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Diabetes Self-Care in Asia, the Gulf Cooperation Council and Western Countries: A Systematic Review with Narrative Synthesis

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Abstract **Background:** As of 2021, 537 million adults worldwide were estimated to have diabetes mellitus; by 2030, that number is expected to rise to 643 million, making it a global public health challenge. Effective self-care is the foundation of glycaemic control and the avoidance of complications, although its application varies greatly between geographical, cultural and economic contexts. **Aims and Objectives:** To systematically examine diabetes self-care awareness, behaviours and complication-prevention strategies in Asia, the Gulf Cooperation Council (GCC)/wider Middle East and North Africa (MENA) and Western countries, and the cultural, religious and economic factors that influence self-care behaviour. **Methods:** This systematic review was reported according to PRISMA 2020; no protocol was prospectively registered. PubMed/MEDLINE, Scopus and Web of Science were searched on 1 September 2024 for English-language publications from January 2000 onwards, supplemented by grey literature (WHO, IDF, NICE) and reference-list screening. Two reviewers independently screened records; extracted data were verified against each source. Included sources were analysed in three separate evidence streams (primary studies; systematic reviews/meta-analyses; guidelines) to avoid double-counting, synthesised narratively following the SWiM guideline, and the certainty of evidence was rated with GRADE for prespecified outcome–intervention comparisons rather than for regions. **Results:** Of 5,305 records retrieved, 38 sources were included: 19 primary studies, 13 systematic reviews/meta-analyses/scoping reviews and six guidelines or consensus statements. Structured diabetes self-management education and mobile-health interventions reduced HbA1c in randomised trials (moderate-certainty evidence), but these trials were conducted mainly in Western or multi-regional settings; only two included primary studies came from GCC member states. Reported self-care practices, medication adherence and diabetes distress varied widely within, as well as between, regions. Because all but one cross-regional contrast relied on indirect comparison of studies using different populations, instruments and time periods, certainty in regional differences was very low and no ranking of regions could be established. The MENA region, which includes the GCC, had the highest age-adjusted diabetes prevalence among IDF regions in 2021 (18.1%). Ramadan fasting, cost and access barriers, health-system organisation and family dynamics were recurring, context-specific considerations. **Conclusions:** The evidence demonstrates heterogeneity and contextual differences in diabetes self-care rather than a ranking of health systems. Context-adapted self-care programmes should be evaluated locally with standardised outcome measures, and direct comparative studies using common instruments—particularly in GCC member states—are needed.

Key Words Diabetes Mellitus, Self-Care, Diabetes Management, Mhealth, Gulf Cooperation Council, Asia, Western Countries, Complication Prevention, Cultural Competence, Digital Health, Systematic Review, Narrative Synthesis

INTRODUCTION

Diabetes mellitus (DM) is one of the most prominent non-communicable disease epidemics of the twenty-first century. According to the International Diabetes Federation (IDF), 537 million people aged 20–79 years had diabetes in 2021, or 10.5% of this population. The IDF predicts that this number

will increase to 643 million by 2030 and 783 million by 2045 [1]. These numbers conceal significant regional differences: South-East Asia and the Western Pacific bear the largest absolute burden, while the Middle East and North Africa (MENA) region, which includes all six GCC countries, recorded the highest adult diabetes prevalence globally at 18.1% (age-adjusted comparative prevalence, 2021) [1].

The chronic and multisystemic nature of diabetes necessitates sustained and active engagement by patients in their own care—commonly termed diabetes self-management or self-care. Self-care encompasses a spectrum of behaviours including adherence to medication, dietary modification, regular physical activity, structured blood glucose monitoring, foot inspection, tobacco abstinence, and engagement with healthcare services for complication screening [2]. Improved glycaemic and blood-pressure control, to which these behaviours contribute, reduces the risk of microvascular complications (retinopathy, nephropathy, neuropathy), macrovascular events (myocardial infarction, stroke), diabetic foot ulcers and premature mortality [3–5].

