Reprint from The Review of DIABETIC STUDIES Vol 20 No 2 2024

The Review of DIABETIC STUDIES

RESEARCH

Hyperglycemic Disorders in the Emergency Room: A Cross-sectional Study

Hernando Vargas-Uricoechea[1]*, María V. Pinzón-Fernández[2], Hernando D. Vargas-Sierra[2], Andrés Guerrero-Guzmán[2], Oscar Rojas-Castro[2], Daniel González-Martínez[2]

[1]Metabolic Diseases Study Group, Department of Internal Medicine, Universidad del Cauca, Popayán-Colombia. [2]Health Research Group, Department of Internal Medicine, Universidad del Cauca, Popayán-Colombia. Address Correspondence to: Hernando Vargas-Uricoechea, Email: hernandovargasuricoechea@gmail.com

Manuscript Submitted April 20, 2024; Resubmitted June 02, 2024; Accepted June 10, 2024

■ Abstract

Objectives: Determine the prevalence of stress hyperglycemia and its different categories in a high complexity hospital, and explore the possible associated factors. **Methods:** An observational, prospective and cross-sectional study was carried out, using non-probabilistic sampling (for convenience), in those patients who were admitted to an emergency room (n=1822), according to different categories of glycemia value and A1c value, and the possible associated factors. **Results:** The distribution of A1C had a direct relationship with the glycemic value on admission, among those who had blood glucose levels between ≥100 to ≤140, the distribution of A1c values (<5.7; between 5.7 and <6.5 and ≥6.5%) occurred in 58%, 40% and 2% of the participants, respectively; while, for those who had blood glucose ranges between >140 and <180, the distribution of the same A1c values was 18%, 70% and 12%, respectively. **Conclusion:** The hyperglycemic disorders, according to the current criteria for defining stress hyperglycemia, may not be identifying a significant proportion of individuals with a diagnosis of intermediate glucose states (or DM). The stratification of these patients, regardless of having a blood glucose value on admission, should be re–evaluated and analyzed in long–term studies.

Keywords: Hyperglycemia, Stress, Blood glucose, A1c, Diabetes.

1. Introduction

Hyperglycemia in hospitalized patients includes stress hyperglycemia, intermediate states of glucose metabolism (such as prediabetes characterized by impaired fasting blood glucose (IFG) and glucose intolerance (IGT)), and Diabetes Mellitus (DM) [1].

DM is a state of chronic hyperglycemia with a heterogeneous etiology, resulting from alterations in the metabolism of carbohydrates, lipids, and proteins. It is associated with an increased risk of microvascular and macrovascular complications, as well as other multisystem outcomes [1-4].

Chronic hyperglycemia also referred to as IFG and impaired glucose tolerance (IGT), is defined by a fasting blood glucose (BG) value ≥100 mg/dL and <126 mg/dL, and a BG value (2 h post-load of 75 gm of glucose) that is ≥140 mg/dL and <200 mg/dL, respectively. Additionally, glycosylated hemoglobin (A1c) enables the diagnosis of prediabetes when it ranges between 5.7 and <6.5% [2, 5-7].

Both IFG and IGT represent and define a high risk for the subsequent development of DM and cardiovascular disease [6, 8].

Stress hyperglycemia is caused by various events classified as "stressful" and is characterized by its resolution once the trigger has been resolved [9-11].

Adult patients with DM constitute 25% of non-critically ill patients in hospitals. Additionally, 12% to 25% of hospitalized patients experience hyperglycemia, defined as BG >140 mg/dL (>7.8 mmol/L) [10, 12-14].

Both diabetes and hyperglycemia in a hospital setting are associated with protracted hospital stays, higher incidences of complications, and disability following hospital discharge [15-19].

Hyperglycemia in hospitalized individuals is defined as BG levels exceeding 140 mg/dL. An admission A1c value equal to or above 6.5% (or 48 mmol/mol) suggests that the onset of DM occurred before hospitalization. Meanwhile, a BG value exceeding 140 mg/dL, in the context of an A1c value less than 6.5%, confirms the diagnosis of stress hyperglycemia [20-24].

In Colombia, data on the frequency of hyperglycemia in individuals admitted to emergency services is scant. Thus, our research question was the following: *What is the prevalence of hyperglycemic disorders, according to different categories of blood glucose and A1c values, in patients who consult for surgical and/or non-surgical pathologies in an emergency department of a high-complexity hospital?*

Hence, the primary objective was to ascertain the prevalence of hyperglycemia and its various categories, according to the initial values of BG and A1c, in individuals who sought medical attention at a high-complexity hospital in Popayán, Colombia.

