

Knowledge And Awareness Of Hypoglycemia Among Healthcare Workers In KSA: A Systematic Review

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Abstract

Background: *This systematic review aimed to evaluate the knowledge and awareness of hypoglycemia among healthcare workers in the Kingdom of Saudi Arabia (KSA), with a focus on understanding causes, symptoms, management, and prevention strategies.*

Methods: *Comprehensive searches were conducted in electronic databases, supplemented by grey literature sources. Studies assessing hypoglycemia knowledge among healthcare workers in KSA were included, encompassing various study designs and healthcare professions. Data extraction and synthesis were performed following established protocols.*

Results: *The initial search yielded 26 studies, with 17 full-text articles reviewed. Two studies met inclusion criteria, both highlighting deficiencies in hypoglycemia knowledge among healthcare workers. One study revealed a significant disparity in understanding among primary care doctors, with factors such as years of practice and education level influencing knowledge scores. Another study focused on pre-travel counseling practices among primary healthcare practitioners, indicating inadequate expertise and poor practice ratings, particularly among younger, male, and Saudi doctors.*

Conclusion: *The findings underscore critical gaps in hypoglycemia awareness among healthcare workers in KSA. Addressing these deficiencies is essential for improving patient outcomes and ensuring effective management of hypoglycemic episodes, particularly within diabetic populations. Targeted educational interventions tailored to the needs of primary care providers are warranted to bridge these knowledge gaps and enhance the quality of care provided to individuals with diabetes in Saudi Arabia.*

Introduction

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High blood sugar levels, or hyperglycemia, are symptoms of diabetes mellitus, a metabolic disorder that may develop over time due to either impaired insulin production or elevated peripheral resistance. An imbalance in the metabolism of carbohydrates, proteins, and lipids, brought about by either full or partial production and activity of insulin, is the root cause of diabetes. The two most common forms of diabetes are type I, which requires insulin, and type II, which does not [1,2]. The global spread of this illness has reached epidemic proportions. Nearly 463 million individuals throughout the globe were living with DM in 2019, with an anticipated 700 million impacted by 2045 [3]. The age-adjusted prevalence (using WHO criteria) was higher in urban areas (12% male and 14% female) compared to rural regions (7% male and 7.7% female), according to an epidemiological research of Saudis aged 15 and up from different parts of KSA. In the same age group of rural women, the prevalence was 29%. Over half of the people with diabetes who were diagnosed did not realize they had the disease when the trial started. There was another research that found 17% of adults aged 30 and higher to have DM [4].

The majority of industrialized nations rank diabetes as their fourth biggest killer. Increased disability, decreased life quality, and massive medical expenses are caused by diabetes complications such as coronary artery disease and vascular disease, acute ischemic stroke, peripheral neuropathy resulting in chronic wounds and amputations, acute kidney injury, and loss of vision. These complications affect nearly every culture. Without a question, it ranks high among the most challenging health issues of the modern era. As an alternative, hypoglycemia, diabetic ketoacidosis (DKA), and hyperosmolar hyperglycemic nonketotic coma (HHNC) are among the acute complications of diabetes. Insulin shortage is linked to DKA and HHNC [5]. Hypoglycemia, defined as blood glucose levels of 70 mg/dL or below, is a significant consequence of diabetes that has significant personal and societal expenses [6]. One of the common adverse effects of insulin therapy is insulin-induced hypoglycemia. There are over 98,000 visits to emergency rooms and 30,000 hospitalizations in the United States each year due to insulin-related hypoglycemia [7].

A comprehensive grasp of the consequences is necessary for preventing or reducing their incidence and effect [6]. Although type 1 diabetics are more likely to have hypoglycemia, prior study has shown that type 2 diabetics are just as likely to experience hypoglycemia needing emergency medical intervention [8]. Among the neurogenic symptoms caused by hypoglycemia are tremors, palpitations, anxiety/arousal, perspiration, hunger, and paresthesias. With lower plasma glucose concentrations, neuroglycopenic symptoms such as vertigo, weakness, lethargy, delirium, confusion, and, at higher concentrations, coma and seizures [9,10]. Cerebrovascular, cardiovascular, retinal cell death, vision loss, cognition impairment, and health-related quality-of-life issues are just a few of the various long- and short-term consequences that diabetes patients may experience from hypoglycemia [11]. Hypoglycemia doubled the risk of falls in elderly diabetic patients [12]. Diabetes patients experiencing severe hypoglycemia had a sixfold increased risk of mortality compared to those without the condition [11].

