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Burden of diabetes in correctional facilities: A global systematic review and meta-analysis

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A R T I C L E I N F O

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A B S T R A C T

Background: Diabetes mellitus presents significant public health challenges worldwide. While its prevalence and management in the general population have been extensively studied, comprehensive research on diabetes among incarcerated individuals is lacking. This study aims to conduct a systematic review and *meta*-analysis to determine the prevalence of diabetes within the prison population.
Methods: The systematic review included studies reporting on the prevalence of diabetes in prison populations. Searches were conducted in PubMed, Web of Science, and EMBASE from 2000 to November 4, 2023, with an update on December 15, 2023. Nested Knowledge web software was utilized for screening and data extraction. Quality assessment was conducted using the JBI tool. A *meta*-analysis was performed using a random-effects model in R software version 4.3.
Results: Thirty-three studies were included, encompassing 807,617 participants, with 67,291 reported as patients with diabetes. The pooled prevalence of diabetes in prison populations was found to be 7.1% (95% CI: 4.9% to 10.1%), exhibiting high heterogeneity ($I^2 = 100\%$). Subgroup analysis revealed significant geographical variability: the United States had a prevalence of 9% (95% CI: 4 %to 17 %), Italy 5% (95% CI: 0% to 40 %), Iran 10% (95% CI: 7 % to 15 %), and Egypt 21% (95% CI: 14% to 28 %). Notable variations in prevalence were also

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observed in countries like France, Australia, Taiwan, India, the UK, Spain, Brazil, and Sub-Saharan Africa. An LFK index of −3.3 indicated the presence of publication bias.
Conclusion: The study reveals that diabetes mellitus is a significant health concern in prisons, with a prevalence of 7.1%, comparable to that in the general population. The marked variability across studies indicates the challenges of diabetes management in correctional settings. These findings highlight the need for tailored healthcare strategies, considering prisons' unique challenges and risk factors.

Introduction

Diabetes Mellitus, a chronic metabolic disorder characterized by elevated blood glucose levels, has become a significant public health concern worldwide [1]. According to the International Diabetes Federation, approximately 463 million adults were living with diabetes in 2019, a number projected to increase to 700 million by 2045 [2]. This condition, often linked with long-term complications affecting various organs, poses substantial challenges to healthcare systems globally. While there has been extensive research on diabetes in the general population, leading to a better understanding of its epidemiology, risk factors, and management strategies, certain subpopulations, such as incarcerated individuals, have not been studied as thoroughly. This lack of attention is critical considering the unique health challenges in the prison environment, including limited healthcare access, a high prevalence of risk behaviors, and increased stress levels, all of which can exacerbate chronic conditions like diabetes [3].

The prevalence of diabetes among prisoners is an area that has yielded intriguing findings. For instance, a cross-sectional study in Sub-Saharan Africa reported a diabetes prevalence of 9.4 % among inmates [4]. In the United States, approximately 9 % of the incarcerated population is estimated to have been diagnosed with diabetes, slightly lower than the general population rate of 10.5 % [5]. Another study highlighted that nearly 80,000 inmates in U.S. correctional institutions have diabetes, equating to a prevalence of 4.8 % [6]. The relationship between incarceration and diabetes is particularly significant for several reasons. The prison environment can greatly impact the management and progression of diabetes due to factors such as different dietary options, limited exercise opportunities, heightened stress, and varying levels of medical care access compared to the outside community [7]. Additionally, the prevalence of diabetes risk factors, like obesity and a sedentary lifestyle, might be higher among prisoners [7]. Moreover, upon release, former inmates with diabetes often encounter challenges in accessing healthcare, potentially leading to worse health outcomes [6,8].

Managing diabetes poses unique challenges in correctional facilities

Table 1
Characteristics of included studies.

Study	Year	Country	Design	Sample size	Number of participants with diabetes	Quality of study (JBI)
Abdalbary 2022 [16]	2022	USA	Retrospective study	86	41	Moderate
Ahmad 2020 [17]	2020	USA	Observational study	86	35	High
Altobelli 2023 [18]	2023	Italy	Retrospective study	604	43	Moderate
Babamahmoodi 2015 [19]	2015	Iran	Cross-sectional study	212	22	Moderate
Bai 2015 [20]	2015	USA	Observational study	759	39	Moderate
Baquero 2020 [21]	2020	USA	Observational study	352,000	46,816	High
Bautista-Arredondo 2015 [22]	2015	Mexico	Cross-sectional study	22,090	1414	Moderate
Befus 2015 [23]	2015	USA	Cross-sectional study	638	37	High
Binswanger 2009 [24]	2009	USA	Cross-sectional study	20,955	231	Moderate
Binswanger 2010 [25]	2010	USA	Observational study	6982	677	Moderate
Bravo-Cucci 2022 [26]	2022	Peru	Cross-sectional study	2658	299	Low
Camplain 2021 [27]	2021	USA	Cross-sectional study	393	27	Low
Chariot 2014 [28]	2014	France	Prospective observational study	13,317	263	Low
Emile 2017 [29]	2017	Egypt	Prospective observational study	145	30	Low
Firth 2015 [30]	2015	USA	Quasi-experimental study	63	17	Low
Gates 2015 [31]	2015	USA	Retrospective longitudinal study	10,841	142	Moderate
Gilles 2008 [32]	2008	Australia	Cross-sectional study	185	28	Low
Hannan-Jones 2016 [33]	2016	Australia	Cross-sectional study	120	6	Low
Harzke 2010 [34]	2010	USA	Cross-sectional study	234,031	9829	Moderate
Heniford 2020 [35]	2020	USA	Prospective observational study	1023	242	Moderate
Lai 2008 [36]	2008	Taiwan	Cross-sectional study	1129	105	Yes
Narayan 2023 [37]	2023	India	Mixed method study	187	12	Low
Packham 2020 [38]	2020	Uk	Cross-sectional study	1648	140	High
Pagarolas-Soler 2020 [39]	2020	Spain	Transversal study	4307	93	Moderate
Rodrigues Monteiro 2023 [40]	2023	Brazil	Cross-sectional study	580	16	High
Romano 2020 [41]	2020	Italy	Cross-sectional study	94	12	Low
Rosen 2019 [42]	2019	USA	Observational study	20,585	618	Moderate
Simeni Njonnou 2020 [43]	2020	Sub Saharan Africa	Cross-sectional study	137	41	Low
Sindeev 2022 [44]	2022	Peru	Retrospective study	37,103	890	High
Vera-Remartínez 2014 [45]	2014	Spain	Transversal study	1170	62	Moderate
Voller 2016 [46]	2016	Italy	Cross-sectional study	15,751	192	Yes
Wright 2019 [47]	2019	England	Cross-sectional study	197	4	Low
Yoon 2021 [48]	2021	Korea	Retrospective study	57,541	4868	High