2. Methods

2.1. Subjects

An observational, prospective, cross-sectional study was conducted. It was decided to carry out a non-probabilistic sampling (convenience) in which participants are selected based on their availability and proximity to the study site. Additionally, to reduce (at least in part) the representativeness bias of this type of sampling, a sample size of at least >1500 participants was established a priori, ultimately selecting 1822 patients.

The study was performed with patients who were admitted to an emergency room under the following inclusion criteria: adults aged 18 years or over, having any indication for surgical and/or medical care, who were under medical observation for at least 48 h, with central BG and A1c (standardized) levels recorded at admission.

The exclusion criteria included: pregnant or lactating women, patients with suspected or known liver or kidney failure (currently on renal replacement therapy), individuals with a prior diagnosis of DM or active treatment (oral and/or parenteral), those suffering from psychiatric illnesses or mental disorders hindering participation in the study, hemoglobinopathies, hemolytic or iron deficiency anemia, active cancer patients who were under chemotherapy in the last three months, those who used systemic steroids in the past 4 weeks, patients requiring management with parenteral dextrosed fluids, those on sympathomimetics or vasoactive agents at the emergency room admission, and individuals with contraindications for the oral route.

2.2. Ethical Issues and Informed Consent

This study was conducted following the principles of the Declaration of Helsinki and approved by the Research Ethics Committee at Hospital Universitario San José (Popayán–Colombia), with the record number: 04 of 2018 (internal code: 0025 HUSJ–CI). Written informed consents were obtained from all study participants. The individuals were recruited between July 1, 2019, and July 31, 2023. A confidentially coded database was created, inaccessible to third parties, and implemented exclusively for this research.

2.3. Measurements

The collection of information was done using a validated instrument that evaluated sociodemographic and clinical data. This information was completed through a physical examination.

For this analysis, patients were classified according to different ranges of BG and A1c levels upon admission. The BG ranges used were as follow: ≥100 to ≤140 mg/dL, >140 to <180 mg/dL, 180 to <200 mg/dL, and ≥200 mg/dL. A1c levels (in %) were measured at a central laboratory, Martha Perdomo Clinical Laboratory in Popayán, Colombia, using the TOSOH G8 HPLC system (TOSOH Biosciences Inc.), % CV: median 0.018; interquartil range: 0.013 to 0.022.

Patients were then sorted into three categories based on their A1c values: <5.7%, 5.7% to <6.5%, and ≥6.5%.

2.4. Statistics

The information was analyzed using the licensed STATA statistical program, version 25.0. The results of qualitative variables were expressed in frequencies and percentages. Additionally, the mean and median were used for parametric and non-parametric quantitative variables, respectively.

Additionally, contingency tables were constructed, integrating the calculation of the Odds Ratio (OR) and its 95% confidence intervals. This was done for the bivariate analysis of potential factors associated with the hyperglycemic states. The Chi-square test (X^2) was conducted as a test of statistical significance, with a P-value of <0.05 indicating a significant result.

3. RESULTS

3.1. Participant characteristics

We initially evaluated 4077 potential participants and eventually included 1822 patients in the final analysis for the respective study (Figure 1).

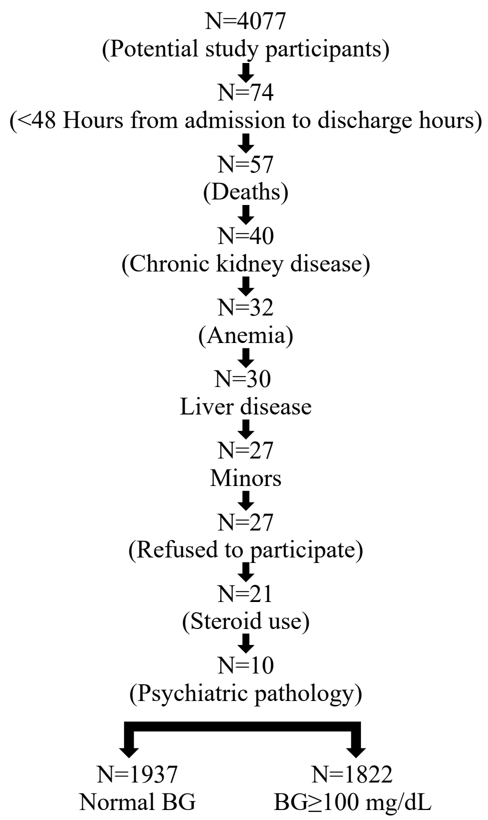

Figure 1: Selection Process of Subjects Entered Into the Study. The Characteristics of the Excluded Patients and the Total Number Included for the Analysis are Described.