Without accounting for the substantial consumption and output losses caused by hypoglycemia, the true cost of diabetes treatment might be grossly underestimated [13]. Patients with long-term diabetes who have also been on insulin for a long time have an increased risk of hypoglycemia, according to prior observational studies [10,14,15]. Individuals with impaired awareness are up to five times more likely to have severe hypoglycemia, according to another study [16]. The Kedia N research found that the most prevalent causes of severe hypoglycemia were not getting enough food (47%), not exercising (23%), not accurately calculating insulin

doses (16%), and having poor awareness of hypoglycemia (5%). Prospective studies that looked at the frequency of hypoglycemic episodes and their symptoms found that those with lower levels of awareness had more bouts of mild to severe hypoglycemia [18]. The study involved 366 individuals with type 2 diabetes and was carried out in the southern region of India. Hypoglycemia was poorly understood by 34% of participants overall. Uncertainty about the future was associated with advanced age, lack of education, and low socioeconomic position [19]. Despite the fact that at least half of the 2530 patients surveyed by the American Association of Clinical Endocrinology had experienced hypoglycemia in the past, many patients were unaware of the causes or circumstances, according to the study [20]. Among the diabetic population in Najran, 44% had a poor understanding of the signs and symptoms of hypoglycemia [21].

The healthcare system is currently facing a global epidemic of type 2 diabetes. Glycemic control may be enhanced if diabetic individuals were better informed about the condition and had a more positive outlook on it, according to the present research. Understanding the risk of diabetes, being motivated to seek medical treatment, and learning how to manage the condition are all goals that will be achieved via this [22].

Methods

Review Question

This systematic review aimed to assess the knowledge and awareness of hypoglycemia among healthcare workers in the Kingdom of Saudi Arabia (KSA). Specifically, the review sought to explore the extent of understanding among healthcare professionals regarding the causes, symptoms, management, and prevention of hypoglycemia.

Search Strategy

A comprehensive search was conducted in electronic databases including PubMed, Scopus, Embase, and Web of Science. Additionally, grey literature sources such as institutional repositories and conference proceedings were searched. The search strategy utilized relevant Medical Subject Headings (MeSH) terms and keywords related to hypoglycemia, healthcare workers, and Saudi Arabia.

Types of Studies Included

This review included both quantitative and qualitative studies that investigated the knowledge and awareness of hypoglycemia among healthcare workers in KSA. Eligible study designs included cross-sectional studies, cohort studies, case-control studies, surveys, interviews, and focus groups.

Participants

The participants of interest were healthcare workers practicing in various settings within KSA, including physicians, nurses, pharmacists, and allied healthcare professionals involved in the management of diabetes and related conditions.

Search Keywords

Key search terms included combinations of "hypoglycemia," "knowledge," "awareness," "healthcare workers," "Saudi Arabia," and related synonyms and Medical Subject Headings (MeSH) terms.

Study Selection Process

The study selection process involved two independent reviewers screening titles and abstracts of identified records for eligibility based on predetermined inclusion and exclusion criteria. Full-text articles of potentially relevant studies were assessed for final inclusion. Any discrepancies were resolved through discussion or consultation with a third reviewer.

Outcomes

The primary outcomes of interest included healthcare workers' understanding of hypoglycemia causes, recognition of symptoms, knowledge of appropriate management strategies, and awareness of preventive measures. Secondary outcomes may have included variations in knowledge and awareness based on healthcare profession, experience, and training.