Despite decades of research confirming the efficacy of self-care interventions—particularly structured diabetes self-management education (DSME) programmes [2,6–8] and physical activity [9]—uptake and practice remain suboptimal in all regions, though for different reasons. In Western healthcare systems, reported barriers include healthcare fragmentation, medication cost (especially in the USA) and psychosocial burden [10]. In the GCC, dietary transition, sedentary lifestyles, the clinical complexity introduced by Ramadan fasting, and access differences between national citizens and expatriate workers have been described [11]. Asia is remarkably diverse: resource-constrained rural areas in South and Southeast Asia coexist with technologically sophisticated urban centres in China, South Korea and Japan; in lower-income settings, out-of-pocket costs can limit access to guideline-recommended care [12].

The rapid development of digital health solutions—telemedicine, continuous glucose monitoring (CGM), mobile health (mHealth) apps and AI-assisted clinical decision support—is another factor. These technologies are changing self-care opportunities, but their adoption is uneven: it is most prevalent in Western countries and parts of East Asia, expanding in GCC metropolitan centres, and nascent or limited in low-resource Asian settings because of cost and connectivity [13–15].

Several reviews have examined diabetes self-management within a single region, population or intervention type. Thirunavukkarasu and Alsaidan synthesised self-management behaviours across GCC countries in a narrative review [11]; Maina *et al.* mapped complication-prevention self-management practices in low- and middle-income countries [12]; Hawthorne *et al.* evaluated culturally appropriate education for ethnic minority groups, predominantly in Western countries [16]; and Piragine *et al.* pooled adherence to oral antidiabetic drugs globally without region-specific estimates [17]. Other reviews have addressed specific interventions—DSME [2,8], mobile health [13–15] and telemedicine [18]—or conceptual models of self-care [19]. To our knowledge, none of these (i) placed Asian, GCC/MENA and Western evidence side by side within a single prespecified framework, (ii) separated intervention-efficacy evidence from regional implementation evidence, or (iii) examined cultural, religious and economic modifiers across all three spheres. The present review addresses this gap. Because the three spheres are internally heterogeneous, we defined them at country level and report findings by subgroup where possible; the cross-regional comparisons that follow are predominantly indirect and are interpreted accordingly.

Importance of the Study

Understanding why and how self-care varies between settings is more than an intellectual endeavour. Complications such as amputation, end-stage renal disease and vision loss consume a disproportionate share of health budgets and have serious effects on affected people and their families. The IDF estimated direct health expenditure attributable to diabetes at USD 966 billion globally in 2021 [1]. Comparative analysis can support the adaptation of proven interventions to new settings, help avoid the repetition of failures, and inform culturally competent clinical guidelines. For GCC health systems undergoing transformation under national visions such as Saudi Arabia's Vision 2030, and for resource-constrained Asian health systems that are expanding capacity, such evidence is needed.

METHODS

Study Design and Reporting

This is a systematic review with narrative synthesis, reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement [20] (completed checklist in Supplementary Appendix S8) and the Synthesis Without Meta-analysis (SWiM) reporting guideline [21]. Because study designs, populations, self-care measures and outcomes were heterogeneous, quantitative pooling was not undertaken; findings were synthesised narratively after systematic identification, screening and appraisal of sources.

Protocol and Registration

No review protocol was prospectively registered in PROSPERO, the Open Science Framework or any other registry, and no protocol was published. Without a registered protocol, post hoc changes to methods cannot be ruled out; this is acknowledged as a limitation (Section 9).

Information Sources and Search Strategy

PubMed/MEDLINE, Scopus and Web of Science Core Collection were searched on 1 September 2024 for records published from 1 January 2000 to the search date. The search was not updated after this date. The strategy combined four

concept blocks—diabetes, self-care, geography, and complication/outcome or digital-health terms—using MeSH and free-text terms in PubMed and equivalent title/abstract/keyword fields in Scopus and Web of Science. The core concept structure was: ("diabetes mellitus" OR "type 2 diabetes" OR "T2DM") AND ("self-care" OR "self-management" OR "patient education" OR "adherence") AND ("Asia" OR "South Asia" OR "Southeast Asia" OR "East Asia" OR "Gulf Cooperation Council" OR "GCC" OR "Saudi Arabia" OR "United Arab Emirates" OR "Middle East" OR "Western countries" OR "Europe" OR "North America") AND ("complication prevention" OR "glycemic control" OR "HbA1c" OR "foot care" OR "retinopathy" OR "nephropathy" OR "digital health" OR "mHealth"). The full, database-specific strategies—with field tags, controlled vocabulary, limits, exact search dates and the number of records retrieved from each database—are reported in Supplementary Appendix S1.