The majority of participants were women, comprising 63.5%, and 54.1% were aged 60 years old or over. The most common reason for their visits was medical non-surgical pathologies, accounting for 58.4% of cases. Place of origin was almost evenly split between urban and rural, at 49.6% and 50.4% respectively.

Most subjects were of mixed race, and the majority had an educational level of high school or higher (Table 1).

Table 1: Sociodemographic Characteristics and Type of Diagnosis on Admission (n=1822).

Characteristics	Percentage (%)	*P–Value*
Sex		
Men	36.5	0.02
Women	63.5	
Age (years)		
0 – 39 years old	20.4	0.03
40 – 59 years old	25.5	
≥60 years	54.1	
Origin		
Urban	49.6	0.48
Rural	50.4	
Marital Status		
Single/widowed/separated	50.3	0.49
Married/other	49.7	
Ethnic Group		
Mixed race	78.8	0.01
Indigenous	15.4	
Afro–descendant	5.8	
Educational Level		
None	20.4	0.02
High school	74.4	
Undergraduate/postgraduate/technical	5.2	
Social Security		
Subsidized	67.8	0.04
Contributory/other	32.2	
Work Activity		
Unemployed	52.5	0.08
Employee	47.5	
Diagnosis		
Medical	58.4	0.02
Surgical	35	
Medical–surgical	6.6	

3.2. Ranges of BG and A1c Values in the Total Population and Participants with Hyperglycemia

Of the 1937 participants, those with a BG at admission of less than 100 mg/dL were categorized as follows: 96.5% had an A1c of less than 5.7%, 3.0% had an A1c between 5.7 to less than 6.5%, and 0.5% had an A1c greater than or equal to 6.5%.

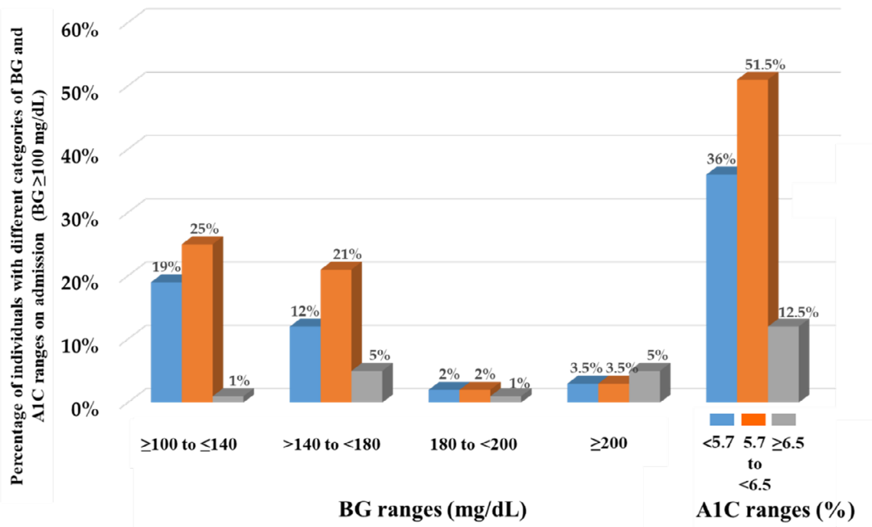

Figure 2: BG and A1c Ranges on Admission, According to Different Classification Categories.
Abbreviation: BG: blood glucose

In the study, out of 1822 individuals with BG levels ≥100 mg/dL, the average weight was 65.6 kg, accompanied by an abdominal perimeter of 89.7 cm, and a body mass index (BMI) of 24.9 kg/m^2. The mean creatinine and BG measures were observed to be 1.33 mg/dL and 160 mg/dL, respectively. The BG value distribution ranged as follows: 820 participants (45%) registered BG values between ≥100 to ≤140; 692 (38%) fell within the >140 to <180 range; 91 (5%) between the brackets of 180 to <200; and 219 (12%) measured values of ≥200. Concerning A1c values, 656 participants (36%) showed A1c values <5.7%; 938 (51.5%) had values within the range of 5.7 to <6.5%; and 228 (12.5%) showed values ≥6.5% (Figure 2).

