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Type 2 diabetes stigma and its association with clinical, psychological, and behavioral outcomes: A systematic review and *meta*-analysis

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ABSTRACT

Aim: To synthesize quantitative research evidence on the association between type 2 diabetes (T2D) stigma and psychological, behavioral, and clinical outcomes.
Methods: We searched APA PsycINFO, Cochrane Central, Scopus, Web of Science, Medline, CINAHL and EMBASE through November 2022. Peer-reviewed observational studies examining the association between T2D stigma and psychological, behavioral, and/or clinical outcomes were eligible for inclusion. Risk of bias was assessed with the JBI critical appraisal checklist. Correlation coefficients were pooled in random effect *meta*-analyses.
Results: Our search produced 9642 citations, 29 met the inclusion criteria. Included articles were published between 2014 and 2022. We found a weak positive correlation between T2D stigma and HbA1C (r = 0.16, 95% CI:0.08 to 025, I^2 = 70%, N = 7 studies), a moderate positive correlation between T2D stigma and depressive symptoms (r = 0.49, 95% CI: 0.44 to 0.54, I^2 = 26.9%, n = 5 studies) and diabetes distress (r = 0.54, 95% CI: 0.35 to 0.72, I^2 = 96.9%, n = 7studies). Persons with T2D stigma who experienced stigma tended to have less engagement in diabetes self-management, though this association was weak (r = -0.17, 95% CI: −0.25 to −0.08, I^2 = 79.8%, n = 7studies).
Conclusions: T2D stigma was associated with negative health outcomes. Further studies are required to disentangle the underlying causal mechanisms to inform the development of appropriate stigma-reduction interventions.

1. Introduction

The prevalence of type 2 diabetes (T2D) is increasing globally [1]. T2D can have significant, and often overlooked, psychosocial sequelae on people living with the condition [2]. The International Diabetes Federation (IDF), in their 2021 Implementation Plan, identified diabetes stigma as an important social consequence of living with diabetes that needs to be addressed globally [3].

Generally, stigma is defined as "a deeply discrediting attribute" that results in societal devaluation of the bearer of that attribute [4]. Stigma may involve labelling persons with their attribute or condition, assigning negative stereotypes to the attributes, and discriminating against individuals based on their condition [5]. There have been some recent critiques of Link and Phelan's definition of stigma including a debate about the consideration of "discrimination" as a component of stigma as opposed to an outcome of stigma [6]. Nonetheless, this definition is still widely used in the health-related and diabetes-related stigma literature [7,8]. Stigma can present at the individual level (interpersonal and intrapersonal) or at the structural level (e.g., discriminating national and institutional policies). Moreover, stigma can also be classified as perceived, enacted, or internalized (self-stigma).

Several qualitative studies have highlighted the unique stigmatizing experiences persons with T2D face. Individuals may experience T2D stigma in the form of being blamed and judged for bringing the disease onto themselves (causal attributions or onset controllability) [9,10] as well as being labelled as "fat", "indiscipline", "lazy", "unmarriageable",

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"not intelligent" and "drug users" [7,8,13].Individuals living with T2D have also reported being monitored by family members or co-workers, facing judgement from their healthcare providers, and being described as witches [11,14]. In a few studies, T2D was perceived as contagious thus leading to patients being socially ostracized [11,12]. These experiences can negatively impact patients' health outcomes.

Indeed, evidence from related chronic health conditions including obesity and epilepsy has shown that stigma can activate patients' stress responses and can negatively impact their psychological, physical and emotional well-being [17–19]. Stigma has also been shown to reduce healthcare utilization and worsen patients' quality of life [20].

The evidence of the negative health consequences of T2D stigma is emerging. T2D stigma can lower patients' engagement in beneficial health behaviors including healthy eating. A qualitative study conducted in Ghana showed that persons with T2D may accept unhealthy foods in social gatherings in order to conceal their disease and pass as normal [14–16]. In Japan, an interview study of 26 persons with T2D revealed that self-stigma can lower patients' self-esteem and increase the likelihood of social isolation [12]. While some evidence of the negative consequences of T2D stigma exist, this evidence has not been systematically synthesized.

Schabert and colleagues (2013) [7], in their highly cited framework for diabetes stigma, proposed that diabetes stigma may lead to poor psychological (depression, anxiety), behavioral (self-management, concealment) and clinical outcomes (Hemoglobin A1C). Due to the limited volume of T2D stigma literature at the time, the stigma framework was based on research evidence from type 1 diabetes, T2D, hepatitis C, HIV/AIDS, epilepsy, celiac disease, and obesity [7]. Moreover, in describing the consequences of T2D stigma, the authors did not provide quantitative evidence to support the association between T2D stigma and any of the identified outcomes. The qualitative evidence used to support the diabetes stigma framework offered valuable perspectives on the impact of this intricate social phenomenon, however, it failed to demonstrate effect sizes of the associations. A decade after this framework was developed, several studies on T2D stigma have been published. It is not known the extent to which the extant literature on T2D stigma support Schabert and colleagues' (2013) stigma framework for persons with T2D.

The purpose of this review was to synthesize quantitative evidence on T2D stigma and its association with clinical (glycated hemoglobin [HbA1c]), psychological (depressive symptoms, anxious symptoms, self-esteem, and diabetes distress), and behavioral (self-management behaviors) outcomes. Synthesizing the evidence from multiple studies allows for a more detailed and nuanced understanding of the negative health outcomes associated with T2D stigma. This review will be useful in identifying gaps in the literature and may subsequently inform the refinement of the existing framework for T2D stigma. The findings from this review may also be useful in guiding clinical practice by highlighting the potential negative health outcomes that are associated with the experience of T2D stigma.

2. Methods

Joanna Briggs Institute (JBI) methodology for conducting systematic reviews of association (etiology) was used to guide the current review [21]. The reporting of findings for this review was done in line with the preferred reporting items for systematic review and *meta*-analysis (PRISMA). The protocol for this review was prospectively registered with PROSPERO (Registration number: CRD42023392324).

2.1. Search strategy

The search strategy was designed and conducted by an expert medical librarian (JB) with input from the investigator (SA). We conducted searches in OVID MEDLINE ALL (1946 – November 08, 2022), OVID EMBASE (1974 – 2022 November 08), OVID APA PsycINFO (1806 to October Week 5, 2022), Web of Science (SCI-EXPANDED, SSCI Timespan, Clarivate), Cochrane Central Registry of Controlled Trials (Wiley Online), SCOPUS. and EBSCO CINAHL Complete. Using the population, exposure, outcomes (PEO) framework we searched controlled vocabulary and keywords to search terms related to the condition "diabetes" and terms related to "stigma" to represent the exposure of interest. The database searches were done with no language or date limitations because we wanted to enhance the sensitivity of our search strategy. Searches were completed on November 9, 2022. Search histories for each database are found in the Appendix 1.