Search Sensitivity

Requiring the fourth concept block (complication/outcome or digital-health terms) increases precision but may reduce sensitivity for self-care studies that do not mention these terms in indexed fields. To mitigate this, the reference lists of all included sources and of key reviews [2,12,16,17] were hand-searched. Residual risk of missed studies is acknowledged as a limitation (Section 9).

Grey Literature

The websites of the World Health Organization (www.who.int/publications and the IRIS repository), the International Diabetes Federation (www.idf.org; www.diabetesatlas.org) and the National Institute for Health and Care Excellence (www.nice.org.uk/guidance) were searched in September 2024, alongside the database searches, using the terms "diabetes", "self-care", "self-management", "education" and "Ramadan". Guidelines, atlases and technical reports were eligible if they were issued by a national or international organisation, described their evidence base or development method, and made recommendations or reported data on self-care, education or complication prevention in adults with diabetes. The grey-literature search log is given in Supplementary Appendix S2.

Publications After the Search Cut-Off

Three publications dated 2025 [11,19,22] appeared in the reference list of the original submission. They were not identified through the systematic search, which ended on 1 September 2024. They are retained only as contextual references, are labelled as such in Supplementary Table S4 (Part B), and do not contribute to the evidence synthesis, the tables of findings or the certainty ratings.

Eligibility Criteria and Geographic Definitions

Studies were included if they: (i) involved adult participants (≥18 years) with type 1 or type 2 diabetes; (ii) reported on self-care behaviours, patient education, awareness or complication-prevention strategies; (iii) were conducted in, or explicitly reported data from, Asia, GCC/MENA or Western countries (Europe, North America, Australia, New Zealand); (iv) were published in English between January 2000 and September 2024; and (v) were primary research studies (randomised or non-randomised trials, cohort, cross-sectional or instrument-validation studies), systematic reviews, meta-analyses or scoping reviews, or evidence-based guidelines/consensus statements from recognised professional bodies. Studies were excluded if they focused exclusively on pharmacological interventions without a self-care component, lacked geographic specificity, studied populations without diabetes, were narrative or conceptual reviews, editorials or commentaries, or if the full text was unavailable. Conference abstracts without full data were also excluded.

Geographic Definitions

Countries were assigned to spheres a priori at country level (full list in Supplementary Appendix S3). *Asia*: East Asia (China, including Hong Kong SAR; Taiwan; Japan; Republic of Korea), South Asia (e.g., India, Pakistan, Bangladesh, Sri Lanka, Nepal) and Southeast Asia (e.g., Vietnam, Thailand, Malaysia, Indonesia, the Philippines, Singapore). *GCC/MENA*: the six GCC member states (Saudi Arabia, United Arab Emirates, Kuwait, Qatar, Bahrain, Oman) form the core group; other countries of the IDF MENA region (e.g., Egypt, Jordan, Palestine, Iran) form a separate "wider MENA" subgroup, whose findings are reported separately and are not attributed to the GCC. *Western countries*: countries of Europe, the United States, Canada, Australia and New Zealand. Countries spanning geographic or cultural classifications were assigned by their IDF region: Iran (IDF MENA region) was assigned to the wider-MENA subgroup, and Turkey (IDF Europe region) was treated as a transcontinental case reported separately and not used to characterise either Western or MENA findings. Multinational studies were classified as "multi-regional", and their findings were attributed to a sphere only when results were reported by country.

Study Selection

Records were de-duplicated with reference-management software. Titles and abstracts, and then full texts, were screened independently by two reviewers against the eligibility criteria; disagreements were resolved by discussion and, where necessary, by a third author. Inter-reviewer agreement was not formally quantified (e.g., with Cohen's kappa), which is acknowledged as a limitation (Section 9). At revision, every source retained after full-text screening was re-assessed against the prespecified criteria (eligibility re-audit); the sources excluded at this stage are listed with reasons in Supplementary Appendix S9.

Data Extraction

Data were extracted with a standardised form that was piloted on an initial sample of sources and refined before use.