Data Extraction and Coding

Data extraction was performed independently by two reviewers using a standardized form. Extracted data included study characteristics, participant demographics, methods, key findings related to hypoglycemia knowledge and awareness, and any reported associations or factors influencing knowledge levels. Data coding was conducted to categorize and synthesize findings across included studies.

Data Management

All retrieved records were managed using bibliographic software such as EndNote or Zotero to facilitate organization, deduplication, and tracking of search results. Throughout the review process, records were documented in a transparent manner to ensure reproducibility and adherence to the established protocol.

Results

The initial search identified a total of 26 studies from PubMed, Embase, Cochrane Library, and CINAHL. There were no duplicates and 26 studies were screened based on their titles and abstracts. Of these, 17 full-text articles were reviewed, and only two studies were eligible for inclusion in this systematic review (Figure 1).

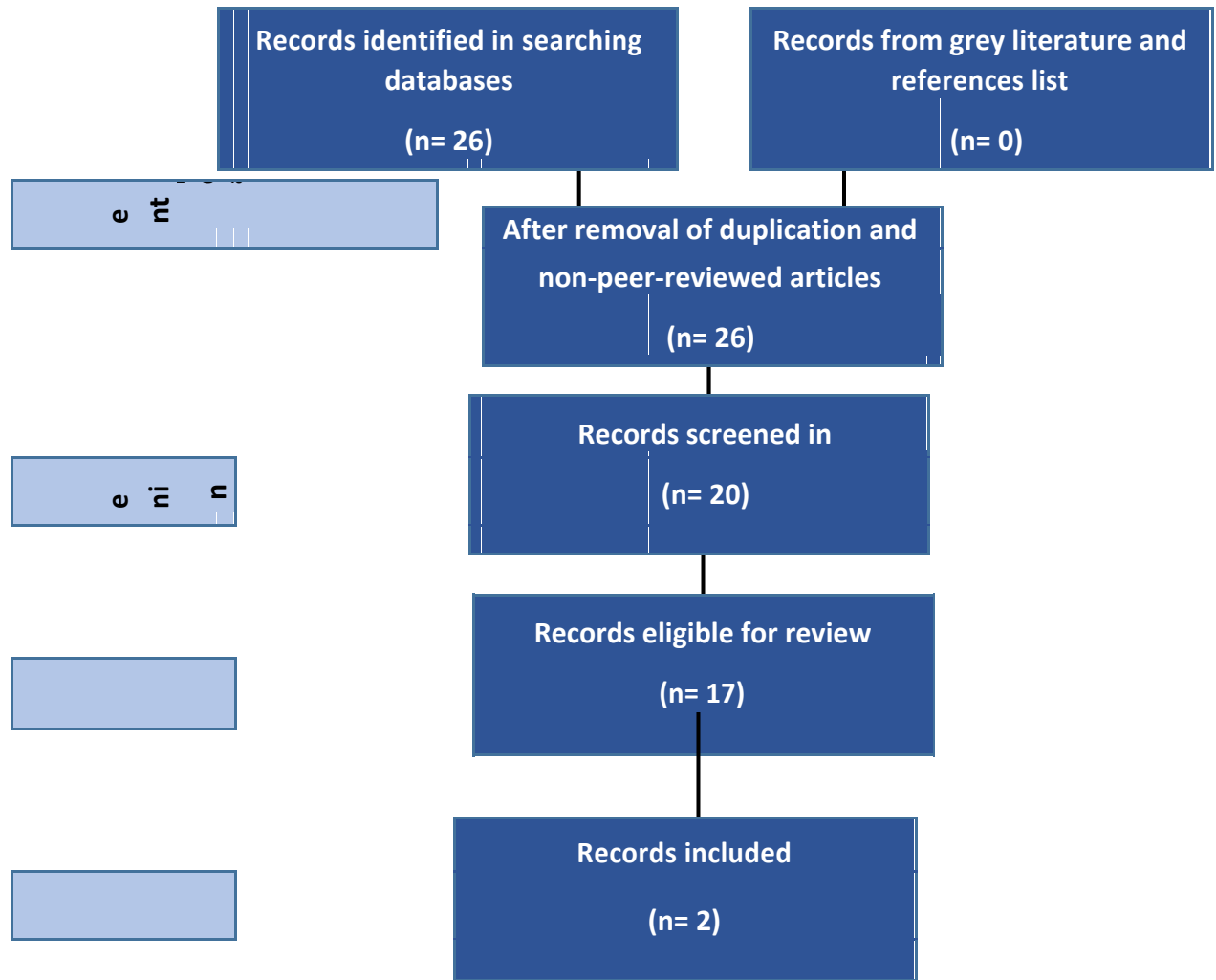


Figure 1: Flow chart of selection process

Most of studies found during the search were assessing knowledge and awareness about hypoglycemia among diabetic patients; both type 1 and type 2. There is an urge need to assess this area among various healthcare workers. One study assessed physicians perspective towards patients’ awareness of hypoglycemia [23]. Between December 2018 and June 2019, 292 primary care doctors from three tertiary hospitals and primary care clinics in Riyadh, Saudi Arabia participated in a cross-sectional research that used a newly-designed self-administered questionnaire. Out of all the participants, 59.9% had a decent understanding of IAH, while only 40.1% had a poor understanding. The mean knowledge scores of the participants who reported below average familiarity with IAH were 4.39 points, whereas the mean scores of the about half of the doctors who assessed their familiarity with the system as average or above average were 5.32 points (p=0.000). Medical professionals with experience treating patients with intraabdominal hemorrhage had higher mean knowledge ratings (5.58 vs 5.01) (p=0.019) compared to those without such experience. There was a statistically significant correlation between the years of practice, amount of education, and age of doctors and their mean knowledge scores. There is a significant disparity in the level of understanding, familiarity, and application of IAH among Saudi Arabian doctors. Additional study is necessary, and primary

care doctors should be the target of comprehensive teaching initiatives aimed at improving their patients' awareness of impaired hypoglycemia [23].