2.2. Results of the search

The search results were uploaded to EndNote (version 20 – Thompson Reuters) and deduplicated. A total of 9,641 references were retrieved from all searches conducted. After removal of duplicates 5,636 references remained. The final set was uploaded into Covidence systematic review software (Veritas Health Information) for screening. The title and abstract screening was completed independently by two reviewers (SA and EE). The full-text articles of tentatively eligible studies (N = 58) were retrieved and reviewed for association between T2D-related stigma or discrimination and clinical (HbA1c), psychological (depression, self-esteem, anxiety, diabetes distress) and behavioral (self-management) outcomes. Ultimately, 28 citations met the inclusion and exclusion criteria. An additional article was located through manual search of reference list. As shown in the PRISMA flow diagram (Fig. 1), studies were primarily excluded because they were conference abstracts, posters, or dissertations. There was a substantial inter-rater reliability between the two reviewers during title and abstract screening (Cohen's Kappa = 0.75) and full-text review (Cohen's Kappa = 0.93).

2.3. Selection of studies

Inclusion criteria were: 1) adults with type 2 diabetes 2) observational study design (case control, cohort, longitudinal and cross-sectional) because they are appropriate for assessing associations 3) published in peer-reviewed journal in English language, 4) included quantitative measure of T2D stigma from the perspective of persons with T2D (including use of validated, non-validated and one-item scales) and 5) assessed the association between T2D stigma and at least one of the following outcomes: clinical (HbA1c), psychological (depressive symptoms, anxious symptoms, self-esteem, and diabetes distress) and behavioral (self-management behaviors). We adopted Link and Phelan's definition of stigma, excluding the "emotional response" component [5]. T2D stigma was conceptually defined as a feeling or experience of differential treatment, monitoring, discrimination, shame, blame and judgement for having T2D [7]. Exclusion criteria were type 1 and gestational diabetes, experimental study designs and articles in the grey literature (e.g., posters, conference abstracts, dissertation). Two independent reviewers (SA and EE) conducted title, abstract and full-text screening. Risk of bias was independently assessed by SA and DAN using the JBI critical appraisal checklist for cross-sectional analytical studies [22]. The JBI appraisal checklist consists of 8 items with response options: "Yes", "No", "Unclear", and "Not applicable". The appraisal checklist allowed us to identify methodological limitations in existing literature. We determined that studies that had 7–8 "yes", 5–6 "yes" and less than 5 "yes" as having low, moderate, and high risk of bias respectively.

2.4. Data extraction and synthesis

We extracted the following data from included studies: authors, year of publication, country, sample characteristics (sociodemographic and clinical), T2D stigma instrument, T2D stigma prevalence, and effect sizes (standardized mean difference, coefficients from path analysis, regression coefficients and correlation coefficients) summarizing the

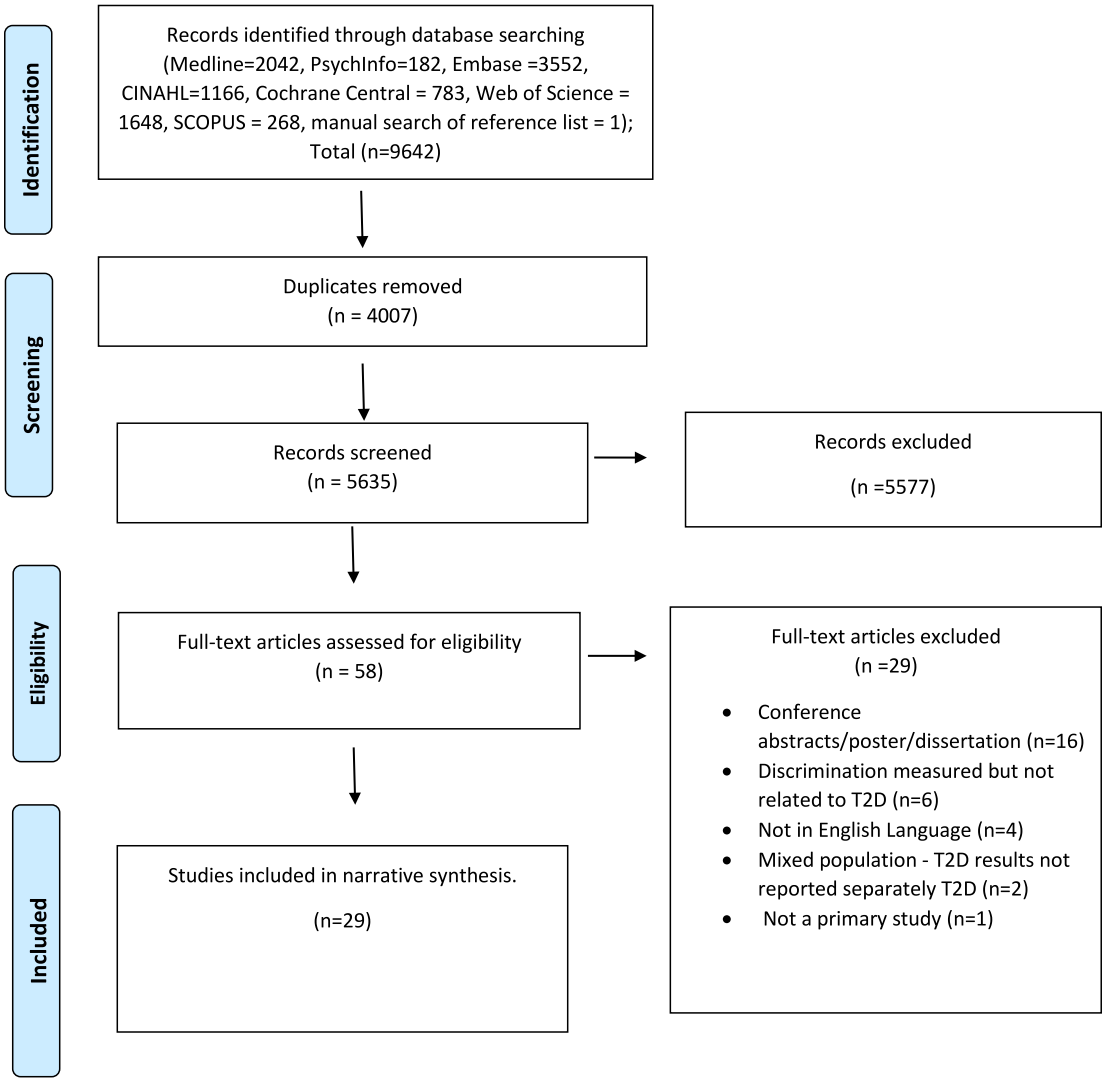

Fig. 1. PRISMA flow chart.