due to factors such as restricted movement, limited dietary options, lack of exercise opportunities, suboptimal access to medical care and medications, and a high prevalence of complicating conditions like mental illness and substance use disorders [9]. Upon release, disruptions in care continuity and access to diabetes resources further exacerbate risks for acute and chronic complications. Given these multifaceted obstacles specific to the prison environment, a comprehensive understanding of the global burden of diabetes among incarcerated populations is crucial.

Given the multiple studies reporting on the prevalence of diabetes among prisoners, a systematic review and *meta*-analysis are crucial to synthesizing this existing research. This comprehensive approach can provide a more accurate picture of the burden of diabetes in this population. Moreover, it can inform future research directions and assist in developing policies to improve healthcare management in correctional facilities. The objective of this study is to systematically review and *meta*-analyze the existing literature to determine the prevalence of diabetes mellitus among prisoners (Table 1).

Methods

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Table S1) [10]. The study protocol has been registered in PROSPERO. For this study, we utilized the semi-automated software AutoLit by Nested Knowledge (Nested-Knowledge, MN, USA).

Inclusion criteria

We included observational and interventional studies that reported the number of individuals with diabetes in prison populations. There were no restrictions based on country or setting for inclusion. However, only articles published in English were considered. Case reports, case series, commentaries, editorials, and reviews were excluded. The detailed inclusion and exclusion criteria are provided in Table S2.

Literature search

The literature search was conducted using electronic databases to ensure a comprehensive collection of relevant studies. Key databases included PubMed, Web of Science, and EMBASE from year 2000 to 4 November 2023 which was later updated on December 15, 2023. Search terms were developed in line with the objectives of the study and were tailored to the syntax and indexing systems of each database. The search strategy combined terms related to “diabetes mellitus” with terms denoting “prison” or “incarcerated populations.” Filters were applied to include only studies published in English. The complete search strategy is documented in the supplementary material (Table S3).

Screening

The screening process for our systematic review, conducted using the Nested Knowledge software. Initially, we uploaded the search results from various databases into the software, which excels in managing and sorting large volumes of data. Its advanced algorithm efficiently removed duplicate entries, ensuring a unique representation of each study. Subsequently, two independent reviewers conducted a screening of titles and abstracts, utilizing the software’s filtering tools to assess each article against our predefined inclusion and exclusion criteria. Discrepancies between the reviewers were resolved by consulting a third reviewer. Articles that passed this phase were subjected to a full-text review. The final selection of studies for inclusion was then confirmed, with the software aiding in data extraction for synthesis.

Data extraction and quality assessment

We streamlined the data extraction phase by utilizing the “tagging” function of the Nested Knowledge software. Two reviewers extracted data, while a third reviewer checked the extracted data for accuracy and consistency. The data extracted included key elements from each study, such as author name, publication year, study design, country, sample sizes, and the number of patients with diabetes. To ensure consistency and thoroughness, we developed a standardized data extraction template within Nested Knowledge. Subsequently, the extracted data were transferred to Excel, facilitating more flexible handling and in-depth analysis. The quality assessment of the studies was performed using the Joanna Briggs Institute (JBI) tool for prevalence studies.

Statistical analysis

We conducted a statistical analysis using R software version 4.3 [11]. Meta-analysis was carried out using specialized R packages such as ’meta’ and ’metafor’ for calculating pooled prevalence and their confidence intervals. The number of patients with diabetes and the total sample size were pooled using a random-effects model. To assess heterogeneity among studies, we used the I^2 statistic and Tau squared [12,13]. Heterogeneity of the included studies in the *meta*-analysis was categorized based on the I^2 statistic: it was deemed low for I^2 values less than 25 %, moderate for values between 25 % and 50 %, and high for values greater than 50 % [14]. A prediction interval was also calculated to provide a range within which we can expect the true effects to lie in similar studies. Subgroup analyses and *meta*-regression were conducted to explore potential sources of heterogeneity and the impact of study-level covariates. Sensitivity analyses were performed to ensure the robustness of our findings. For publication bias assessment, the Doi plot and LFK index were utilized [15]. Statistical significance was set at a p-value of less than 0.05.

Results

Literatures search result

The literature search yielded a total of 431 records. Before screening, duplicates were removed, resulting in 133 exclusions and leaving 298 records for detailed screening. Upon screening, 218 records have been excluded due to irrelevant publication types such as book chapters and case reports, articles with missing outcomes of interest, and inaccessible full articles, among others. The next phase involved retrieving and assessing the eligibility of the remaining 80 records, all of which were retrieved successfully. However, 47 records were excluded during this phase due to reasons including language constraints, lack of primary data, missing outcomes or populations of interest, and the nature of the publication being unsuitable, such as letters to the editor and workshop papers. Finally, 33 studies [16–48] were eligible for inclusion. Fig. 1 presents the selection process as a PRISMA flowchart.

