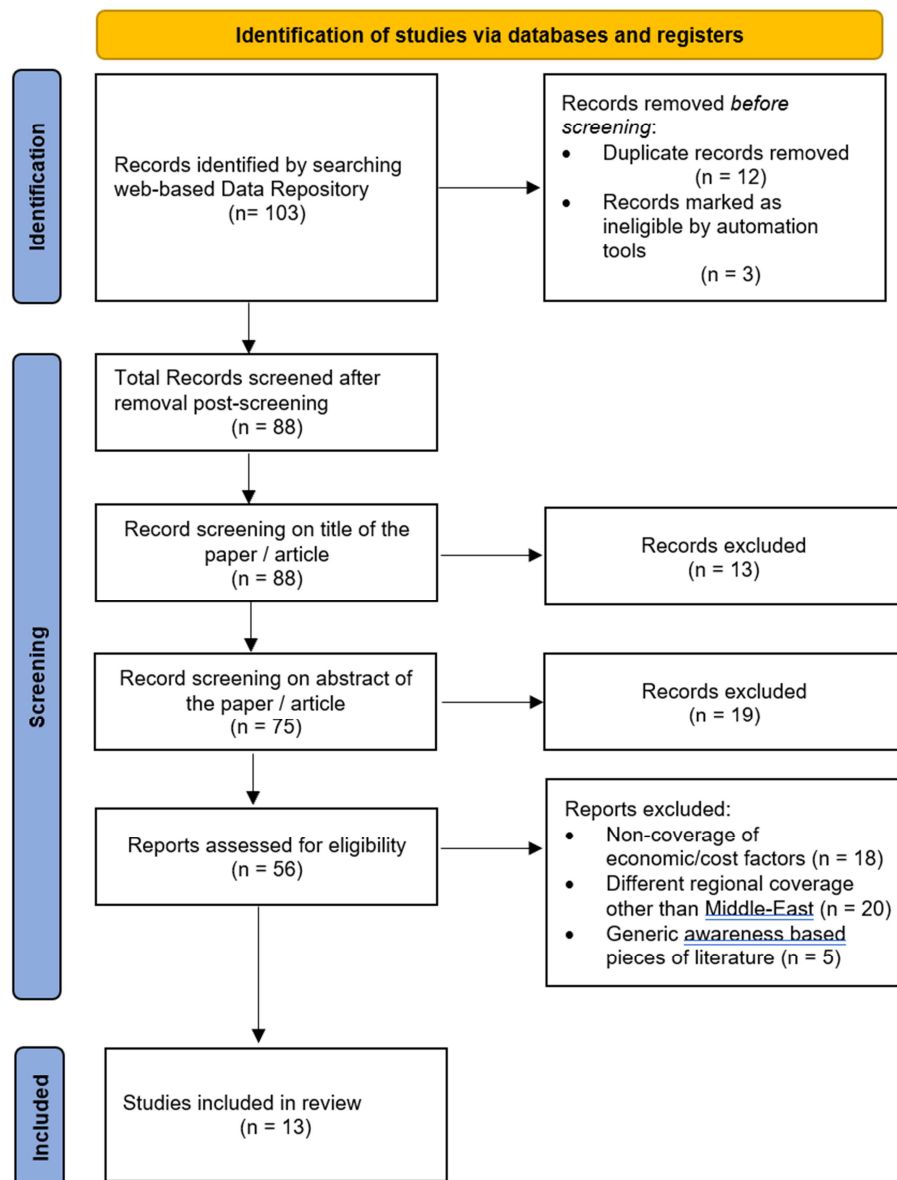


Figure 1. PRISMA flow diagram for systematic reviews which included searches of identified databases.

## 2.1. Literature Search Strategy

The article search was attempted in PubMed, EMBASE, Medline, Google Scholar, and Science Direct. Additionally, an exploration was led in the World Health Organization Global Health Library and the International Diabetes Federation (IDF). Keywords were carefully chosen to guarantee that all

significant material was incorporated and to avoid any incorporation of irrelevant articles. The search words and search procedure applied was reviewed and checked by specialized colleagues. The search terms were adjusted for every data set utilizing (1) terms for the Middle East or any country from the middle east AND (2) terms identified with (diabetes OR diabetes mellitus OR diabetic) AND (3) terms

indicating costs (economic cost OR burden OR expenses OR expenditure OR consumption OR financial load OR medical services cost OR cost of disease OR cos of illness).