At revision, all extracted data were re-checked against the full text or published abstract of each source and corrected where necessary. Extracted variables were: first author and year; country, sphere and subgroup; study design and evidence stream; setting; population (diabetes type, age, sample size); self-care domain(s); measurement instrument; intervention and comparator (where applicable); outcomes and effect estimates; period of data collection; and appraisal results. The extracted characteristics of every source are given in Supplementary Table S4.

Evidence Streams and Avoidance of Double-Counting

Included sources were allocated to three evidence streams that were analysed separately: Stream A, primary studies; Stream B, systematic reviews, meta-analyses and scoping reviews; and Stream C, guidelines and consensus statements. Stream B was used to answer intervention-efficacy questions; Stream A was used to describe regional practice, implementation and determinants. When a primary study was also included in an included systematic review, its results were not counted again within the same evidence body (overlap was checked by comparing reference lists). Stream C documents were used to define recommended standards (e.g., screening intervals) and to frame recommendations, not as evidence of effect. References cited only for background are identified as contextual in Supplementary Table S4 (Part B) and were not used to derive findings or certainty ratings.

Quality Appraisal

Methodological quality was appraised with design-specific tools: the Cochrane RoB 2 tool for randomised trials [23], JBI critical appraisal checklists for cohort, analytical cross-sectional and instrument-validation studies [24], AMSTAR 2 for systematic reviews [25], and AGREE II domains for guidelines [26]. Appraisal was completed at the revision stage, after study selection, against the published criteria of each tool; the judgement for every source is reported in Supplementary Table S4.

Data Synthesis

Meta-analysis was not possible because of variation in study designs, populations and outcome measures. Synthesis followed the SWiM guideline [21] and the ESRC guidance on narrative synthesis [27] in six steps. (1) Grouping: findings were grouped by self-care domain—(a) awareness and education; (b) medication adherence; (c) diet; (d) physical activity; (e) foot care and complication screening; (f) glucose monitoring and digital health; (g) cultural, religious, economic and psychosocial factors; (h) complication prevention—and, within each domain, by sphere and subgroup. (2) Standardised metric: for intervention questions, the mean difference in HbA1c (percentage points) reported by included systematic reviews or trials was used; for practice and adherence questions, proportions were tabulated as reported, with the instrument used, and were not pooled. (3) Vote counting based on statistical significance was not used. (4) Conflicting findings were examined against study design, risk of bias, measurement instrument, setting and period; conflicts that could not be explained are reported as inconsistency. (5) Direct versus indirect comparison: a cross-regional comparison was classified as direct only when a single study measured self-care in more than one sphere using the same methods (e.g., the DAWN study [10]); all other contrasts are labelled indirect and interpreted cautiously. (6) Strength and consistency of evidence were summarised with GRADE.