Characteristics on included studies

The included studies were from a wide geographical spectrum, each utilizing unique methodological approaches. From the USA, one study leveraged a large dataset of 352,000 participants to conduct retrospective analysis [21]. Smaller scale American studies also adopted retrospective and observational designs [16,17,20]. European contributions included Italian and Spanish studies, both employing retrospective methodologies [17,18]. The inclusion of cross-sectional studies from Iran and Peru added to the variety of research designs [19,26]. The timeline of the included research stretched from 2008 to 2023, offering a historical as well as a recent perspective on the subject matter. Cross-sectional studies were a common design choice, as seen in the works from Mexico and the USA [22–24]. Australian studies were represented by cross-sectional analyses [32,33], and from Asia, prospective observational and mixed-methods research designs were presented by studies from Egypt and India [29,37]. Further contributions included

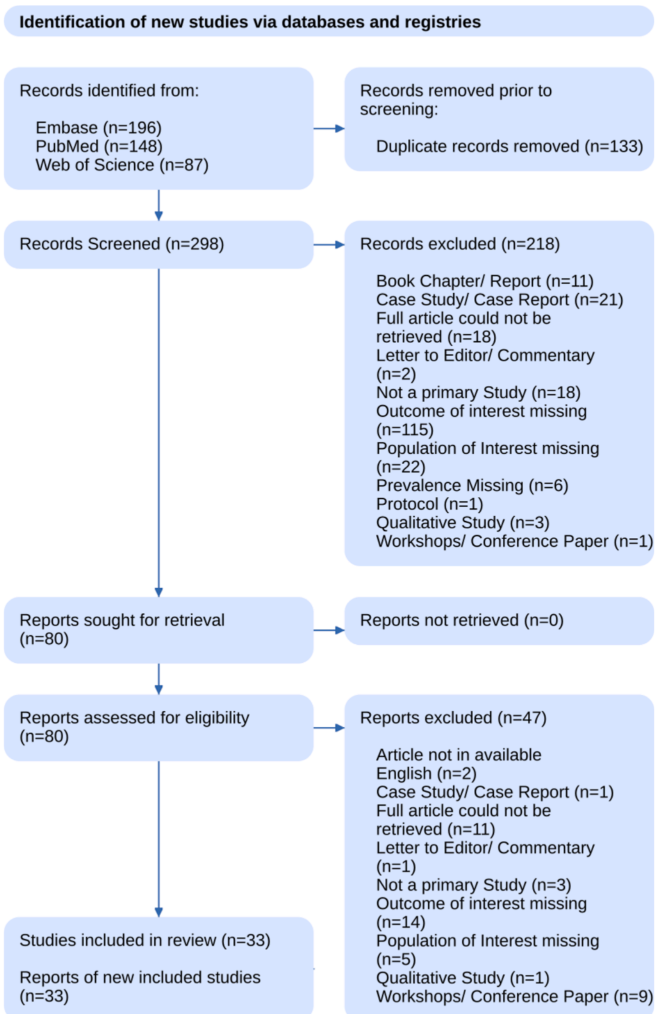

Fig. 1. PRISMA flow diagram showing article screening and selection process.

observational studies from Taiwan and the [29,36,42]. Notable for their methodology were high-quality retrospective studies from Peru and Korea, which showcased significant sample sizes [44,48]. In terms of quality assessment, the studies varied from moderate to high quality, with a few exceptions. American studies had a range of moderate to high quality, while European studies consistently showed moderate quality. The cross-sectional studies from Iran and Peru demonstrated a spectrum from moderate to low in quality. The Australian studies were noted to be of low quality. In contrast, high-quality evidence emerged from the UK and Brazilian studies, which stood out for their rigorous observational and cross-sectional designs. The diversity in quality underscores the varied levels of evidence contributing to the *meta*-analysis (Fig. 2).

Prevalence of diabetes in prison population

In the *meta*-analysis assessing the prevalence of diabetes among incarcerated individuals, data from 33 studies involving a total of 807,617 participants, among whom 67,291 were reported as having diabetes, were aggregated to estimate the overall prevalence rate. The individual studies reported diabetes prevalence rates ranging widely from 1.1 % to 47.7 %. Using a random-effects *meta*-analysis, the pooled prevalence of diabetes in prison populations was estimated to be 7.1 % (95 % CI: 4.9 % to 10.1 %). The range of this interval reflects moderate uncertainty about the exact prevalence, likely due to the high heterogeneity observed across studies. This heterogeneity was quantified at 100 %, suggesting that variability in diabetes prevalence estimates across studies was entirely due to differences between studies rather than random chance. The prediction interval, which extends from 0.8 % to 42.7 %, indicates substantial variability in diabetes prevalence among different prison populations, hinting at the impact of various unexamined factors. Fig. 3 displays the forest plot of the *meta*-analysis.

We performed a sensitivity analysis to assess the stability of the overall prevalence estimate. This method involves recalculating the pooled estimate multiple times, each time omitting a different study, to observe the influence of each individual study on the overall result. From the sensitivity analysis given in Fig. S1, it is evident that the pooled prevalence of diabetes remains relatively consistent despite the sequential omission of each study. The recalculated pooled prevalence rates across these sensitivity analyses range narrowly from 6.6 % to 7.4 %. The 95 % CIs for these estimates are largely overlapping, indicating that no single study disproportionately affects the overall prevalence estimate.