After literature scanning, further elimination procedure of duplication was conducted, which has been executed with EndNote. Single evaluator reviewed clickbait headlines during the first phase of scanning to find articles to be incorporated in the research. Had it been uncertain if the investigation seemed pertinent with the study topic established on the main article only, the summary was therefore assessed. Here, we come to the next phase when the procedure involved was to examine criterion through a complete-article check to see if the inclusion and exclusion standards have been met. Thereafter, the papers have been acquired for a complete analysis. When a supervisor couldn't get a hold of the entire document, letters were addressed to the relevant writers of whom we could obtain the account information, seeking a copy of the relevant papers. All admissible publications' citations, as well as the academic journals of eliminated papers, were reviewed for supplementary necessary information. Whenever any ambiguity about the identification of a paper at any point throughout the screening procedure arose, an additional expert's opinion was taken into account.

## 2.2. Inclusion and Exclusion Criteria

The incorporated articles shall compulsorily have a focus on diabetes, as one or only variable in the study, and have an analysis of economic/financial impact of it on a population located in the Middle East. Studies have been considered only when they satisfied the followings: (1) released within 2003 and 2021; (2) has been written in the English language; (3) must be a peer-reviewed publication; (4) provided independent study results on diabetes mellitus and cost on economy or expenditure - based on health conditions arising from diabetes statistics; and (5) included a minimum of one nation from the Middle East region. Exclusion of publications were done by the following criteria: (1) cost-effectiveness analysis findings which mentioned economic sustainability out of another research or journal; (2) just indicated expenses in connection to preventative measures on diabetes; (3) publications which failed to include exclusive findings or relevant information on the procedure involved in determining the cost analysis; (4) studies not comprising any specific clinical expenditures; and (5) research papers where experimentation and observation on animals were carried out have all been excluded from this study.

## 3. Results

The initial search strategy incorporated in this review resulted in an overall 103 articles, from which 12 results were removed due to duplication and multiple appearances. Of the remaining 91 articles, 3 were removed due to their ineligibility while testing those by an automation tool. Subsequently, 13 records were not considered in the next level of filtering taking into account the title of the paper/article. This study excavated

deeper into evaluating the subject matter, methodology, research outcomes, and analysis parameters. This process further removed 19 records resulting in 56 articles for the last phase of filtering. Non-inclusion of economic/cost factors, different geographical coverage other than the Middle East, generic awareness-based pieces of literature were found in this detailed screening and this yielded 13 records left for detailed evaluation and conclusion. Country-specific and geographical-area wise final set of articles under consideration has been listed down with the year of publication in Table 1 below.

**Table 1.** Number of Studies, Region/Country of Origin, and Year of Publication.

Country / Geographical Area	Number of Records	Year of Records
Middle-East & Eastern Mediterranean region	2	2020 & 2018
Arabian Region	3	2016, 2014 & 2013
Iran	1	2016
Kingdom of Saudi Arabia	6	2018, 2015, 2014, 2013 & 2012
United Arab Emirates	1	2010
Total	13	

According to a study conducted by the International Diabetes Federation (IDF), it is estimated that in 2017 the total amount of medical expenses on diabetes reached USD 850 billion worldwide, of which the Middle-East region scored the highest in the world with around 16% of its budgets dedicated to the treatment of diabetes. [15] Moreover, Ansari-Moghaddam et al. reported that the yearly per capita cost of treatment for diabetes in the Eastern Mediterranean region countries (EMRO) amounted to USD 1150. The study argues that males with family history of diabetes who have been diabetic for long time were the highest in spending on diabetes treatment. Cost analysis showed that the largest stake of diabetes expenditure went to diabetes drugs. Also, the cost varied according to accompanying comorbidities such as cardiovascular diseases and strokes. [16].

The Arabian region exhibited startling trends in the prevalence of diabetes compared to other Middle-Eastern countries. Projections indicated that by the year 2035, the diabetic population will rise by 96.2%. These estimates were attributed to several factors such as genetic disposition, population growth, and family history. Juvenile diabetes in the Arab world will be of great concern and if uncontrolled will increase the economic burden of treating future diabetic people. [17] Furthermore, Boutayeb et al. have focused on the direct cost of diabetes in the Arab world. They found that the overall direct cost of diabetes in all Arabian countries ranged from USD 9 to USD 22 billion annually. The study went further and analyzed the direct cost of diabetes in the Arabian region by dividing the region into three categories: low-, middle-, and high-income countries. It valued the yearly per-patient direct cost of diabetes treatment at USD 351 for low-income countries, at USD 529 for middle-income countries, and at USD 860 for high-income countries. When compared to the average per-capita expenditure on other health complications, the treatment cost of diabetes was 1.4 to

3.5 times higher. [18].