association between T2D stigma and outcomes of interest including depressive and anxious symptoms, diabetes distress, self-management behaviors, self-esteem and HbA1c. We did not make any assumption about missing or unclear data during data extraction. We used "not reported" and "not clear" to represent the data. Narrative synthesis was used to textually summarize findings under psychological, behavioral, and clinical outcomes associated with T2D stigma. Moreover, we pooled correlation coefficients (*r)* across studies using random effects *meta*-analysis. We conducted Fisher's z transformation on all *r*'s prior to the *meta*-analysis. The "metafor" package in R statistical software was used for this *meta*-analysis. We used multiple approaches to identify correlation coefficients for studies that did not explicitly report this effect size. First, coefficients from path analyses were considered to be equivalent to *r* if the outcome variable was a function of a single predictor. Second, we converted standardized mean differences and unadjusted regression coefficients to correlation coefficients using the formulas below [23]:

$$r = \frac{d}{\sqrt{d^2 + a}} where a = \frac{(N_1 + N_2)^2}{N_1 * N_2}$$

r = correlation coefficient, d = standardized mean difference, N_1=sample size of group 1, N_2= sample size for group 2.and

$$r = \frac{SD(X)}{SD(Y)} * b$$

b = unadjusted regression coefficient, $SD(X)$ = standard deviation of the predictor, $SD(Y)$= standard deviation of the dependent variable.

Pooled correlation coefficients were interpreted as weak, moderate, and strong associations for $r < 0.4$ (or > -0.4), between 0.4 and 0.7 (or -0.4 to -0.7) and > 0.7 (or < -0.7) respectively [24]. We assessed heterogeneity of our *meta*-analysis model using the I^2 statistic and the corresponding p value.

3. Findings

3.1. Study and sample characteristics

This review included 29 articles from 25 unique studies. Included articles were published between 2014 and 2022, with > 70% published between 2020 and 2022. All studies had cross-sectional design. Five studies reported T2D stigma instrument development and/or validation [8,25–28]. Six studies used mediation analysis (path analysis or structural equation modelling) to evaluate how T2D stigma impact life satisfaction through self-care behaviors [29], self-management behaviors [30–33], self-efficacy, and HbA1C [34]. Most articles originated from Japan (N = 7) and USA (N = 6) and only two articles originated

from Africa as shown in Table 1. Across studies, sample size ranged from 52 to 3,850 (total sample size = 14,426). The majority of participants were female (average = 50.8%) and had a mean age of 56.17 years (N = 21 studies, range 36.7–66.07 years). Participants had an average HbA1c of 7.6% (N = 11 studies, range = 7.0–9.2%). Sixteen studies reported time since diagnosis, and it ranged from 3.36 years to 14.8 years (mean = 11.04 years) as shown in Table 1. Proportion of participants who had at least one diabetes-related complication or used insulin ranged from 11.8% to 73.9% and 30.9%-100% respectively.

3.2. Quality of included studies.

The Supplementary Table S1 details the results of the quality assessment. Majority of studies had low risk of bias (55%, n = 16). Most studies clearly indicated the criteria for participants' inclusion (n = 25), described study setting in details (n = 20), measured exposure in a valid and reliable way (n = 21) and measured outcomes using reliable instruments (n = 24). In eleven (11) studies, strategies to deal with confounding factors were not explicitly stated. The vast majority of studies used appropriate statistical analysis (n = 25).

3.3. Measurement and prevalence of T2D stigma

In most studies, T2D stigma was measured using validated instruments (n = 17 studies), including generic stigma scales that were adapted to measure T2D stigma (n = 4 studies) as well as T2D stigma-specific measures (n = 13 studies). The most used instrument (n = 11 studies) for measuring T2D stigma was the type 2 diabetes stigma assessment scale (DSAS-2). The DSAS-2 was originally developed in Australia but has been translated and validated in United Arab Emirates, China, and Turkey. In 8 studies, stigma was measured with the Self-stigma scale (SSS). DSAS-2 and SSS demonstrated good psychometric properties across all studies. Other instruments included the Kandem Institute Stigma Scale (KISS) which was developed and tested in Japan. Stigma domains included differential treatment, self-stigma, workplace discrimination, blame and judgement, enacted stigma, perceived stigma, anticipated stigma, comparative incompetence, social withdrawal, self-devaluation, shame, diabetes concealment and apprehensive feeling. Table 2 provides further details regarding the measurement of T2D stigma.

Ten (10) studies provided data on the prevalence of T2D stigma. The original developers of the DSAS-2 scale defined "problematic level of stigma" as scores greater than one standard deviation from the sample mean. Based on this definition, the prevalence of "problematic level of stigma" was reported by two studies and it ranged from 16.4% to 19.3% [25,33]. In another study that used the median stigma score as a cut-off point, 49.6% of participants were found to have "high" diabetes-related stigma. Studies that used 1-item instrument, asking individuals with T2D whether they had experienced stigma related to their diabetes reported T2D stigma prevalence ranging from 12% to 70%. In another study, 42.6% of persons with T2D experienced anticipated stigma in relation to insulin use [35]. Another study found that 17.5% of persons with T2D concealed their diabetes from colleagues and friends and 32.9% experienced diabetes-related shame [36]. In Denmark, Olesen and colleagues (2020)[37] found that 6% of persons with T2D experienced some form of diabetes-related discrimination at the workplace.

3.4. Association between T2D stigma and HbA1C

As shown in Supplementary Table S2, nine articles evaluated the association between T2D stigma and HbA1c. In six of those articles, the association was positive and statistically significant [28,31,34,38–40]. The effect size for the association between T2D stigma and HbA1c ranged from small to medium (r = 0.02 to 0.17; mean HbA1c difference between persons who experienced T2D stigma and those who did not ranged from 0.2% to 1.0%). The three remaining studies that did not find significant stigma-HbA1c association used non-validated instruments for T2D stigma assessment [36,41,42]. Most studies relied on self-reported HbA1c (n = 3) or recent (<6 months) HbA1c from participants' medical records (n = 2). Three studies measured HbA1c but only one provided details of the instrument used for HbA1c assessment [41].