Subgroup analysis

In our *meta*-analysis, the prevalence of diabetes among prisoners of the across various countries exhibited significant variability. Within the United States, ten studies involving 648,442 participants showed a pooled prevalence of 9 % (95 % CI: 4 % to 17 %), but with heterogeneity at 100 %. Similarly, three studies from Italy with 16,449 participants reported a prevalence of 5 % (95 % CI: 0.00 % to 40 %) with nearly complete heterogeneity. A single study from Iran with 212 participants and another from Mexico with 22,090 participants estimated prevalences at 10 % (95 % CI: 7 % to 15 %) and 6 % (95 % CI: 6 % to 7 %), respectively. Peru presented a 5 % prevalence (95 % CI: 0 % to 99 %) across two studies with 37,961 participants, while France's lone study of 13,317 participants showed 2 % prevalence (95 % CI: 2 % to 2 %), and Egypt's single study with 145 participants indicated a higher rate of 21 % (95 % CI: 14 % to 28 %). Australia's prevalence was 9 % (95 % CI: 0 % to 96 %) from 305 participants in two studies, with 85 % heterogeneity. Taiwan and India, from their respective single studies, reported prevalences of 9 % (95 % CI: 8 % to 11 %) and 6 % (95 % CI: 3 % to 11 %). The UK's prevalence was 8 % (95 % CI: 7 % to 10 %) based on a single study with 1,648 participants, whereas Spain reported 3 % (95 % CI: 0 % 69 %) with 97 % heterogeneity from two studies with 5,477 participants. Brazil and Sub-Saharan Africa each reported a prevalence of 3 % (95 % CI: 2 % to 4 %) from 580 participants and 30 % (95 % CI: 22 % to 38 %) from 137 participants, respectively. England and Korea, with a single study each, had prevalences of 2 % (95 % CI: 1 % to 5 %) and 8 % (95 % CI: 8 % to 9 %). Fig. 3 displays the forest plot of the subgroup *meta*-analysis based on country.

Meta-regression

To further explore the heterogeneity observed in our study, we performed *meta*-regression analyses to assess the impact of sample size and year of publication on the prevalence of diabetes among prisoners. Bubble plots from these analyses revealed no significant associations for either variable. Specifically, the analysis regarding sample size, with a p-value of 0.916, indicated that larger studies did not consistently report different prevalence rates compared to smaller studies, as the horizontal regression line across sample sizes suggests (Fig. S2). Likewise, the year of publication, with a p-value of 0.263, showed no significant temporal trend in the reported prevalence rates over the years (Fig. S3).

Publication bias

To assess the presence of publication bias within our *meta*-analysis, we employed a Doi plot and calculated the LFK index (Fig. 4). The Doi plot visually represents each study's effect size against its corresponding z-score, enabling a qualitative assessment of asymmetry within the data. Our analysis revealed a pronounced asymmetry as evidenced by the LFK

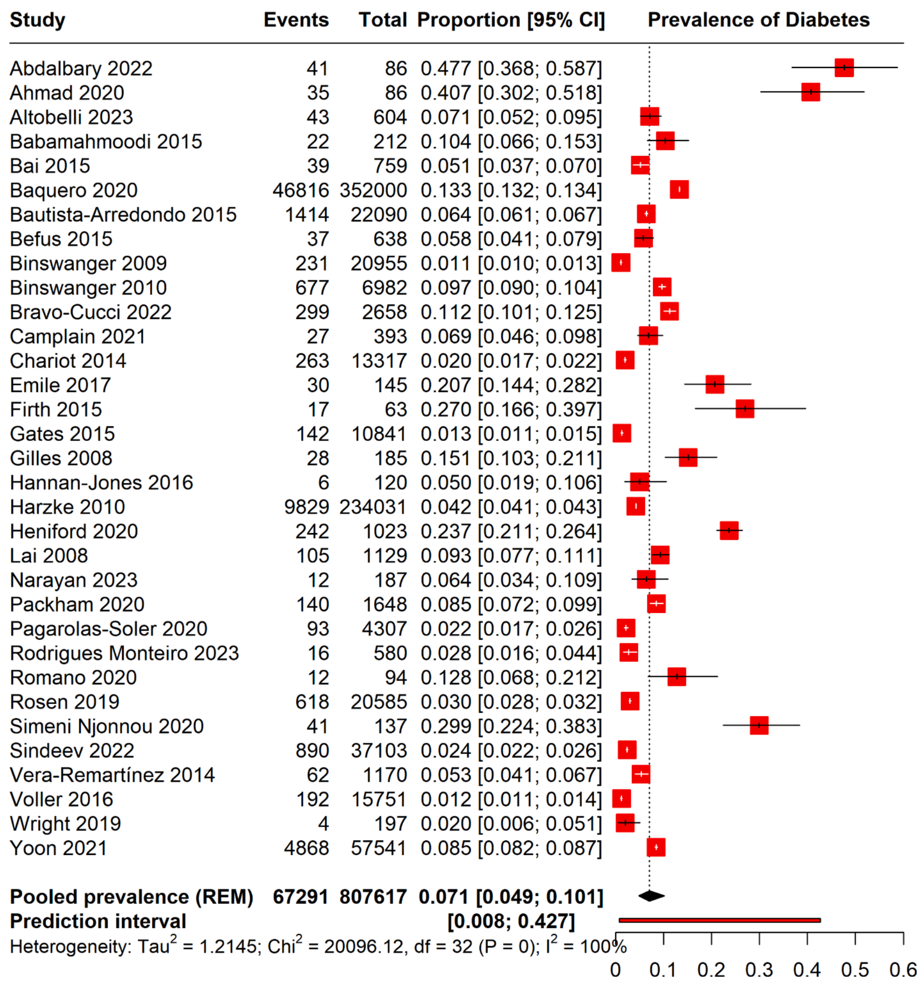

Fig. 2. Pooled prevalence of diabetes among prison population.

index of −3.3, which lies outside the accepted symmetry range of −1 to + 1. This substantial negative value of the LFK index suggests the presence of publication bias, indicating a potential underrepresentation of smaller studies or those with negative or less significant results. The trend observed in the Doi plot, where studies with more negative effect sizes appear to have higher z-scores, further supports this indication of bias. Such findings necessitate caution in interpreting the overall effect estimates from our *meta*-analysis and highlight the need for further investigation into the contributing factors to this asymmetry.