The second study focused on pre-travel counseling of patients with diabetes mellitus with regard to hypoglycemia [24]. The primary healthcare centers in Riyadh, Saudi Arabia, that are part of the Ministry of Health were the subjects of this cross-sectional research that ran from 2018 to 2019. In order to find doctors to participate, researchers employed a cluster multistage random sampling method. An individual completed a self-administered questionnaire to provide the data. We sought out 385 family doctors and other primary care practitioners. Over half of the primary health care doctors surveyed in this research had low levels of expertise. Also, being a general practitioner with little experience (0-5 years), being male, being younger, and Saudi were substantially correlated with inadequate understanding. When asked about the significance of pre-travel counseling for diabetic patients, 183 people (or 47.5% of the total) expressed dissatisfaction. Being older and more experienced were also strongly linked to these disagreeable sentiments. Poor practice ratings were reported by the majority of the doctors (62.6%). Doctors with a general practitioner specialization and degree who were younger, male, and Saudi were found to have poor practices. It seems that primary care doctors don't know enough about type 2 diabetes to properly advise their patients before they travel. Hence, in order to better treat diabetic travelers, it is essential to develop conveniently accessible travel medicine education programs for Saudi PHC providers [24].

Discussion

Hypoglycemia, characterized by low blood sugar levels, presents a significant clinical challenge in the management of diabetes, necessitating adequate knowledge and awareness among healthcare workers for effective prevention and management [25]. This systematic review aimed to evaluate the knowledge and awareness of hypoglycemia among healthcare workers in the Kingdom of Saudi Arabia (KSA), shedding light on existing deficiencies and highlighting areas for improvement. The discussion section will delve into the findings of the included studies, interpret their implications, and propose strategies for enhancing hypoglycemia awareness among healthcare professionals in KSA.

The findings of this systematic review revealed a notable gap in the understanding of hypoglycemia among healthcare workers in KSA, as evidenced by the limited number of eligible studies and the disparities in knowledge levels among primary care doctors [23-24]. Despite the prevalence of diabetes in KSA and the critical role of healthcare professionals in its management, the identified studies underscored deficiencies in hypoglycemia knowledge, particularly concerning impaired awareness of hypoglycemia (IAH) [26]. These findings are consistent with previous research highlighting inadequate hypoglycemia awareness among healthcare workers globally, suggesting a need for targeted educational interventions to address this issue [27-30].