3.5. Association between T2D stigma and self-management behaviors

Nine studies assessed the association between T2D stigma and at least one domain of diabetes self-management behaviors (including diet, glucose monitoring, physical activity, medication, and foot care). Diabetes self-management was assessed by the summary of diabetes self-care activities (n = 3), diabetes self-care inventory (n = 1), Diabetes Self- Care Behaviors Scale (n = 1), diabetes self-management questionnaire (n = 2) and Godin Leisure time exercise questionnaire (n = 1). Overall, higher T2D stigma was associated with lower engagement in recommended diabetes self-management behaviors including dietary and physical activity behaviors with correlation coefficients ranging from −0.02 to −0.29 [33,38]. In five articles, the behavioral effects of specific domains of T2D stigma (self-stigma and differential treatment) were assessed. Self-stigma and self-blame were significantly associated with lower engagement in self-management behaviors [29–31,43,44]. In contrast, the domain of differential treatment was significantly associated with higher self-care engagement ($p < 0.001$) [44] and physical activity ($p = 0.047$) [45]. One study did not find significant differences in self-management behaviors among persons with T2D who experienced diabetes-related shame and those that did not [36] (Supplementary Table S3).

3.6. Association between T2D stigma and psychological outcomes

Psychological outcomes included depressive symptoms, anxious symptoms, self-esteem, and diabetes distress (see Supplementary Table S4). Four studies assessed the association between T2D stigma and depressive symptoms using the 8- or 9-item patient health questionnaire (PHQ-8 or PHQ-9). All four included studies reported significant positive associations between T2D stigma and depressive symptoms with correlation coefficients ranging from 0.14 to 0.52 [8,27,28,38]. Two studies assessed the association between T2D stigma and anxious symptoms. Anxiety was assessed by the 7-item generalized anxiety disorder (GAD-7). T2D stigma was significantly and positively correlated with anxious symptoms (Correlation coefficient ranging from 0.12 to 0.46).

Seven studies examined the association between T2D stigma and self-esteem [8,25,26,32–34]. Self-esteem was measured with the Rosenberg Self-Esteem Scale (RSES) (n = 6) and a 1-item self-esteem scale (n = 1). Across studies, higher T2D stigma was significantly associated with lower self-esteem (correlation r from −0.29 to −0.51). Seven studies measured diabetes distress using the 5-item or 20-item Problem Areas in Diabetes (PAID) and the Diabetes Distress Scale [8,25,30,33,36,38,44]. Higher T2D stigma was significantly associated with higher diabetes distress with correlation coefficients ranging from 0.20 to 0.68. For every 1 unit increase in T2D stigma (as measured with DSAS-2), PAID increased by 0.87 units [38]. Moreover, self-stigma ($\beta = 0.35$, $p < 0.001$) and differential treatment ($\beta = 0.15$, $p < 0.001$) were independently associated with greater PAID [44].

3.7. Results of the meta-analysis

The Holmes-Truscott et al. (2020) [38] article reported separate effect sizes for independent samples of type 2 diabetes patients who used insulin and those that did not use insulin. For this reason, we split the article into two and considered each part as a separate article for the *meta*-analysis. For multiple articles published from one parent study, we included only one article for which the correlation coefficient was explicitly reported. As shown in Figs. 2 and 3, the results of the *meta*-

Table 1
Study and sample characteristics.

Citation	Country	Design	N	Age	% Female	HbA1c/ FBG	BMI	Complications	Insulin use	Mean time since diagnosis	Comments/ form of survey
Alzubaidi 2022	Unite Arab Emirates	Cross-sectional (validation)	327	NR	56%	NR	NR	NR	30.9%	NR	
Botchway 2021	Ghana	Cross-sectional	254	62.90 (10.20)	59.45%	Mean A1C = 9.2	NR	NR	NR	13.14 (7.10)	In person at the hospital
Browne 2016	Australia	Cross-sectional (validation)	1064	61.20 (9.40)	43%	NR	NR	NR	43.4%	11.12 (7.59)	
Girma 2020	Ethiopia	Cross-sectional	409	48 (8.47)	51%	FBS (mg/dl) – 200 (75.7)	28.6 (4.7)	67%	Not clear	Median – 7	
Harper 2018	USA	Cross-sectional	53	57.3 (8.7)	73.6%	A1c – 8.0 (2.2)	NR	NR	47%	11.2 (8.2)	
Himmelstein 2021	USA	Cross-sectional	1212	52.12 (14.9)	51%	NR	31.61 (8.86)	NR	NR	8.99 (8.07)	Weight stigma was also measured
Holmes-Truscott 2018	Australia	Cross-sectional	456	61.2 (8.8)	38%	NR	32.8 (6.3)	Mean number of complications was 1.4 out of 7	100%	14.5 (7.5)	Data from MILES-2 study (focus T2D using insulin)/ online survey
Holmes-Truscott 2020	Australia	Cross-sectional	1129 (having T2D)	61.1 (9.4)	43%	7 (1.7)	31.79 (6.5)	57%	43.1%	11.1 (7.6)	Data from MILES-2 study/ online survey
Inkaya 2021	Turkey	Cross-sectional (validation)	153	NR	55.19%	7.34 (2.11)	NR	NR	NR	NR	
Kato 2021; Kato 2020; Kato 2016; Kato 2017	Japan	Cross-sectional	209	60.2 (10.1)	19.6%	7.3 (1.2)	26.3 (5.2)	Mean number of complications was 0.57 out of 6	Not clear	13.3 (9.4)	From one Japan study
Kato 2014	Japan	Cross-sectional (validation)	210	60.1 (10)	19.5%	7.3 (1.2)	NR	37.6% had complications	Not clear	13.3 (9.6)	From the same study sample as above
Kawoun 2021	Korea	Cross-sectional	377	66.07 (12.02)	58.6%	NR	NR	NR	Not clear	11.83 (9.42)	
Lee 2015	Singapore	Cross-sectional	125	50.76 (9.69)	32%	8.6 (1.6)	28.1 (5.6)	NR	Not clear	11.76 (6.9)	Face-to-face at the hospital
Lin 2022	Taiwan (China)	Cross-sectional	115	36.7 (6.22)	44%	8.57 (1.93)	28.7 (4.67)	NR	21%	3.37 (2.82)	
Li 2022	China	Cross-sectional	258	61.98 (12.69)	51.16%	8.63 (1.93)	23.78 (3.39)	63.18%	57.36%	13.59 (8.07)	
Liu 2017	USA	Cross-sectional	3,850 (having T2D)	NR	62%	NR	NR	NR	55%	NR	Both T1D and T2D. Results for T2D extracted
Olesen 2020	Denmark	Cross-sectional	586 (having T2D)	55.8	35%	NR	30.6	NR	NR	NR	Results for T2D extracted. / Online survey
Ozturk 2022	Turkey	Cross-sectional	162	49.59 (9.3)	42.6%	NR	NR	NR	Not clear	NR	Face-to-face – Hospital
Pedrero 2021	Colombia	Cross-sectional	501	60 (12)	63.3%	NR	NR	73.9%	35.5%	8.78 (8.14)	Face-to-face - Home
Persky, 2021	USA	Cross-sectional	186 (having T2D)	54.01 (11.47)	72%	NR	33.54 (9.12)	NR	NR	NR	Results for T2D extracted. Online survey
Puhl 2020; Puhl 2022	USA	Cross-sectional	1227	52.04 (14.96)	51.4%	NR	31.64 (8.86	NR	NR	8.96 (8.03)	Online survey
Raghavendran 2020	India	Cross-sectional	148	49.53 (9.8)	68.9%	NR	NR	NR	NR	NR	Face-to-face
Tanaka 2022	Japan	Cross-sectional (validation)	452 (T2D – 369)	62.2 (14.4)	32.7%	8 (3.7)	25.1 (4.2)	NR	NR	14.8 (10.7)	
Zhang 2022	China	Cross-sectional	453	43.11 (11.26)	55%	NR	NR	38.6%	75.9%	Median = 10 years	In-person data collection
Inagaki 2022	Japan	Cross-sectional	510	63.7 (8.7)	32.9%	7.0 (1.1)	24.8 (4.4)	11.8%	NR	13.2 (8.5)	Online survey