Discussion

Our systematic review and *meta*-analysis provide an examination of the prevalence of diabetes mellitus among prisoners, a subpopulation that often receives less attention in public health research. The pooled prevalence of diabetes in prison populations was found to be 7.1 %, indicating that diabetes is a significant health issue within correctional facilities. The variability in prevalence rates across different countries and study designs suggests that local environmental, genetic, lifestyle, and healthcare factors may play crucial roles in influencing diabetes prevalence among incarcerated individuals. For instance, the higher prevalence rates observed in the United States and Australia compared to European countries may reflect differences in diet, exercise opportunities, healthcare access, and the prevalence of obesity and other diabetes risk factors within prisons. The high heterogeneity also highlights the complexity of comparing diabetes prevalence across different prison populations. Factors such as differences in prison diets, exercise facilities, stress levels, and the quality of healthcare available can all significantly impact diabetes prevalence and management [6,7].

The prevalence of diabetes mellitus among prisoners, as revealed in our analysis, appears to be roughly comparable to that of the general population but slightly different. According to the International Diabetes Federation, the global adult population had a diabetes prevalence of about 9.3 % in 2019, a figure expected to rise to 700 million by 2045 [2]. In contrast, in the United States, the prevalence of diagnosed diabetes in the general adult population is slightly higher at around 11.6 %, as per CDC data [49], compared to an estimated 9 % among the U.S. incarcerated population. This comparison, however, should be approached with an understanding of the nuances involved. The prison population differs from the general population in several key aspects such as demographic composition, particularly in terms of age, gender, and socioeconomic status, which are significant determinants of diabetes prevalence. Additionally, the level and quality of healthcare access in prisons, which can greatly influence diabetes diagnosis and management, is generally different from that in the broader community. The lifestyle within prisons, including diet and physical activity regimes, also differs significantly from that in the general community and has a substantial impact on the prevalence and management of diabetes [3]. Furthermore, data on diabetes prevalence in prison populations may not be as robust or regularly updated as that for the general population, leading to potential limitations in data quality and coverage [50,51]. Therefore, while the prevalence rates in both populations are somewhat similar, understanding these key differences is essential for interpreting the data accurately and for tailoring public health interventions to each group's specific needs.

A prior systematic review highlighted a notable trend of weight gain

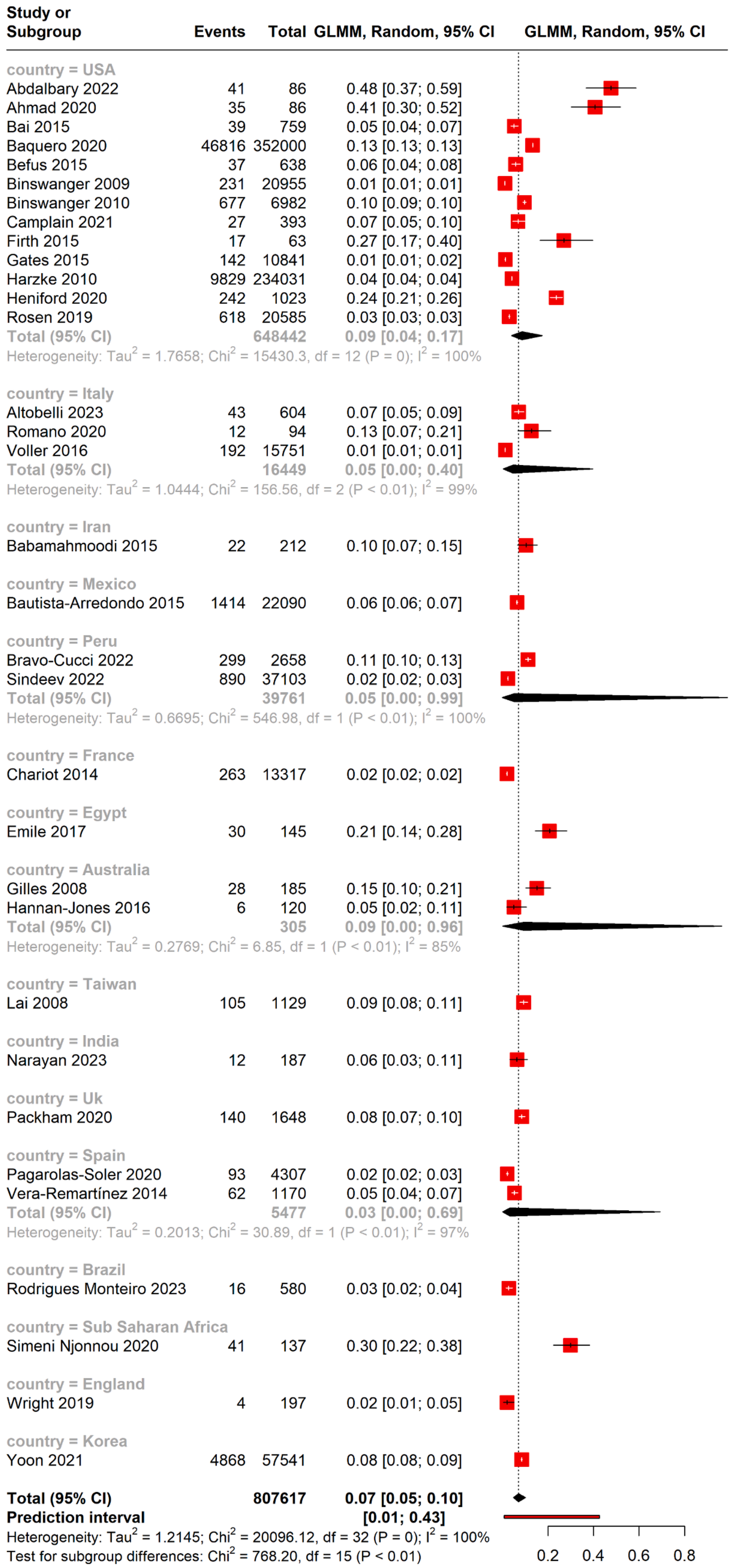

Fig. 3. Subgroup analysis of Pooled prevalence of diabetes among prison population based on country.