In addition to direct expenses of diabetes, the indirect cost of this disease in the Arab region was estimated by calculating the low productivity that diabetic patients suffer from as a result of some sort of disability and early deaths. Similar to the previous study, Boutayeb et al. analyzed the indirect economic cost of diabetes in the same three income groups and found that the average indirect expenses incurred per patient reached USD 2770, ranging from USD 423 for patients in low-income countries to USD 7959 for those in high-income countries. While the overall indirect expenses of diabetes in all countries amounted to USD 72 billion. [19].

It seems that most of the studies were conducted in the Kingdom of Saudi Arabia (six studies). This is not surprising since the Kingdom was ranked as one of the top countries where diabetic people live. (20) This trend significantly affects the country economically. For instance, multiple studies estimated the total cost of diabetes in Saudi Arabia to reach around USD 4.5 billion. [21, 22]. This figure was calculated without considering the undiagnosed population which in some estimates the cost would increase to about USD 7.2 billion, and to around USD 11.5 billion when pre-diabetic people are considered given the current growth rates of such group. [22] Another study evaluated the economic burden of diabetes on the Saudi healthcare system to surpass USD 0.87 billion, not including other indirect expenses related to productivity loss, disability, and pre-mature deaths. [23] Furthermore, Saudi individuals bare substantial medical costs due to diabetes which are ten times higher than those with no diabetes. According to a study by Alhawaish, those with

diabetes incur around USD 3686 compared to non-diabetic people who incur about USD 380 in medical expenses. The study also found that the economic burden of diabetes differs depending on the age of the diabetic person, where those aged 45-60 have the highest (45% of overall diabetes cost). The cost ranges from 3.8% for those below 15 years old, to 27.5% for 15-44 age group, to 23.8% for those over 60 years old. [24] The treatment of Type II diabetes was also calculated per patient, and it was found that the Saudi Ministry of Health endures between USD 1334 and USD 2134 to treat such patients per year. This number of annual costs rises substantially when those patients of Type II diabetes have relevant complications to reach between USD 26,667 and USD 48,000. [25] The inclusion of the indirect cost of diabetes by considering diabetes-related diseases noticeably revealed significant costs. Hnoosh et al. analyzed the cost of diabetes complications and found that, for instance, renal and cardiovascular complications had the highest annual costs compared to other complications. [26].

A study conducted in Iran estimated the annual direct medical costs per diabetic patient to be USD 155.8. From these expenses, diabetes medications shared the largest portion of the burden. The total direct expenditure on diabetes in Iran reached USD 4.05 billion annually. [27] In the United Arab Emirates, a study found that the yearly direct cost for treating diabetes without its complications was 3.2 times more than the per capita spending on healthcare. When including complications, the figure increased 2.2 times, and escalated to 3.7 times when hospitalization was counted. [28] Table 2 below summarizes all previous findings.

**Table 2.** Summary of review results categorized by author; year; region/country, and outcome. of Studies,

Author/Year	Country / Geographical Area	Cost of Diabetes	Notes
Cho et al., 2018	Middle-East & Eastern Mediterranean region	16% of budgets	Total cost
Ansari-Moghaddam et al., 2020	Middle-East & Eastern Mediterranean region	\$1150 per capita	Males with family history & diabetes drugs were highest drivers of cost
Boutayeb et al., 2014	Arabian Region	\$9-22 billion annually	Direct cost
Boutayeb et al., 2013	Arabian Region	\$72 billion annually	Indirect cost
AlMazroa, 2018 & Mokdad et al., 2015	Kingdom of Saudi Arabia	\$4.5 billion	Total cost
Naeem et al., 2015	Kingdom of Saudi Arabia	\$0.87 billion on health system	Not including indirect cost
Alhawaish, 2013	Kingdom of Saudi Arabia	\$3686 per patient	Older population endures 45% of total diabetes cost
Arab News, 2015	Kingdom of Saudi Arabia	\$1334-2134 per patient on the Ministry of Health	The figure increases with diabetes complications
Hosseini, 2016	Iran	\$155.8 per patient & \$4.05 billion annually	Diabetes drugs were highest drivers of cost
Al-Maskari et al., 2010	United Arab Emirates	3.2 times per capita spending on health	The figure increases with complications and hospitalization

## 4. Discussion

Diabetes management is one of the challenges which needs to be tackled in the Middle-East. The high treatment costs along with the growing prevalence, micro-and macrovascular complications, lifestyle changes, late diagnosis, poor awareness need the immediate attention of policy makers in the region. The studies provide clear

overview of the problem that affect healthcare systems in the Middle-East and it can be observed that the cost of diabetes in the Middle-East has been increasing year by year. Unfortunately, current research in the Arab nations does not match the level of this health crisis in the area. Large portions of critical data and information are unavailable in many countries from the Arab world. [17].