It was also discovered that the distribution of A1c had a direct correlation with the glycemic value upon admission, with the highest proportion of normal A1c values found among patients with glycemia between ≥100 to ≤140 mg/dL, and the highest A1c values found in those with BG values ≥200 mg/dL.

Similarly, among those who had BG levels between ≥100 and ≤140 mg/dL, the distribution of A1c values (<5.7; between 5.7 and <6.5, and ≥6.5%) occurred in 58%, 40%, and 2% of the participants, respectively.

Whereas, for those with BG levels ranging from >140 to <180 mg/dL, the distribution of the same A1c values was 18%, 70%, and 12% respectively. Similarly, among those who had BG levels between 180 and <200, the distribution of A1c values was 10%, 56.5%, and 33.5%, respectively.

Finally, among those with admission BG levels ≥200, the distribution of A1c values was 9%, 42%, and 49%, respectively.

The highest percentage of individuals with A1c values <5.7% was observed in participants with BG levels between ≥100 and ≤140 (58%); the lowest percentage was found among those with BG levels ≥200 (0.9%).

The highest percentage of patients with A1c values between 5.7 and <6.5% was found among those with a BG range between >140 and <180. The highest percentage of patients with A1c values >6.5%, conversely, was found in subjects with BG values ≥200 mg/dL (Table 2). Lastly, the percentage of patients with BG >140 mg/dL with A1c <6.5% (stress hyperglycemia) stood at 36%.

Table 2: Percentage of Participants with Different A1c Ranges, in Relation to the Category of BG Values at Admission.

BG Categories (n=1822)	**Participants (%) and A1c Values, According to the BG Category**			**Participants (%) According to the BG Category**
BG Ranges (mg/dL)	**A1c (<5.7%)**	**A1c (5.7 to <6.5%)**	**A1c (≥6.5%)**	
≥100 to ≤140	58	40	2	100
>140 to <180	18	70	12	100
180 to <200	10	56.5	33.5	100
≥200	9	42	49	100

Abbreviations: BG: blood glucose.

3.3. Factors Associated with Hyperglycemia in the Emergency Room

Among the potential factors associated with hyperglycemia, arterial hypertension (AH) was notable, being present in 35.8% of the patients while a sedentary lifestyle was observed in 56%. Furthermore, 19% were diagnosed with dyslipidemia (Table 3).

Table 3: Frequency of Lifestyle Activities. The Percentage or Frequency (mean, SD) of Times Per Week in which Individuals Carried it Out is Described. The Percentage of Individuals with other Associated Factors is Described. *Exercise was Considered a Minimum of 10 Minutes/Week.

Characteristic	**Percentage**
Do not engage in physical activity	56%
Sitting time 1 to 4 hours	54%
Exercise in free time*	1.6 (SD: 2.37)
Alcohol use >1 time per month	16%
Smoking	11%
High blood pressure	35.8%
Dyslipidemia	19%

3.4. Other Variables Probably Associated with Hyperglycemia in the Emergency Department

In conducting the bivariate analysis to determine if certain variables were associated with the presence of hyperglycemic conditions, no significant correlations were found among variables such as ethnicity, origin, alcohol consumption, and most family history aspects.

On the other hand, a significant protective association was found between intense levels of physical activity and the presence of hyperglycemic states. However, a significant association was also discovered between the presence of hyperglycemic states and several factors: age (>60 years), sex (women), work status (unemployed), marital status (married), BMI >25, being part of a subsidized social security scheme, having a low or no educational level, mixed race, presenting a non-surgical medical pathology that led to the consultation, dyslipidemia, hypertension, lack of physical activity, increased abdominal perimeter, and a family history of DM or cerebrovascular disease (Table 4).

Table 4: Associated Factors with Hyperglycemic States. The Results are Expressed in Odds Ratio (OR), Confidence Intervals (CI: 95%) and Statistical Significance *(P–value)*.