One of the included studies assessed physicians' perspectives towards patients' awareness of hypoglycemia, revealing significant disparities in knowledge levels among primary care doctors in KSA [23]. Factors such as years of practice, level of education, and experience treating patients with IAH were found to influence knowledge scores, indicating a need for tailored educational initiatives targeting primary care providers [23]. The observed correlation between years of practice and knowledge scores suggests that ongoing professional development and experience may contribute to improved understanding of hypoglycemia among healthcare professionals. Moreover, the association between education level and

knowledge scores underscores the importance of comprehensive training programs in equipping healthcare workers with the necessary skills to effectively manage hypoglycemia [31-33].

Similarly, the second included study focused on pre-travel counseling practices among primary healthcare practitioners in KSA, highlighting deficiencies in expertise and practice ratings [24]. The findings revealed that over half of the primary care doctors surveyed had low levels of expertise in providing pre-travel counseling to diabetic patients, with factors such as age, gender, and years of experience influencing knowledge levels [24]. These findings are consistent with previous research indicating suboptimal pre-travel counseling practices among healthcare providers globally, underscoring the need for standardized guidelines and training programs to improve the quality of care provided to diabetic travelers [34-38].

The identified gaps in hypoglycemia awareness among healthcare workers in KSA have several implications for clinical practice and patient outcomes. Inadequate knowledge of hypoglycemia among healthcare professionals can lead to delays in recognition and treatment, potentially resulting in adverse health outcomes for patients with diabetes [39-40]. Moreover, poor pre-travel counseling practices may increase the risk of hypoglycemic episodes during travel, posing significant challenges for diabetic individuals and healthcare systems. Addressing these deficiencies is essential for improving patient safety and quality of care in the management of diabetes in KSA [41-43].

To enhance hypoglycemia awareness among healthcare workers in KSA, several strategies can be implemented. First, comprehensive educational initiatives should be developed to provide healthcare professionals with up-to-date information on the causes, symptoms, management, and prevention of hypoglycemia [44]. These initiatives should be tailored to the specific needs of primary care providers and incorporate interactive learning methods to promote active engagement and retention of knowledge. Additionally, the integration of hypoglycemia management guidelines into clinical practice can help standardize care and improve patient outcomes. Collaborative efforts between healthcare organizations, professional societies, and educational institutions are essential to ensure the widespread implementation of these initiatives and promote a culture of continuous learning and improvement among healthcare professionals [45-47].

Furthermore, raising awareness of hypoglycemia among diabetic individuals and their families is crucial for empowering patients to recognize and manage hypoglycemic episodes effectively. Patient education programs should be developed to provide individuals with diabetes with the necessary knowledge and skills to identify early warning signs of hypoglycemia, take appropriate action, and seek timely medical assistance when needed. These programs should be accessible, culturally sensitive, and tailored to the diverse needs of diabetic populations in KSA [48-50].

This systematic review provides valuable insights into the knowledge and awareness of hypoglycemia among healthcare workers in the Kingdom of Saudi Arabia. The identified gaps in understanding underscore the need for targeted educational interventions and standardized guidelines to improve hypoglycemia awareness and management practices among healthcare professionals. By addressing these deficiencies and empowering patients with the necessary knowledge and skills, healthcare systems in KSA can enhance patient safety, improve clinical outcomes, and mitigate the burden of diabetes on individuals and society. Collaborative efforts between stakeholders are essential to ensure the successful implementation of these initiatives and promote a culture of excellence in diabetes care.