NR – Not reported; A1C or HbA1c – glycosylated hemoglobin; BMI – body mass index; FBG – fasting blood glucose; T2D – Type 2 diabetes; MILE = 2 – Second phase of the Management and Impact for Long-term Empowerment and Success study.

Table 2
Measurement and prevalence of T2D stigma.

Stigma instrument	Domains	Prevalence	Psychometric properties	Studies in which instrument was used
19-items DSAS-2 (English, Turkish and Arabic versions)	Being treated differently, blame and judgement and self-stigma	19.3% had problematic level of T2D stigma (Browne 2016); 16.4% had problematic level of stigma (Pedrero, 2021)	Internal reliability was satisfactory. Cronbach's alpha for a single factor scale ranged from 0.76 to 0.95. Alphas for each subscale ranged from 0.87 to 0.94 for differential treatment, 0.88–0.93 for self-stigma and blame and judgement 0.78 to 0.92.	Alzubaidi 2022; Browne 2016; Himmelstein 2021; Holmes-Truscott 2018; Holmes-Truscott 2020; Inkaya 2021; Puhl 2020, 2022; Pedrero 2021; Ozturk 2022; Zhang 2022
Self-stigma scale (Japanese and Chinese versions)	Cognitive, affective and behavioral dimensions	NR	Cronbach's alpha of the SSS-J ranged from 0.96 to 0.98 (cognitive: alpha = 0.92; affective: alpha = 0.93; behavioral: alpha = 0.83)	Kato 2021; Kato 2020; Kato 2016; Kato 2017; Kato 2014; Lin 2022; Li 2022
28-items modified DSAS-2	Enacted stigma, perceived stigma and self-stigma	49.6% had high T2D stigma	Enacted stigma (alpha = 0.68), perceived stigma (alpha = 0.82), and self-stigma (alpha = 0.81)	Botchway 2021
1-item instrument	None	70% reported perceived social stigma	NR	Girma 2020
14-item family stigma instrument	Perceived family stigma; consequences of family stigma	57% agreed with at least one experience of stigma	Family stigma subscale had an alpha of $\alpha = 0.84$ and the consequences of stigma had an alpha of $\alpha = 0.87$	Harper 2018
16-item self-stigma instrument	Comparative incompetence, social withdrawal, self-devaluation, and apprehensive feeling	NR	Alpha = 0.9	Kawoun 2021
1-item instrument ('Do you feel that your colleagues look at or treat you or would look at or would treat you differently because of your having diabetes?')	Stigma at the workplace	12% were stigma positive	NR	Lee 2015
Six-item instrument for stigma	the presence, forms, and impact of diabetes stigma.	52% reporting experiencing stigma; flaw/failure of personal responsibility (81%), perception of being a burden on the health care system (65%). 16% with type 2 diabetes said they experienced stigma from misunderstandings about diabetes.	No	Liu 2017
Universal Measures of Bias	Self-blame and internalized stigma (negative attitudes and distancing)		Cronbach's alpha for T2D = 0.89	Persky, 2021
1-item instrument	Diabetes-related workplace discrimination	6% reported experiencing some type of discrimination at work owing to their diabetes	NA	Olesen 2020
1-item instrument	Anticipated stigma regarding use of insulin	42.6% anticipated that they will be stigmatized if they start using insulin	NA	Raghavendran 2020
KISS	Social-enacted; discordant-enacted; self-enacted; social-perceived; discordant-perceived; and self-perceived		The coefficient of the KISS score was 0.910 with each subscale: (i) social-enacted, 0.775; (ii) discordant-enacted, 0.712; (iii) self-enacted, 0.861; (iv) social perceived, 0.891; (v) discordant-perceived, 0.729; and (vi) self-perceived, 0.869, which shows excellent internal consistency.	Tanaka 2022
2-item questionnaire	Diabetes-related shame and diabetes concealment	17.5% concealed their diabetes from colleagues and friends; 32.9% felt diabetes-related shame	NA	Inagaki 2022

NR – Not reported; NA – Not applicable; DSAS-2 – Type 2 Diabetes stigma assessment scale; KISS – Kandem Institute Stigma Scale.

analysis indicate a weak positive correlation between T2D stigma and HbA1C (r = 0.16, 95% CI: 0.08 to 025, I^2 = 70%, N = 7 studies), and a moderate positive correlation between T2D stigma and depressive symptoms (r = 0.49, 95% CI: 0.44 to 0.54, I^2 = 26.9%, n = 5 studies) and T2D stigma and diabetes distress (r = 0.54, 95% CI: 0.35 to 0.72, I^2 = 96.9%, n = 7 studies). There was also a moderate negative correlation between T2D stigma and self-esteem (r = -0.44, 95% CI: −0.53 to −0.35, I^2 = 74%, n = 5 studies). Lastly, persons with T2D stigma who experienced stigma tended to have less engagement in diabetes self-management behaviors, although this association was weak (r = -0.17, 95% CI: −0.25 to −0.08, I^2 = 79.8%, n = 7 studies).