Factores Asociados	Odds Ratio (OR)	*P–value* (x^2)
Age (years)		
<39	0.47 (CI 95%: 0.21–1.05)	
40 – 59	2.5 (CI 95%: 0.89–7.05)	0.001
>60	9 (CI 95%: 3.3–24.1)	
Sex (female)	3.6 (CI 95%: 1.8–7.08)	0.001
Origin		
Rural	1.6 (CI 95%: 0.99–2.6)	0.06
Urban	1.3 (CI 95%: 0.61–2.49)	
Dyslipidemia	4.2 (CI 95%: 1.58–11.1)	0.004
AH	2.9 (CI 95%: 1.57–5.43)	0.001
Frequency of Alcohol Intake		
Diary	1.8 (CI 95%: 0.76–3.8)	
1–4 days/week	0.47 (CI 95%: 0.12–2.5)	0.56
<1 time per month	0.62 (CI 95%: 0.11–1.21)	
Smoking	1.1 (CI 95%: 0.41–3.15)	0.79
Family Background		
DM	2.2 (CI 95%: 1.24–3.64)	0.039
AH	1.3 (CI 95%: 0.85–2.18)	0.19
Kidney disease or dialysis	0.33 (CI 95%: 0.09–1.35)	0.17
Cerebrovascular disease	3.0 (CI 95%: 1.59–6.25)	0.033
Acute myocardial infarction	1.3 (CI 95%: 0.72–2.60)	0.33
Dyslipidemia	1.7 (CI 95%: 0.72–2.61)	0.33
Physical activity (intense)	0.22 (CI 95%: 0.06–0.72)	0.012
Absence of physical activity	2.2 (CI 95%: 1.39–3.63)	0.001
AC: >91 cm (males) and >89 cm (females)	2.97 (CI 95%: 1.43–6.19)	0.004
BMI Range (kg/m²)		
<24.9	1.12 (CI 95%: 0.70–1.81)	0.628
25–29.9	2.22 (CI 95%: 1.01–4.85)	0.040
>30	5.03 (CI 95%: 3.35–6.79)	0.016

Abbreviations: AC: abdominal circumference, AH: arterial hypertension, BMI: body mass index, DM: Diabetes mellitus.

4. Discussion

In this study, sociodemographic characteristics, along with glycemic and A1c values, were evaluated upon entry into the emergency department of a high-complexity hospital. The observed differences, based on sex and age, stand in contrast with earlier research showing that men in the young and middle-aged demographic exhibit a higher prevalence of type 2 DM than their female counterparts. Nonetheless, postprandial hyperglycemia increases more significantly in women as they get older, leading to a higher prevalence of undiagnosed diabetes in women over the age of 60, and total diabetes after the age of 70 [25-27].

Similarly, the disparities in race type, educational level, and health regimen among participants reflect the distribution of these variables in the socioeconomic context of Colombia. A priori, these findings were anticipated, following data outlined in the 2018 National Population and Housing Census for Colombia [28].

On the other hand, more than half of the patients had a "medical" reason for consultation. This can be attributed to our inclusion criterion, which required potential participants to stay at least 48 h in the emergency department. This excluded patients with surgical or medical-surgical indications that required immediate management and resolution of their health condition. Thus, this aspect should be considered a selection bias. Likely, the number of individuals with surgical or medical reasons for consultation or those needing medical-surgical procedures would have been higher and could have, in some way, altered the results found [29, 30]. Even so, the absolute number of individuals with surgical or medical-surgical reasons for consultation exceeded 40%.

For its part, over a third and a fifth of the population had AH and dyslipidemia, respectively, which is consistent with what is typically documented in patients with DM2 and other hyperglycemic states [31-33]. Additionally, the prevalence of a sedentary lifestyle was high, possibly indicating a lack of adherence to therapeutic lifestyle changes. Intriguingly, the average BMI within these patients was merely 24.9 kg/m².

Regarding glycemia categories, more than 40% of individuals with values between ≥100 and ≤140 mg/dL already had an A1c value of ≥5.7%. This indicates that the patient had a pre-existing and undiagnosed alteration in glucose metabolism.

This aspect may be relevant, as the presence of unidentified or undiagnosed intermediate states of glucose metabolism (or DM) in hospitalized patients is associated with higher rates of adverse outcomes such as mortality, infections, and longer hospital stays, among others [16, 34-36].

A cut-off glycemic value, established for the diagnosis of stress hyperglycemia, at >140 mg/dL, may prevent the early identification of intermediate glucose states. This can result in a "misclassification" phenomenon, thereby decreasing the prospect of initiating preventive interventions earlier [37, 38].

Similarly, the higher the BG value, the greater the proportion of a high A1c value. Intriguingly, more than two-thirds of the participants with BG levels between >140 to <180 mg/dL had already received a previous diagnosis of prediabetes or DM (either unidentified or diagnosed). This was the case even without any type of pharmacological or non-pharmacological intervention. This suggests that current population screening strategies and identification of individuals at high risk of developing prediabetes or DM in our environment might not be optimal [39, 40].