Conclusion

Findings indicated a concerning lack of familiarity with impaired awareness of hypoglycemia (IAH) among primary care doctors, with a substantial proportion demonstrating inadequate knowledge scores. Factors such as years of practice, level of education, and experience treating patients with IAH were found to influence knowledge levels, highlighting the need for targeted educational interventions aimed at enhancing healthcare professionals' understanding of hypoglycemia. These findings emphasize the critical importance of addressing knowledge gaps and enhancing awareness of hypoglycemia among healthcare workers in KSA to improve patient outcomes and ensure effective management of hypoglycemic episodes, particularly within diabetic populations. Further research and implementation of tailored educational initiatives are warranted to bridge these knowledge gaps and enhance the quality of care provided to individuals with diabetes in Saudi Arabia.

References

1. Diagnosis and classification of diabetes mellitus. American Diabetes Association. *Diabetes Care*. 2005;28 Suppl 1:0–42.
2. Diabetes mellitus: complications and therapeutics. Tripathi BK, Srivastava AK. <https://pubmed.ncbi.nlm.nih.gov/16810145/> *Med Sci Monit*. 2006;12:0–47.
3. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9(th) edition. Saeedi P, Petersohn I, Salpea P, et al. *Diabetes Res Clin Pract*. 2019;157:107843.
4. Is diabetes becoming the biggest epidemic of the twenty-first century? Tabish SA. <https://pubmed.ncbi.nlm.nih.gov/21475425/> *Int J Health Sci (Qassim)* 2007;1:0.
5. Acute metabolic complications of diabetes mellitus. Abdelmalek BM. *Med J Ahmed Maher Teach Hosp*. 2012;1:779–781.
6. Determinants of severe hypoglycemia complicating type 2 diabetes: the Fremantle diabetes study. Davis TM, Brown SG, Jacobs IG, Bulsara M, Bruce DG, Davis WA. *J Clin Endocrinol Metab*. 2010;95:2240–2247.
7. High prevalence of impaired awareness of hypoglycemia and severe hypoglycemia among people with insulin-treated type 2 diabetes: the Dutch Diabetes Pearl Cohort. van Meijel LA, de Vegt F, Abbink EJ, et al. *BMJ Open Diabetes Res Care*. 2020;8:0.
8. Frequency of severe hypoglycemia requiring emergency treatment in type 1 and type 2 diabetes: a population-based study of health service resource use. Leese GP, Wang J, Broomhall J, et al. *Diabetes Care*. 2003;26:1176–1180.
9. Cryer PE. American Diabetes Association. Alexandria. Alexandria: American Diabetes Association; 2016. *Hypoglycemia in Diabetes: Pathophysiology, Prevalence, and Prevention*.
10. Symptoms of acute insulin-induced hypoglycemia in humans with and without IDDM. Factor-analysis approach. Hepburn DA, Deary IJ, Frier BM, Patrick AW, Quinn JD, Fisher BM. *Diabetes Care*. 1991;14:949–957.
11. Hypoglycemia: the neglected complication. Kalra S, Mukherjee JJ, Venkataraman S, et al. *Indian J Endocrinol Metab*. 2013;17:819–834.