In this ongoing global pandemic, scientists have already declared that people having diabetes mellitus and/or

comorbidities are vulnerable to succumb to the coronavirus disease, therefore a nation where almost half the population has diabetes; puts a humongous amount of pressure on the economy and human resources. Societal inequities in diabetes management must be considered because a socioeconomically disadvantaged status has repeatedly been identified as a potential cause for diabetes and troubles arising out of it. To resolve this concern, initiatives that have scientific proof, are economical, and intended policies to maximize healthcare coverage must be implemented. One disturbing result is the gap between men and women, which expresses itself through women showing a larger frequency of weight gain and obesity than men. This demands an assessment of probable risk factors as well as corrective and preventive measures, particularly because diabetes during pregnancy poses a threat of type II diabetes mellitus inheritance from generation to generation. It must be made mandatory for the food manufacturing companies to highlight the respective dietary and caloric composition of all the edible products they are manufacturing. Learning initiatives must be implemented in the classroom, neighborhood, and corporate sectors, with a focus on authentic and conventional approaches so that the common people can understand their importance.

This review, however, suffers from couple of limitations including the insufficient number of studies and publications proportionally covering this region of the world. There were multiple studies omitted due to poor publication standards, which may entail important results on the economic cost of diabetes. Also, some of the included peer-reviewed studies have notable drawbacks in its methodology that could affect the results of this review. Despite the existence of such limitations, the issue remains significant and the results of this review seems valid given multiple objective measures and indicators clearly inclining towards the presence of trends highlighting the high economic burden of diabetes in the Middle-East.

## 5. Conclusion

The study tried to highlight the significance of diabetes mellitus in the Middle-East by focusing on the economic impact of such disease. The research showed that the Middle East has been facing serious health issues related to diabetes. The cost of diabetes is also increasing gradually. It is the need of the hour to estimate the direct and indirect cost of diabetes and its complications in the region for better understanding of the economic burden of the disease on health systems, societies, and nations.

Policy makers need to conduct health awareness programs at the grassroots level to make the public aware of diabetes and its fatalities. The GCC governments, in particular, must implement regular health screening programs for its citizens and parents must encourage their children to consume healthy food and adopt a healthy lifestyle. The study recommends for immediate action to estimate the latest economic cost of the diabetes and to reduce the burden of diabetes in the region. The study also encourages the development and

implementation of a regional plan to prevent and control the rising burden of diabetes in the Middle East.