Additionally, 36% of our patients met the diagnostic criteria for stress hyperglycemia, contrasting with other studies that demonstrate a prevalence between 12–25%. However, this prevalence can significantly vary depending on the severity of the underlying medical or surgical condition [16, 41-43].

Finally, a family history of DM2 or cerebrovascular disease and an increased risk of hyperglycemic states in our patients may well indicate a stronger genetic predisposition in these patients. Given the higher prevalence of DM and other cardiometabolic risk factors, it becomes more likely that metabolic conditions such as diabetes or prediabetes will manifest in the offspring [44-46].

Several weaknesses can be identified within this study. For instance, conducting the study in a high-complexity center limits the findings' extrapolation to lower-complexity centers. Moreover, individuals treated in high-complexity centers are more likely to have a greater number of underlying conditions and comorbidities, such as DM2 and AH, among others. Furthermore, the cross-sectional nature of the study does not allow for the establishment of causality; it merely prompts some hypotheses that need addressing in studies with more vigorous designs. It is also important to note that diagnoses of other comorbidities and associated factors were done through self-report, which diminishes the sensitivity and specificity of said comorbidities' diagnosis.

We did not consider other indicators, such as the stress hyperglycemia ratio (SHR) [47]. However, the nature and design of our study aimed to assess the prevalence of hyperglycemic states and some associated factors, rather than evaluating prognostic and/or survival markers. Such questions should be addressed by studies specifically designed to investigate these conditions.

Lastly, we did not consider the type of diagnosis upon admission (we only addressed two categories: medical or surgical diagnosis). In this regard, some pathologies may trigger a higher level of "stress" than others, which could potentially affect the categories of BG values.

5. Conclusion

The assessment of hyperglycemic disorders in patients arriving at the emergency room might not identify a substantial proportion of individuals diagnosed with intermediate glucose states (or DM), under the existing criteria for defining stress hyperglycemia. The stratification of these patients – including those with a BG glucose value on admission ≤140 mg/dL – should be reevaluated and analyzed in long-term studies.

5.1. Data Availability

The authors declare that data supporting the findings of this study are available within the article.

5.2. Acknowledgments

We appreciate the support of the Asociación Colombiana de Endocrinología Diabetes y Metabolismo, and of the Laboratorio Clínico Especializado Martha Cecilia Perdomo, Popayán-Colombia.

5.3. Research Funding

None declared.

5.4. Author Contributions

All authors have accepted responsibility for the entire content of this manuscript and approved its submission.

5.5. Competing Interests

Authors state no conflict of interest.

5.6. Informed Consent

Informed consent was obtained from all individuals included in this study.

5.7. Ethical Approval

The local Institutional Review Board deemed the study exempt from review.

■ References

1. **American Diabetes Association**. Diabetes Care in the Hospital: Standards of Medical Care in Diabetes—2021. *Diabetes Care* 2021. 44(1):S211–S20.
2. **American Diabetes Association Professional Practice Committee**. Diagnosis and Classification of Diabetes: Standards of Care in Diabetes-2024. *Diabetes Care* 2024. 47(Suppl 1):S20-s42.
3. **Del Prato S**. Diabetes and vascular disease: New therapeutic avenues. *Vascul Pharmacol* 2024. 154:107247.
4. **Stedman JM, Spalding TL, Gagné CL, Hancock CL**. The Relationship of Concepts, Memory, and Language in the Cognitive Psychology of Thinking: An Aristotelian–Thomistic Appraisal. *The Journal*

of Mind and Behavior 2023. 44(1/2):15-36.