4. Discussion

In this review, we synthesized quantitative evidence on the association between T2D stigma and clinical, psychological, and behavioral

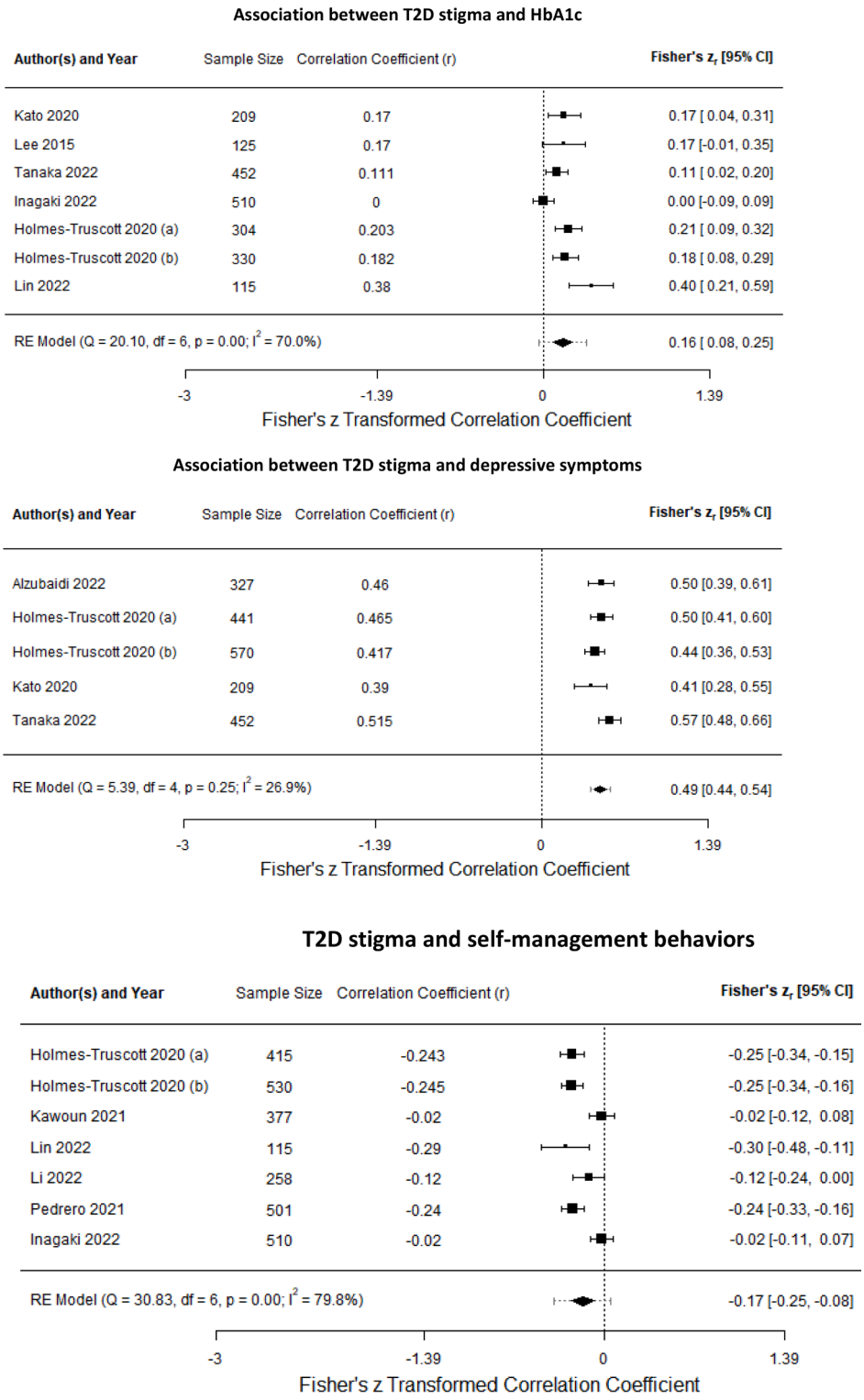

Fig. 2. Results from the *meta*-analysis.

outcomes. Overall, our findings highlight the prevalence of T2D stigma globally. Our findings also indicate that T2D stigma is positively associated with HbA1c, depressive symptoms, anxious symptoms and diabetes distress and negatively associated with self-esteem and self-management behaviors. These findings support Schabert and Colleagues' framework for diabetes stigma.

HbA1c is a strong predictor of diabetes complications and diabetes-related deaths. Persons with T2D with higher HbA1c are more likely to develop macrovascular and microvascular complications [46,47]. For this reason, treatment goals for T2D often include the maintenance of optimal HbA1c [48]. Thus, our finding that higher T2D stigma is associated with higher HbA1c (or worse glycemic management), when taken together with the association of stigma with low self-management behaviors and high depressive and anxious symptoms, highlights the seriousness of the T2D stigma problem – a conclusion that is consistent with the IDF Implementation Plan [3].