12. Association between hypoglycemia and fall-related events in type 2 diabetes mellitus: analysis of a U.S. commercial database. Kachroo S, Kawabata H, Colilla S, et al. *J Manag Care Spec Pharm.* 2015;21:243–253.
13. Economic impact of severe and non-severe hypoglycemia in patients with type 1 and type 2 diabetes in the United States. Foos V, Varol N, Curtis BH, Boye KS, Grant D, Palmer JL, McEwan P. *J Med Econ.* 2015;18:420–432.
14. Severe hypoglycemia is associated with antidiabetic oral treatment compared with insulin analogs in nursing home patients with type 2 diabetes and dementia: results from the DIMORA study. Abbatecola AM, Bo M, Barbagallo M, et al. *J Am Med Dir Assoc.* 2015;16:349–312.
15. Frequency and risk factors of severe hypoglycaemia in insulin-treated Type 2 diabetes: a cross-sectional survey. Akram K, Pedersen-Bjergaard U, Carstensen B, Borch-Johnsen K, Thorsteinsson B. *Diabet Med.* 2006;23:750–756.
16. Medically minimising the impact of hypoglycaemia in type 2 diabetes: a review. Noh RM, Graveling AJ, Frier BM. *Expert Opin Pharmacother.* 2011;12:2161–2175.
17. Treatment of severe diabetic hypoglycemia with glucagon: an underutilized therapeutic approach. Kedia N. *Diabetes Metab Syndr Obes.* 2011;4:337–346.
18. Reduced awareness of hypoglycemia in adults with IDDM. A prospective study of hypoglycemic frequency and associated symptoms. Clarke WL, Cox DJ, Gonder-Frederick LA, Julian D, Schlundt D, Polonsky W. *Diabetes Care.* 1995;18:517–522.
19. Knowledge of hypoglycemia and its associated factors among type 2 diabetes mellitus patients in a tertiary care hospital in South India. Shriram V, Mahadevan S, Anitharani M, Jagadeesh NS, Kurup SB, Vidya TA, Seshadri KG. *Indian J Endocrinol Metab.* 2015;19:378–382.
20. Survey reveals low hypoglycemia awareness among patients with diabetes. [Jan; 2023]. <https://www.healio.com/news/endocrinology/20120325/survey-reveals-low-hypoglycemia-awareness-among-patients-with-diabetes>.
21. Level of knowledge and self-care in diabetics in a community hospital in Najran. Khan LA, Khan SA. *Ann Saudi Med.* 2000;20:300–301.
22. Overview of glycemic control, knowledge, awareness and attitude among type-2 diabetes male patient's. Khan NA, Venkatachalam V V., Al Akhali KM, Alavudeen SS, Dhanapal CK, Mohammad AAS. <https://www.longdom.org/open-access/overview-of-glycemic-control-knowledge-awareness-and-attitude-among-type2-diabetes-male-patients-.pdf> *J Appl Pharm.* 2015;7.
23. Alomani M, Alrasheed AA, Almigbal TH, Aldossari KK, Batais MA. Physicians perspective towards impaired awareness of hypoglycaemia in patients with diabetes: A forgotten area. *Australasian Medical Journal (Online).* 2021;14(9):225-33.
24. Alduraibi RK, Almigbal TH, Alrasheed AA, Batais MA. Knowledge, attitudes, and practices of primary health care physicians regarding the pre-travel counselling of patients with type 2 diabetes in Riyadh, Saudi Arabia. *BMC Family Practice.* 2020 Dec;21:1-9.
25. Pottie E, Bellanger AP, Piton G, et al. Pre-travel consultation: evaluation of primary care physician practice in the Franche-comté region. *J Travel Med.* 2013;20:221–7.
26. Lengyel I, Felkai P. Pre-travel advice and patient education of Hungarian travellers. *Orv Hetil.* 2018;159:357–62.