5. **Echouffo-Tcheugui JB, Perreault L, Ji L, Dagogo-Jack S**. Diagnosis and Management of Prediabetes: A Review. *Jama* 2023. 329(14):1206-16.
6. **Goyal R, Nguyen M, Jialal I.** Glucose Intolerance. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2024.
7. **Shareef MS, Charfeddine B, Roomi AB**. The Association between Spexin Levels, Lipid Profiles, Glucose Metabolism, and Immune Function in Newly Diagnosed Diabetes in Postmenopausal Iraqi Women. *Rev Diabet Stud* 2023. 19(3):166-70.
8. **Davidson MB**. Historical review of the diagnosis of prediabetes/intermediate hyperglycemia: Case for the international criteria. *Diabetes Res Clin Pract* 2022. 185:109219.
9. **Bogun M, Inzucchi SE**. Inpatient management of diabetes and hyperglycemia. *Clin Ther* 2013. 35(5):724-33.
10. **Mifsud S, Schembri EL, Gruppetta M**. Stress-induced hyperglycaemia. *Br J Hosp Med (Lond)* 2018. 79(11):634-9.
11. **Tahamtan I, Bornmann L**. The Social Systems Citation Theory (SSCT): A proposal to use the social systems theory for conceptualizing publications and their citations links. *Profesional de la información* 2022. 31(4):e310411.
12. **McCowen KC, Malhotra A, Bistrian BR**. Stress-induced hyperglycemia. *Crit Care Clin* 2001. 17(1):107-24.
13. **Dungan KM, Braithwaite SS, Preiser JC**. Stress hyperglycaemia. *Lancet* 2009. 373(9677):1798-807.
14. **Sundriyal N, Ramirez JM, Corrochano EB**. A comparison of geometric algebra and harmonic domain for linear circuit analysis. *Math Appl* 2023. 12:115-27.
15. **Thornton-Swan TD, Armitage LC, Curtis AM, Farmer AJ**. Assessment of glycaemic status in adult hospital patients for the detection of undiagnosed diabetes mellitus: A systematic review. *Diabet Med* 2022. 39(4):e14777.
16. **Vedantam D, Poman DS, Motwani L, Asif N, Patel A, Anne KK**. Stress-Induced Hyperglycemia: Consequences and Management. *Cureus* 2022. 14(7):e26714.
17. **Plummer MP, Bellomo R, Cousins CE, Annink CE, Sundararajan K, Reddi BA, et al.** Dysglycaemia in the critically ill and the interaction of chronic and acute glycaemia with mortality. *Intensive Care Med* 2014. 40(7):973-80.
18. **Wang J**. The Latinxua Sin Wenz Movement in the Shaanxi-Gansu-Ningxia Border Region of China: Centred on Winter schools in Yan'an County. *Cultura* 2022. 19(1):101-20.
19. **Cordeiro-Rodrigues L**. Towards a global philosophy of religion: Reply to Schellenberg and Draper. *European Journal for Philosophy of Religion* 2022. 14(3):263-84.
20. **Moghissi ES, Korytkowski MT, DiNardo M, Einhorn D, Hellman R, Hirsch IB, et al.** American Association of Clinical Endocrinologists and American Diabetes Association consensus statement on inpatient glycemic control. *Diabetes Care* 2009. 32(6):1119-31.
21. **American Diabetes Association Professional Practice Committee**. Diabetes Care in the Hospital: Standards of Care in Diabetes-2024. *Diabetes Care* 2024. 47(Suppl 1):S295-s306.
22. **Umpierrez GE, Hellman R, Korytkowski MT, Kosiborod M, Maynard GA, Montori VM, et al.** Management of hyperglycemia in hospitalized patients in non-critical care setting: an endocrine society clinical practice guideline. *J Clin Endocrinol Metab* 2012. 97(1):16-38.
23. **Sunaryo S, Al-Fatih S**. How Corruptor Should Be Punished? A Comparative Study Between Criminal Law, Islamic Law, and Customary Law. *International Journal of Criminal Justice Sciences* 2022. 17(2):91-100.
24. **Razzaiq TA, Rah FA, Enad HA, Ali MH, Abed AS, Hussein HA, et al.** Analyzing Psychological Health and Physical Vitals of Metastasis Cancer Patients Diagnosed during COVID Pandemic in Iraq. *J Carcinog* 2022. 21(1):20-6.
25. **Mauvais-Jarvis F, Bairey Merz N, Barnes PJ, Brinton RD, Carrero JJ, DeMeo DL, et al.** Sex and gender: modifiers of health, disease, and medicine. *Lancet* 2020. 396(10250):565-82.
26. **Magliano DJ, Boyko EJ.** IDF Diabetes Atlas. 10th ed. Brussels: International Diabetes Federation; 2021.
27. **Kautzky-Willer A, Leutner M, Harreiter J**. Sex differences in type 2 diabetes. *Diabetologia* 2023. 66(6):986-1002.
28. **National Administrative Department of Statistics - Dane.** Censo Nacional de Población y Vivienda 2018. Available from: https://www.dane.gov.co/index.php/estadisticas-por-tema/demografia-y-poblacion/censo-nacional-de-poblacion-y-vivenda-2018.
29. **Warden G**. Definitions of Bias in Clinical Research. *Methods Mol Biol* 2021. 2249:35-52.
30. **Stuckless S, Parfrey PS**. Bias in Clinical Research. *Methods Mol Biol* 2021. 2249:17-34.
31. **Vargas-Uricoechea H, Cáceres-Acosta MF**. Blood pressure control and impact on cardiovascular events in patients with type 2 diabetes mellitus: A critical analysis of the literature. *Clin Investig Arterioscler* 2019. 31(1):31-47.
32. **Abushamat LA, Nambi V**. Break the "HOLD": The Need to Strengthen the Management of Hypertension, Obesity, Lipids, and Diabetes (HOLD) and Improve Cardiovascular Health in People With Diabetes. *J Am Heart Assoc* 2023. 12(10):e029944.
33. **Nelson AJ, Nicholls SJ**. Treating Dyslipidemia in Type 2 Diabetes. *Cardiol Clin* 2018. 36(2):233-9.
34. **Scheen M, Giraud R, Bendjelid K**. Stress hyperglycemia, cardiac glucotoxicity, and critically ill patient outcomes current clinical and pathophysiological evidence. *Physiol Rep* 2021. 9(2):e14713.