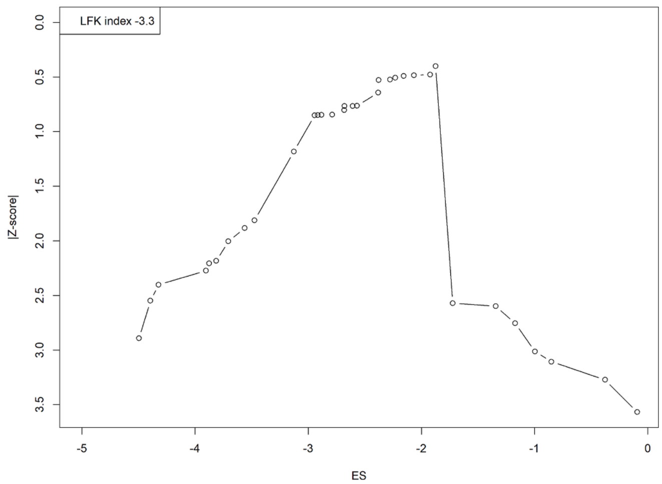

Fig. 4. Doi plot and LFK index assessing publication bias.

among inmates during incarceration, revealing an average increase of approximately 5.3 kg and a rise in body mass index (BMI) of about 1.8 kg/m^2 (95 % CI −0.9 to 4.6 kg/m^2) over a two-year period [52]. The authors mentioned that this weight gain was most significant immediately after entering prison, stabilizing after two years. In terms of hypertension, the findings were less definitive. While there was a tendency towards an increase in blood pressure or the prevalence of hypertension during the time in prison, the results did not conclusively support this trend. Another review also noted that hypertension was frequently observed among prisoners, alongside other cardiovascular disease (CVD) risk factors such as smoking, physical inactivity, and obesity [53]. It was identified as one of the three most prevalent CVD risk factors in this population. Additionally, specific groups within the prison population, namely women and younger offenders, showed a higher prevalence of hypercholesterolemia. However, the evidence regarding the risk of diabetes in relation to incarceration remains insufficient and inconclusive. This gap in knowledge underscores the need for further research to investigate the impact of incarceration on diabetes risk and prevalence. Such investigation is crucial to understand better the health implications of incarceration on chronic conditions like diabetes, potentially leading to more effective healthcare strategies and interventions within the prison system. This research should also consider the unique healthcare challenges and environmental factors within prisons that could influence the development and management of diabetes among inmates.

Our study, while comprehensive, presents several limitations that warrant attention. A notable constraint is our focus solely on articles published in English, which could have excluded pertinent research in other languages, potentially skewing our findings and insights, especially in the context of global diabetes prevalence and management. The high heterogeneity ($I^2 = 100$ %) observed in the results suggests substantial variability in the study outcomes, which complicates the interpretation and generalization of the findings. The presence of publication bias, indicated by an LFK index of −3.3, suggests that smaller studies or studies with less significant results might be underrepresented in the review. Additionally, despite employing subgroup analysis and *meta*-regression in an attempt to explain the observed heterogeneity, we were unable to identify definitive sources of this variability, which might affect the interpretability and generalizability of our results. Geographically, the majority of the studies we included were from the United States, leading to a potential geographical bias, as other countries were not adequately represented in terms of study volume. This limitation poses a challenge to understanding the global scope of diabetes prevalence and characteristics in prison populations. Furthermore, the small sample sizes in some of the included studies raise concerns regarding the quality and robustness of these findings, potentially introducing bias and weakening the overall conclusions of our systematic review and *meta*-analysis. These factors collectively underscore the need for more extensive and diverse research, including studies from various geographical locations and published in multiple languages, to achieve a more holistic and accurate comprehension of the prevalence and management of diabetes among prison populations globally.

Conclusion

Our analysis revealed that diabetes mellitus is a significant health concern in prison populations, with a pooled prevalence of 7.1 %. This prevalence is broadly comparable to that in the general population. The high heterogeneity observed across studies indicates the complexity of diabetes management in correctional facilities and highlights the need for tailored healthcare strategies. Our findings emphasize the importance of addressing diabetes as a key aspect of prisoner health, considering the unique challenges and risk factors present in the correctional setting.

Ethical approval

Not required.

CRediT authorship contribution statement

Muhammed Shabil: Writing – original draft, Resources, Methodology, Conceptualization. **Shilpa Gaidhane:** Writing – review & editing, Supervision, Resources. **Sorabh Lakhanpal:** Resources, Supervision. **Sara Irshaidat:** Project administration, Resources. **Suhas Ballal:** Investigation, Methodology. **Sanjay Kumar:** Writing – original draft. **Mahakshit Bhat:** Writing – review & editing. **Shilpa Sharma:** Writing – review & editing, Supervision, Resources. **M. Ravi Kumar:** Investigation. **Sarvesh Rustagi:** Writing – review & editing, Supervision, Investigation. **Mahalaqua Nazli Khatib:** Writing – review & editing, Resources, Methodology, Investigation. **Sunil Kumar Mishra:** Writing – review & editing, Resources, Formal analysis, Conceptualization. **Sanjit Sah:** Writing – review & editing, Resources, Formal analysis. **Hashem Abu Serhan:** Writing – review & editing, Writing – original draft, Methodology, Conceptualization. **Ganesh Bushi:** Methodology, Writing – review & editing. **Bijaya K. Padhi:** Writing – review & editing, Writing – original draft, Formal analysis, Conceptualization.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jcte.2024.100374.