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## References

- [1] Lin, X., Xu, Y., Pan, X. *et al.* Global, regional, and national burden and trend of diabetes in 195 countries and territories: an analysis from 1990 to 2025. *Sci Rep* [Internet]. 2020 [cited 2022 Jul 07]; 10 (14790). Available from: <https://doi.org/10.1038/s41598-020-71908-9>.
- [2] What is diabetes? [Internet]. Centers for Disease Control and Prevention. Centers for Disease Control and Prevention; 2022 [cited 2022 Jul 08]. Available from: <https://www.cdc.gov/diabetes/basics/diabetes.html>.
- [3] Abuyassin B, Laher I. Diabetes epidemic sweeping the Arab world. *World J Diabetes* [Internet]. 2016 Apr 25 [cited 2022 Jul 08]; 7 (8): 165-74. Available from: doi: 10.4239/wjd.v7.i8.165. PMID: 27114755; PMCID: PMC4835661.
- [4] American Diabetes Association. Diabetes In General [Internet]. American Diabetes Association; 2022 [cited 2022 Jul 08]. Available from: <https://diabetes.org/>.
- [5] Medical News Today. The Signs of Uncontrolled Diabetes [Internet]. Brighton: Medical News Today; 2019 Apr 16 [cited 2022 Jul 10]. Available from: <https://www.medicalnewstoday.com/articles/317465>.
- [6] IDF Diabetes Atlas. Diabetes around the world 2021 [Internet]. IDF Diabetes Atlas; 2022 [cited 2022 Jul 10]. Available from: <https://diabetesatlas.org/>.
- [7] Schäfer-Graf UM, Gembruch U, Kainer F, Groten T, Hummel S, Hösl I, Grieshop M, Kaltheuner M, Bühner C, Kautzky-Willer A, Laubner K, Bancher-Todesca D. Gestational Diabetes Mellitus (GDM) - Diagnosis, Treatment and Follow-Up. Guideline of the DDG and DGGG (S3 Level, AWMF Registry Number 057/008, February 2018). *Geburtshilfe Frauenheilkd* [Internet]. 2018 Dec [cited 2022 Jul 10]; 78 (12): 1219-1231. Available from: doi: 10.1055/a-0659-2596. Epub 2018 Dec 14. PMID: 30651660; PMCID: PMC6301211.
- [8] El-Kebbi IM, Bidikian NH, Hneiny L, Nasrallah MP. Epidemiology of type 2 diabetes in the Middle East and North Africa: Challenges and call for action. *World J Diabetes* [Internet]. 2021 Sep 15 [cited 2022 Aug 02]; 12 (9): 1401-1425. Available from: doi: 10.4239/wjd.v12.i9.1401. PMID: 34630897; PMCID: PMC8472500.
- [9] Saraswathi S., Al-Khawaga S., Elkum N. and Hussain K. A Systematic Review of Childhood Diabetes Research in the Middle East Region. *Front* [Internet]. 2019 [cited 2022 Aug 03]; 10: 805. Available from: doi: 10.3389/fendo.2019.00805.
- [10] Arab News. High Diabetes and Obesity Rates Complicate GCC's Coronavirus Fight [Internet]. Dubai: 2020 Jun 02 [Updated 2020 Aug 12] [cited 2022 Aug 03]. Available from: <https://www.arabnews.com/node/1683821/middle-east>.