35. **Mi D, Li Z, Gu H, Jiang Y, Zhao X, Wang Y, et al.** Stress hyperglycemia is associated with in-hospital mortality in patients with diabetes and acute ischemic stroke. *CNS Neurosci Ther* 2022. 28(3):372-81.
36. **Fabbri A, Marchesini G, Benazzi B, Morelli A, Montesi D, Bini C, et al.** Stress Hyperglycemia and Mortality in Subjects With Diabetes and Sepsis. *Crit Care Explor* 2020. 2(7):e0152.
37. **Staimez LR, Kipling LM, Nina Ham J, Legvold BT, Jackson SL, Wilson PWF, et al.** Potential misclassification of diabetes and prediabetes in the U.S.: Mismatched HbA1c and glucose in NHANES 2005-2016. *Diabetes Res Clin Pract* 2022. 189:109935.
38. **Bergman M, Abdul-Ghani M, DeFronzo RA, Manco M, Sesti G, Fiorentino TV, et al.** Review of methods for detecting glycemic disorders. *Diabetes Res Clin Pract* 2020. 165:108233.
39. **Barry E, Roberts S, Oke J, Vijayaraghavan S, Normansell R, Greenhalgh T**. Efficacy and effectiveness of screen and treat policies in prevention of type 2 diabetes: systematic review and meta-analysis of screening tests and interventions. *Bmj* 2017. 356:i6538.
40. **Xiong Y, Huo Z, Wong SYS, Yip BHK**. Cost effectiveness of nonpharmacological prevention programs for diabetes: A systematic review of trial-based studies. *Chronic Dis Transl Med* 2024. 10(1):12-21.
41. **Sharma J, Chittawar S, Maniram RS, Dubey TN, Singh A**. Clinical and epidemiological study of stress hyperglycemia among medical intensive care unit patients in Central India. *Indian J Endocrinol Metab* 2017. 21(1):137-41.
42. **Di Luzio R, Dusi R, Barbanti FA, Calogero P, Marchesini G, Bianchi G**. Prognostic Value of Stress Hyperglycemia in Patients Admitted to Medical/Geriatric Departments for Acute Medical Illness. *Diabetes Ther* 2022. 13(1):145-59.
43. **Seghieri G, Policardo L, Profili F, Francesconi P, Anichini R, Del Prato S**. Hospital incidental diagnosis of diabetes: A population study. *J Diabetes Complications* 2016. 30(3):457-61.
44. **Alon Y, Wainstock T, Sheiner E, Pariente G**. Family history of diabetes mellitus and long-term endocrine morbidity of the offspring. *Gynecol Endocrinol* 2020. 36(10):869-72.
45. **Abbasi A, Corpeleijn E, van der Schouw YT, Stolk RP, Spijkerman A, van der AD, et al.** Parental history of type 2 diabetes and cardiometabolic biomarkers in offspring. *Eur J Clin Invest* 2012. 42(9):974-82.
46. **Hart ND, Cupples ME, Wiggam MI, Patterson CC, Yarnell JW**. The stroke offspring study: is parental stroke history of value in targeted risk factor screening? *Prim Health Care Res Dev* 2011. 12(1):21-8.
47. **Li L, Zhao M, Zhang Z, Zhou L, Zhang Z, Xiong Y, et al.** Prognostic significance of the stress hyperglycemia ratio in critically ill patients. *Cardiovasc Diabetol* 2023. 22(1):275.