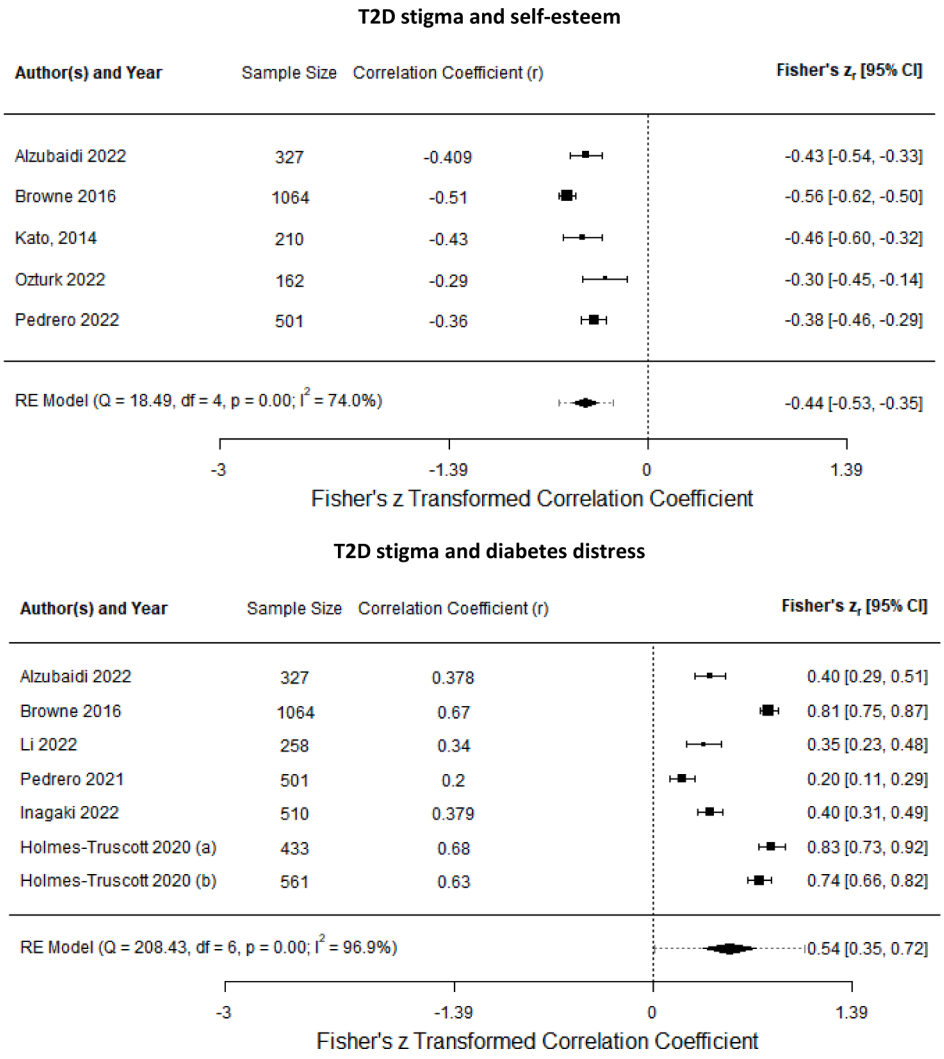

Fig. 3. Results of the *meta*-analysis (cont'd).

Although the underlying biological mechanism of the association between T2D stigma and HbA1c has not been examined, previous studies have shown that stigma and discrimination can directly trigger biochemical stress responses that may result in an increase in oxidative stress biomarkers including cortisol [18,49,50]. In persons with T2D, higher cortisol is associated with higher HbA1c [51]. Moreover, as found in this review, T2D stigma is positively associated with depressive symptoms, anxious symptoms, and diabetes distress. These psychological outcomes have been shown in previous studies to be independently associated with higher HbA1c among persons with T2D [52,53]. In the present review, only one study used path analysis to evaluate the "causal mechanisms" underpinning the relationship between T2D stigma and HbA1c (Kato, 2020). Patient activation, depressive symptoms, self-esteem, and self-efficacy were found to be significant mediators of the stigma-HbA1c relationship.

While we found consistent evidence on the detrimental association of T2D stigma with self-management behaviors, no study evaluated the mediating role of self-management behaviors on the stigma-HbA1c relationship. When persons with T2D overtly engage in self-management behaviors, the concealability of their disease is curtailed thus exposing them to higher levels of stigma [9,10]. Patients' response to the stigma may include active concealment of disease by avoiding self-management behaviors (e.g. insulin use) and in some instances engaging in unhealthy practices to appear normal [54]. Moreover, it is known that lower engagement in self-management behaviors is associated with worse glycemic management [55]. It is thus plausible that self-management behaviors and diabetes concealment may mediate the stigma-HbA1c relationship. Future studies should explore this relationship further.

We found one study in the USA that reported that people with T2D who are treated differently are more likely to engage in self-management behaviors. Although the study had large sample size (N = 1227) and had used valid and reliable instruments [34], the results contradict the theorized pathways proposed in the widely used diabetes stigma framework [7], the stigma framework for visible and invisible chronic diseases [54], and other qualitative studies [15,56]. The diabetes stigma framework stipulates that people who experience any form of T2D stigma are less likely to engage in diabetes self-management behaviors [7]. Indeed, as expected, the other domains of T2D stigma including self-stigma, blame and judgement were all negatively associated with diabetes self-management behaviors [29–31,43,44]. Since no other study, to the best of our knowledge, has evaluated the association between differential treatment (as measured on the DSAS-2 scale) and self-management behaviors, further studies in other settings are required to confirm this relationship.

Our findings on the prevalence and association of T2D stigma with negative health outcomes have several implications for clinical practice and research. First, there is the need for clinicians to recognize the experience of T2D stigma as a barrier to maintaining optimal glycemic management. Once this important fact is recognized, clinicians

(particularly diabetes educators) can then incorporate ways to address or cope with stigmatizing experiences in their routine diabetes self-management classes. Second, while our review did not explicitly explore stigmatizing experiences at the healthcare facility, some of the included studies using the DSAS-2 instrument reported up to 18% (n = 192) of persons with T2D agreeing to the statement/item "Because of my type 2 diabetes, health professionals have made negative judgments about me" [25]. It is thus important for clinicians to adopt judgement-free, non-biased diabetes language when interacting with patients at the healthcare facility. Third, although our review did not specifically focus on interpersonal and intrapersonal stigma, majority of our findings aligned with these forms of stigma. Only one study examined structural stigma (workplace discrimination) and its correlates [37]. Structural stigma refers conditions within society/community such as the culture, national, local, and organizational policies and practices that limit the opportunities, resources, and wellbeing for marginalized group of people [57]. In T2D, examples of structural stigma may include state authorities requiring persons with T2D to obtain health certificate from their physician to renew driver's license [58]. Owing to the subtleness of T2D stigma, there is limited awareness of what constitutes diabetes stigma in the general population. Indeed, research evidence shows that people without diabetes often deny the existence of diabetes stigma [7]. This could make the measurement of structural diabetes-related stigma challenging (particularly the cultural dimension of structural stigma). Future studies should explore designing valid and reliable instruments to measure the prevalence and impact of structural diabetes-related stigma on the physical and mental well-being of persons with T2D. Fourth, future research should focus on exploring the intersection of multiple stigmatizing identities such as T2D, obesity, and lower socio-economic class. The intersectionality framework should be used as a unifying theoretical framework to guide these studies [59]. Fifth, appropriate interventions should be developed to address both individual and structural forms of T2D stigma. Sixth, while the findings from our review largely support Schabert's framework, the positive association between "being treated differently" (as measured with DSAS-2) and diabetes self-management [35] may indicate that some domains of stigma may have positive influence on diabetes outcomes. This finding is formative and may require further studies to confirm and subsequently refine Schabert's framework. Lastly, more research on T2D stigma is required globally and in particularly, Africa, South America, and Europe, to address the paucity of T2D stigma studies in these regions. This is important given the rising prevalence of diabetes in these three regions [1].