References

[1] Diabetes: World Health Organisation; [Available from: https://www.who.int/health-topics/diabetes#tab=tab_1.

[2] Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N, et al. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas. Diabetes Res Clin Pract 2019;157:107843.

[3] Endocrinology TLD. Diabetes behind bars: challenging inadequate care in prisons. 2018. p. 347.

[4] Njonnou SRS, Boombhi J, Etoga MCE, Timnou AT, Jingi AM, Efon KN, et al. Research Article Prevalence of Diabetes and Associated Risk Factors among a Group of Prisoners in the Yaoundé Central Prison. 2020.

[5] Association AD. Diabetes management in detention facilities. Position Statement accessed at https://diabetes org/sites/default/files/2021-11/ADA-position-statement-diabetes-management-detention-settings-2021 pdf. 2021.

[6] Association AD. Diabetes management in correctional institutions. Diab Care 2013;36(Supplement_1):S86–92.

[7] Dhaliwal KK, Johnson NG, Lorenzetti DL, Campbell DJ. Diabetes in the context of incarceration: a scoping review. EClinicalMedicine 2023;55.

[8] Rolling CA, Vaughn MG, Velez D, Jackson DB, Holzer KJ, Jaegers L, et al. Prevalence and correlates of diabetes among criminal justice–involved individuals in the United States. Ann Epidemiol 2019;36:55–61.

[9] Fine A, Gallaway MS, Dukate A. Prevention in prison: the diabetes prevention program in a correctional setting. Diab Spectrum 2019;32(4):331–7.

[10] Page MJ, Moher D, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. PRISMA 2020 explanation and elaboration: updated guidance and exemplars for reporting systematic reviews. BMJ 2021;372.

[11] Shamim MA, Gandhi AP, Dwivedi P, Padhi BK. How to perform meta-analysis in R: a simple yet comprehensive guide. Evidence 2023;1(1):60–80.

[12] Langan D, Higgins JP, Jackson D, Bowden J, Veroniki AA, Kontopantelis E, et al. A comparison of heterogeneity variance estimators in simulated random-effects meta-analyses. Res Synth Methods 2019;10(1):83–98.

[13] Gandhi AP, Shamim MA, Padhi BK. Steps in undertaking meta-analysis and addressing heterogeneity in meta-analysis. Evidence 2023;1(1):44–59.

[14] Gandhi AP, Satapathy P, Rustagi S, Hermis AH, Sah R, Padhi BK. Comments on" Shigellosis in Southeast Asia: a systematic review and meta-analysis. Travel Med Infect Dis 2023:102593 -.

[15] Shamim MA, Dwivedi P, Padhi BK. Beyond the funnel plot: the advantages of Doi plots and prediction intervals in meta-analyses. Asian J Psychiatr 2023;84:103550 -.

[16] Abdalbary M, Kakani E, Yahya A, Shea M, Neyra JA, El-Husseini A. Characteristics and outcomes of prisoners hospitalized due to COVID-19 disease. Clin Nephrol 2022;97(4):232.

[17] Ahmad Y, Shea M, Abdalbary M, Kakani E, Neyra J, Mohamed A. Kidney involvement and outcome of COVID-19 patients admitted from a federal medical facility. J Am Soc Nephrol 2020:284 -.

[18] Altobelli E, Galassi F, Mastrodomenico M, Frabotta F, Marzi F, Angelone AM, et al. SARS-CoV2 infection and comorbidity in inmates: a study of Central Italy. Int J Environ Res Public Health 2023;20(4):3079.

[19] Babamahmoodi F, Alikhani A, Yazdani Charati J, Ghovvati A, Ahangarkani F, Delavarian L, et al. Clinical epidemiology and paraclinical findings in tuberculosis patients in north of Iran. Biomed Res Int 2015;2015.

[20] Bai JR, Befus M, Mukherjee DV, Lowy FD, Larson EL. Prevalence and predictors of chronic health conditions of inmates newly admitted to maximum security prisons. J Correct Health Care 2015;21(3):255–64.

[21] Baquero M, Zweig K, Angell SY, Meropol SB. Health behaviors and outcomes associated with personal and family history of criminal justice system involvement, New York City, 2017. Am J Public Health 2020;110(3):378–84.

[22] Bautista-Arredondo S, González A, Servan-Mori E, Beynon F, Juarez-Figueroa L, Conde-Glez CJ, et al. A cross-sectional study of prisoners in Mexico City comparing prevalence of transmissible infections and chronic diseases with that in the general population. PLoS One 2015;10(7):e0131718.

[23] Befus M, Lowy FD, Miko BA, Mukherjee DV, Herzig CT, Larson EL. Obesity as a determinant of Staphylococcus aureus colonization among inmates in maximum-security prisons in New York State. Am J Epidemiol 2015;182(6):494–502.

[24] Binswanger IA, Krueger PM, Steiner JF. Prevalence of chronic medical conditions among jail and prison inmates in the United States compared with the general population. J Epidemiol Community Health 2009.

[25] Binswanger IA, Merrill JO, Krueger PM, White MC, Booth RE, Elmore JG. Gender differences in chronic medical, psychiatric, and substance-dependence disorders among jail inmates. Am J Public Health 2010;100(3):476–82.

[26] Bravo-Cucci S, Cruz-Gonzales G, Medina-Espinoza R, Paca-Palao A. The comorbidity of diabetes-depression and its association with disability amongst elderly prison inmates. Revista Española de Sanidad Penitenciaria 2022;24(2):56.

[27] Camplain R, Lininger MR, Baldwin JA, Trotter RT. Cardiovascular Risk Factors among Individuals Incarcerated in an Arizona County Jail. Int J Environ Res Public Health 2021;18(13):7007.