- [11] Huang Y., Fernandes JR., Karuranga S., Malanda B., Cho NH. Diabetes Prevalence in Middle East and Africa Region (Estimates for 2017 and 2045). International Diabetes Federation (IDF) [Internet]. 2017 [cited 2022 Aug 04]; p-0749. Available from: [https://poshukach.com/redir?user\\_type=40&type=sr&redir=eJzLKCKpKLbS1y8vL9fLTEnTyy9K18\\_MS0mt0CvIKLDPLyjJzM-zTc7PjU8sKUIIMzshNzSspVitJLM62Tckvz8vJT0xRy0yxNTQ1sLRyLMIJLNa1SNUtyC8uSS3S9XX1c9QTSk0HmsDAYGhmZmhoYWlhYsywp8Mz6qJdXdjtJBurZW155gBRiy6g&src=458022&via\\_page=1](https://poshukach.com/redir?user_type=40&type=sr&redir=eJzLKCKpKLbS1y8vL9fLTEnTyy9K18_MS0mt0CvIKLDPLyjJzM-zTc7PjU8sKUIIMzshNzSspVitJLM62Tckvz8vJT0xRy0yxNTQ1sLRyLMIJLNa1SNUtyC8uSS3S9XX1c9QTSk0HmsDAYGhmZmhoYWlhYsywp8Mz6qJdXdjtJBurZW155gBRiy6g&src=458022&via_page=1).
- [12] Javanbakht M, Baradaran HR, Mashayekhi A, Haghdoust AA, Khamseh ME, Kharazmi E, Sadeghi A. Cost-of-illness analysis of type 2 diabetes mellitus in Iran. *PLoS One* [Internet]. 2011 [cited 2022 Aug 04]; 6 (10): e26864. Available from: doi: 10.1371/journal.pone.0026864. Epub 2011 Oct 31. PMID: 22066013; PMCID: PMC3204988.
- [13] Farshchi A, Esteghamati A, Sari AA, Kebriaeezadeh A, Abdollahi M, Dorkoosh FA, Khamseh ME, Aghili R, Keshtkar A, Ebadi M. The cost of diabetes chronic complications among Iranian people with type 2 diabetes mellitus. *J Diabetes Metab Disord* [Internet]. 2014 Mar 4 [cited 2022 Aug 05]; 13 (1): 42. Available from: doi: 10.1186/2251-6581-13-42. PMID: 24593991; PMCID: PMC3975900.
- [14] Systematic Reviews (OPEN ACCESS) Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *Systematic Reviews* 2021; 10: 89.
- [15] Cho, N., Shaw, J., Karuranga, S., Huang, Y., da Rocha Fernandes, J., Ohlrogge, A., & Malanda, B. IDF Diabetes Atlas: Global estimates of diabetes prevalence for 2017 and projections for 2045. *Diabetes Research and Clinical Practice* [Internet]. 2018 [cited 2022 Aug 05]; 138: 271–281. Available from: <https://doi.org/10.1016/j.diabres.2018.02.023>.
- [16] Ansari-Moghaddam, A., Setoodehzadeh, F., Khammarnia, M., & Adineh, H. A. Economic cost of diabetes in the Eastern Mediterranean region countries: A meta-analysis. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews* [Internet]. 2020 [cited 2022 Aug 07]; 14 (5): 1101–1108. Available from: <https://doi.org/10.1016/j.dsx.2020.06.044>.
- [17] Abuyassin, B., & Laher, I. Diabetes epidemic sweeping the Arab world. *World Journal of Diabetes* [Internet]. 2016 [cited 2022 Aug 07]; 7 (8): 165. Available from: <https://doi.org/10.4239/wjd.v7.i8.165>.
- [18] Boutayeb, A., Boutayeb, W., Lamlili, M. E., & Boutayeb, S. Estimation of the direct cost of diabetes in the Arab region. *Mediterranean Journal of Nutrition and Metabolism* [Internet]. 2014 [cited 2022 Aug 09]; 7 (1): 21–32. Available from: <https://doi.org/10.3233/mnm-140002>.
- [19] Boutayeb, W. Boutayeb, M. E. N. Lamlili, S. Boutayeb. Indirect Cost Of Diabetes In The Arab Region. *International Journal of Diabetology & Vascular Disease Research* [Internet]. 2013 [cited 2022 Aug 10]; 2 4–28. Available from: <https://doi.org/10.19070/2328-353x-130005>.
- [20] The World Bank. Diabetes Prevalence [Internet]. 2022 [cited 2022 Aug 10]. Available from: [https://data.worldbank.org/indicator/SH.STA.DIAB.ZS?most\\_recent\\_value\\_desc=true](https://data.worldbank.org/indicator/SH.STA.DIAB.ZS?most_recent_value_desc=true).
- [21] AlMazroa, M. Cost of Diabetes in Saudi Arabia. *Iproceedings* [Internet]. 2018 [cited 2022 Aug 11]; 4 (1): e10566. Available from: <https://doi.org/10.2196/10566>.
- [22] Mokdad, A., Tuffaha, M., Bcheraoui, C. E., & Daoud, F. Cost of diabetes in the Kingdom of Saudi Arabia, 2014. *Institute for Health Metrics and Evaluation* [Internet]. 2015 Sep 14 [cited 2022 Aug 11]. Available from: <https://www.healthdata.org/research-article/cost-diabetes-kingdom-saudi-arabia-2014>.
- [23] Naeem, Z. Burden of Diabetes Mellitus in Saudi Arabia. *International Journal of Health Sciences* [Internet]. 2015 [cited 2022 Aug 12]; 9 (3): V–VI. Available from: <https://doi.org/10.12816/0024690>.
- [24] Alhowaish, A. Economic costs of diabetes in Saudi Arabia. *Journal of Family and Community Medicine* [Internet]. 2013 [cited 2022 Aug 13]; 20 (1). Available from: <https://doi.org/10.4103/2230-8229.108174>.
- [25] Arab News. Cost of diabetes escalating [Internet]. Jeddah: 2015 Nov 27 [cited 2022 Aug 13]. Available from: <https://www.arabnews.com/saudi-arabia/news/842271>.
- [26] Hnoosh, A., Vega-Hernández, G., Jugrin, A., & Todorova, L. PDB45 Direct Medical Costs of Diabetes-Related Complications in Saudi Arabia. *Value in Health* [Internet]. 2012 [cited 2022 Aug 14]; 15 (4): A178. Available from: <https://doi.org/10.1016/j.jval.2012.03.966>.
- [27] Hosseini, M., Davari, M., Boroumand, Z., Amini, M., & Aslani, A. The direct medical costs of outpatient cares of Type 2 diabetes in Iran: A retrospective study. *International Journal of Preventive Medicine* [Internet]. 2016 [cited 2022 Aug 15]; 7 (1): 72. Available from: <https://doi.org/10.4103/2008-7802.181758>.
- [28] Al-Maskari, F., El-Sadig, M., & Nagelkerke, N. (2010a). Assessment of the direct medical costs of diabetes mellitus and its complications in the United Arab Emirates. *BMC Public Health* [Internet]. 2010 [cited 2022 Aug 15]; 10 (1). Available from: <https://doi.org/10.1186/1471-2458-10-679>.