This review had some limitations. First, the exclusion of non-English articles meant that valuable evidence might have been missed. Inclusion of non-English articles would have increased the generalizability of the review by allowing for the representation of the perspectives of persons with T2D from diverse cultural and linguistic background. Notwithstanding, the present review is a valuable contribution to the diabetes stigma literature as it provides comprehensive insights into the negative health outcomes associated with T2D stigma. Second, we were unable to assess publication bias because each of our *meta*-analysis model had less than the minimum recommended number of studies ($K = 10$) required for funnel plot asymmetry test [60]. While some of our *meta*-analysis models produced large I^2 values (>70%), the limited number of studies and the high number of missing data on certain variables such as "insulin use" did not allow for subgroup analyses to evaluate sources of heterogeneity. Third, the inclusion of conceptually diverse validated and non-validated instruments for T2D stigma and the compilation of scales measuring multiple but related concepts within one *meta*-analyses (for instance considering physical activity and healthy eating under the umbrella term "self-management") may have limited the interpretability of the pooled effect sizes. Lastly, while we present an estimate of the prevalence of T2D stigma in this review, the varied assessment tools and the arbitrary cut-off points used by studies to categorize participants as having "high", "low", and "problematic" stigma make it difficult to make a firm conclusion about the global burden of T2D stigma.

5. Conclusion

T2D stigma has negative associations with glycemic management and engagement in self-management behaviors, and positive associations with depressive and anxious symptoms. We found limited evidence on structural level T2D stigma and its impact. More studies are required to fully understand stigma at all socio-ecological levels to facilitate the development and testing of stigma reduction interventions. In the interim, clinicians should openly discuss stigmatizing experiences with patients during routine diabetes classes to help patients cope. Also, clinicians should adopt judgement-free, non-biased diabetes language when interacting with patients at the healthcare facility.

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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.

Appendix 1. . Search strategies

Ovid MEDLINE(R) ALL < 1946 to November 08, 2022>

1	social stigma/ or stigma/ or stereotyping/ or social discrimination/ or perceived discrimination/
2	(stereotyp* or stigma* or negative image* or ignoran* or misconception* or misperception* or discriminat* or ((public* or community or social or popular) adj perception*)).tw.
3	type 2 diabetes.mp. or exp Diabetes Mellitus, Type 2/ or diabetes type 2.mp.
4	type 1 diabetes.mp. or exp Diabetes Mellitus, Type 1/
5	1 or 2
6	3 and 5
7	6 not 4
8	limit 7 to (conference abstract or conference paper or "conference review" or editorial or erratum or letter or note)
9	7 not 8

Embase < 1974 to 2022 November 08>

1	Stereotyping/ or Social Stigma/ or Discrimination, Psychological/
2	(stereotyp* or stigma* or negative image* or ignoran* or misconception* or misperception* or discriminat* or ((public* or community or social or popular) adj perception*)).tw.
3	type 2 diabetes.mp. or exp Diabetes Mellitus, Type 2/ or diabetes type 2.mp.
4	type 1 diabetes.mp. or exp Diabetes Mellitus, Type 1/
5	1 or 2
6	3 and 5
7	6 not 4
8	limit 6 to (autobiography or bibliography or biography or comment or consensus development conference or consensus development conference, nih or dictionary or directory or editorial or "expression of concern" or interactive tutorial or interview or lecture or legal case or legislation or letter or news or newspaper article or observational study, veterinary or patient education handout or periodical index or randomized controlled trial, veterinary or video-audio media or webcast)
9	6 not 8

APA PsycInfo < 1806 to October Week 5 2022>

1	Stigma/ or Stereotyped Attitudes/ or Discrimination/ or Social Discrimination/
2	(stereotyp* or stigma* or negative image* or ignoran* or misconception* or misperception* or discriminat* or ((public* or community or social or popular) adj perception*)).tw.
3	exp Type 2 Diabetes/ or diabetes type 2.mp. or type 2 diabetes.mp.
4	1 or 2
5	3 and 4

Web of Science

Set	Results
#3	#1 AND #2
#2	ALL=("type 2 diabetes" OR "diabetes type 2")
#1	TOPIC=(stereotyp* OR stigma* OR negative image* OR ignoran* OR misconception* OR misperception* OR discriminat* or "public* perception*" or "community perception*" or "social perception*" or popular perception*)

COCHRANE CENTRAL

ID	Search
#1	MeSH descriptor: [Social Stigma] explode all trees
#2	MeSH descriptor: [Stereotyping] explode all trees
#3	MeSH descriptor: [Social Discrimination] explode all trees
#4	MeSH descriptor: [Perceived Discrimination] explode all trees
#5	stereotyp* or stigma* or negative image* or ignoran* or misconception* or misperception* or discriminat* or public* perception* or community perception* or social perception* or popular perception*
#6	#1 OR #2 OR #3 OR #4 OR #5
#7	MeSH descriptor: [Diabetes Mellitus, Type 2] explode all trees
#8	"type 2 diabetes" OR "diabetes type 2"
#9	#7 OR #8
#10	#5 AND #9

CINAHL Complete

S10	S6 AND S9
S9	S7 OR S8
S8	type 2 diabetes OR diabetes type 2
S7	(MH "Diabetes Mellitus, Type 2\prime\prime)
S6	S1 OR S2 OR S3 OR S4 OR S5
S5	((public* or community or social or popular) N2 perception*))
S4	stereotyp* OR stigma* OR negative image* OR ignoran* OR misconception* OR misperception* OR discriminat*
S3	(MH "Discrimination+")
S2	(MH "Stereotyping")
S1	(MH "Stigma")

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.diabres.2023.110774.

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