[28] Chariot P, Beaufrère A, Denis C, Dang C, Vincent R, Boraud C. Detainees in police custody in the Paris, France area: medical data and high-risk situations (a prospective study over 1 year). Int J Leg Med 2014;128:853–60.

[29] Emile SH, Elgendy H, Sakr A, Gado WA, Abdelmawla AA, Abdelnaby M, et al. Outcomes following repair of incarcerated and strangulated ventral hernias with or without synthetic mesh. World J Emerg Surg 2017;12(1):1–9.

[30] Firth CL, Sazie E, Hedberg K, Drach L, Maher J. Female inmates with diabetes: results from changes in a prison food environment. Womens Health Issues 2015;25(6):732–8.

[31] Gates ML, Bradford RK. The impact of incarceration on obesity: are prisoners with chronic diseases becoming overweight and obese during their confinement? J Obes 2015;2015.

[32] Gilles M, Swingler E, Craven C, Larson A. Prison health and public health responses at a regional prison in Western Australia. Aust N Z J Public Health 2008;32(6):549–53.

[33] Hannan-Jones M, Capra S. Prevalence of diet-related risk factors for chronic disease in male prisoners in a high secure prison. Eur J Clin Nutr 2016;70(2):212–6.

[34] Harzke AJ, Baillargeon JG, Pruitt SL, Pulvino JS, Paar DP, Kelley MF. Prevalence of chronic medical conditions among inmates in the Texas prison system. J Urban Health 2010;87:486–503.

[35] Heniford BT, Ross SW, Wormer BA, Walters AL, Lincourt AE, Colavita PD, et al. Preperitoneal ventral hernia repair: a decade long prospective observational study with analysis of 1023 patient outcomes. Ann Surg 2020;271(2):364–74.

[36] Lai S-W, Liao K-F, Chang W-L. Assessment of health status among incarcerated men. Am J Med Sci 2008;335(6):465–8.

[37] Narayan G, Vasudevan K, Rajagopal A, Gunasekaran K, Savla H, Suvvari TK, et al. Active Screening for Pulmonary Tuberculosis Among Jail Inmates: a Mixed Method Study From Puducherry, South India. Cureus 2023;15(5).

[38] Packham C, Butcher E, Williams M, Miksza J, Morriss R, Khunti K. Cardiovascular risk profiles and the uptake of the NHS Healthcheck programme in male prisoners in six UK prisons: an observational cross-sectional survey. BMJ Open 2020;10(5):e033498.

[39] Pagarolas-Soler M, Alonso-Gaitón P, Sapera-Miquel N, Valiente-Soler J, Sánchez-Roig M, Coll-Cámara A. Diagnosed diabetes and optimal disease control of prisoners in Catalonia. Revista Espanola de Sanidad Penitenciaria 2020;22(1):16.

[40] Rodrigues Monteiro A, Schadock I, da Rosa C, Aranalde L, Peres Martinez D, Rodrigues Fernandes N, et al. Prevalence of Overweight and Associated Factors in a Male Prison Population in the Extreme South of Brazil: a cross-sectional study. Metab Syndr Relat Disord 2023;21(1):63–9.

[41] Romano C, Ravagnani L, Convertini A, Dassisti L, Fanizza A, Misceo F, et al. The aging process in prison: pathologies and health conditions in old inmates. An epidemiological research in Italy. Clin Ter 2020;171(4):e340–5.

[42] Rosen DL, Thomas S, Kavee AL, Ashkin EA. Prevalence of chronic health conditions among adults released from the North Carolina prison system, 2015–2016. N C Med J 2019;80(6):332–7.

[43] Simeni Njonnou SR, Boombhi J, Etoa Etoga MC, Tiodoung Timnou A, Jingi AM, Nkem Efon K, et al. Prevalence of diabetes and associated risk factors among a group of prisoners in the Yaoundé central prison. J Diab Res 2020;2020.

[44] Sindeev A, Martínez-Álvarez B. Clinical and epidemiological characteristics of prisoners infected and deceased by COVID-19, National Penitentiary Institute of Peru, 2020. Revista Española de Sanidad Penitenciaria 2022;24(1):15.

[45] Vera-Remartínez E, Borraz-Fernández J, Domínguez-Zamorano J, Mora-Parra L, Casado-Hoces S, González-Gómez J, et al. Prevalence of chronic diseases and risk factors among the Spanish prison population. Rev Esp Sanid Penit 2014;16(2):38–47.

[46] Voller F, Silvestri C, Martino G, Fanti E, Bazzerla G, Ferrari F, et al. Health conditions of inmates in Italy. BMC Public Health 2016;16(1):1–10.

[47] Wright NM, Hearty P, Allgar V. Prison primary care and non-communicable diseases: a data-linkage survey of prevalence and associated risk factors. BJGP open 2019;3(2).

[48] Yoon S, Ju Y-S, Yoon J, Kim J-H, Choi B, Kim S-S. Health inequalities of 57,541 prisoners in Korea: a comparison with the general population. Epidemiol Health 2021;43.

[49] National Diabetes Statistics Report: Centers for Disease Control and Prevention; [Available from: https://www.cdc.gov/diabetes/data/statistics-report/index.html.

[50] Bellass S, Canvin K, McLintock K, Wright N, Farragher T, Foy R, et al. Quality indicators and performance measures for prison healthcare: a scoping review. Health Justice 2022;10(1):1–19.

[51] Zaitzow BH, Willis AK. Behind the wall of indifference: Prisoner voices about the realities of prison health care. Laws 2021;10(1):11.

[52] Bondolfi C, Taffe P, Augsburger A, Jaques C, Malebranche M, Clair C, et al. Impact of incarceration on cardiovascular disease risk factors: a systematic review and meta-regression on weight and BMI change. BMJ Open 2020;10(10):e039278.

[53] Arries EJ, Maposa S. Cardiovascular risk factors among prisoners: an integrative review. J Forensic Nurs 2013;9(1):52–64.