27. Steffen R. 3. Travel medicine—prevention based on epidemiological data. *Trans R Soc Trop Med Hyg.* 1991;85:156–62.
28. Burnett JCD. Long- and short-haul travel by air: issues for people with diabetes on insulin. *J Travel Med.* 2006;13:255–60.
29. Pinsker JE, Schoenberg BE, Garey C, et al. Perspectives on long-distance air travel with type 1 diabetes. *Diabetes Technol Ther.* 2017;19:744–8.
30. Gill GV, Redmond S. Insulin treatment, time-zones and air travel: a survey of current advice from british diabetic clinics. *Diabet Med.* 1993;10:764–7.
31. Paudel P, Raina C, Zwar N, et al. Risk activities and pre-travel health seeking practices of notified cases of imported infectious diseases in Australia. *J Travel Med.* 2017;24. .
32. Ghosh S, Bajaj S, Chatterjee P, et al. Diabetes and travel. *Int J Diabetes Dev Ctries.* 2018;38:4–10.
33. Morteza I, Sadat HM, Hossein P. Travel guidance for people with diabetes. *Int J Travel Med Global Health.* 2015;3:149–54.
34. Elkins BE, True MW, Ramos RG, Cranston MM. How do you get there with diabetes? Results of a survey of diabetic travelers. *J Tourism Hospitality.* 2014;3.
35. Al-Hajri M, Bener A, Balbaid O, Eljack E. Knowledge and practice of travel medicine among primary health care physicians in Qatar. *Southeast Asian J Trop Med Public Health.* 2011;42:1546–52.
36. Kogelman L, Barnett ED, Chen LH, et al. Knowledge, attitudes, and practices of US practitioners who provide pre-travel advice. *J Travel Med.* 2014;21:104–14.
37. Schunk M, Wachinger W, Nothdurft HD. Vaccination status and prophylactic measures of travelers from Germany to subtropical and tropical areas: results of an airport survey. *J Travel Med.* 2001;8(5):260.
38. Marchand C, Merrina F, Gagnayre R, Bouchaud O. A descriptive study of advising practices during travel health consultations in France. *J Travel Med.* 2017;24.
39. Prevalence and incidence of hypoglycaemia in 532,542 people with type 2 diabetes on oral therapies and insulin: a systematic review and meta-analysis of population based studies. Edridge CL, Dunkley AJ, Bodicoat DH, Rose TC, Gray LJ, Davies MJ, Khunti K. *PLoS One.* 2015;10:0.
40. Avoiding hypoglycemia: a key to success for glucose-lowering therapy in type 2 diabetes. Ahrén B. *Vasc Health Risk Manag.* 2013;9:155–163.
41. Hypoglycemia in patient with type 2 diabetes treated with insulin: it can happen. Heller SR, Peyrot M, Oates SK, Taylor AD. *BMJ Open Diabetes Res Care.* 2020;8:0.
42. Awareness of complications of diabetes mellitus and its associated factors among type 2 diabetic patients at Addis Zemen District Hospital, northwest Ethiopia. Belsti Y, Akalu Y, Fekadu H, Animut Y. *BMC Res Notes.* 2019;12:602.
43. Hypoglycemia among patients with type 2 diabetes: epidemiology, risk factors, and prevention strategies. Silbert R, Salcido-Montenegro A, Rodriguez-Gutierrez R, Katabi A, McCoy RG. *Curr Diab Rep.* 2018;18:53.

44. Association between knowledge of hypoglycemia and likelihood of experiencing hypoglycemia among patients with insulin-treated diabetes mellitus. Almigbal TH. *Diabetes Metab Syndr Obes.* 2021;14:3821–3829.
45. Awareness of symptoms and early management of hypoglycemia among patients with diabetes mellitus. Sharma SK, Kant R. *J Diabetes Endocrinol Assoc Nepal.* 2018;1:12–17.
46. Knowledge of hypoglycemia and its associated risk factors among type 2 diabetes mellitus patients in diabetes centre, Security Forces Hospital, Riyadh, Saudi Arabia. Albaqami NM. *J Med Sci Clin Res.* 2018;6:1–8.
47. The incidence of hypoglycemia and its risk factors among diabetic patients in the eastern province of Saudi Arabia. Elshebiny AM, Alali HA, Alamer ZM, Alsultan YK, Alkhalaf HE, Alkishi AM, Alsuwaylih MA. *IJMDC.* 2021;5:614–621.
48. Information seeking behavior of patients with diabetes mellitus: a cross-sectional study in an outpatient clinic of a university-affiliated hospital in Athens, Greece. Kalantzi S, Kostagiolas P, Kechagias G, Niakas D, Makrilakis K. *BMC Res Notes.* 2015;8:48.
49. Al Hussaini H, Alismael A, Alquraini M, Alhabdan T, Alramadan H, Alqattan J, Ali S, Aljalal B, Almulhim M, Al Sahlawi M, Alismael AM. Knowledge Regarding Hypoglycemia and Its Management Among Patients With Insulin-Requiring Diabetes Mellitus in Al-Ahsa, Saudi Arabia. *Cureus.* 2023 Oct 18;15(10).
50. AlTowayan A, Alharbi S, Aldehami M, Albahli R, Alnafessah S, Alharbi AM, Alharbi SM. Awareness level of hypoglycemia among diabetes mellitus type 2 patients in al Qassim region. *Cureus.* 2023 Feb 22;15(2).