Certainty of Evidence

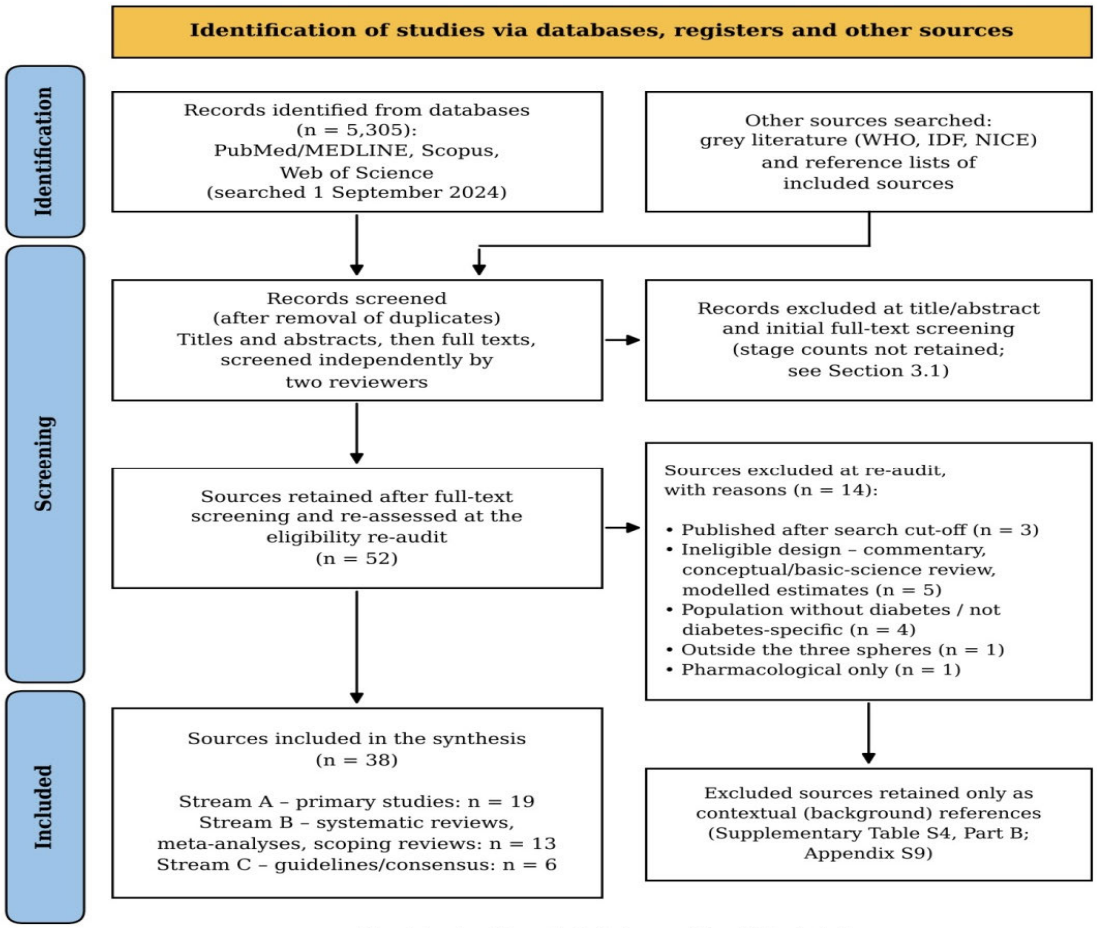
Certainty was rated with GRADE [28] for eleven prespecified outcome–comparison evidence bodies (Section 3.10), not for regions as a whole. Bodies of randomised evidence (or systematic reviews of trials) started at high certainty and observational evidence at low certainty, and were downgraded for risk of bias, inconsistency, indirectness (including transfer of findings across regions), imprecision or publication bias, or upgraded for large effects or a dose–response gradient. Where no single pooled estimate was available, ratings followed the approach of Murad *et al.* for narrative syntheses [29]. Downgrading and upgrading decisions are explained in Section 3.10 and Supplementary Appendix S5.

RESULTS AND SYNTHESIS

Study Selection

The database searches retrieved 5,305 records. After removal of duplicates, screening of titles, abstracts and full texts against the eligibility criteria, and supplementary hand-searching of reference lists and grey literature, 52 sources were retained and cited in the original submission. At revision, these 52 sources were re-assessed against the prespecified criteria (eligibility re-audit), and 14 were excluded with reasons: published after the search cut-off (n = 3) [11,19,22]; ineligible design, such as commentary, conceptual or basic-science review or modelled epidemiological estimates (n = 5) [30–34]; population without diabetes or topic not diabetes-specific (n = 4) [35–38]; outside the three spheres (n = 1) [39]; and pharmacological intervention without a self-care component (n = 1) [40] (Figure 1; Supplementary Appendix S9). Thirty-eight sources were therefore included: 19 primary studies (Stream A), 13 systematic reviews, meta-analyses or scoping reviews (Stream B) and six guidelines or consensus statements (Stream C). The excluded sources are still cited where they provide background and are labelled as contextual references (Supplementary Table S4, Part B). The numbers of duplicates and of records excluded at the title/abstract and initial full-text stages were not retained in a form that allows exact reporting; this is acknowledged as a limitation (Section 9).

Adapted from the PRISMA 2020 flow diagram template [20]. 52 sources retained after full-text screening − 14 excluded at the eligibility re-audit = 38 included sources.



Characteristics of Included Sources

Table 1 summarises the evidence base by stream and sphere; Supplementary Table S4 lists every source with its design, country, population, sample size, self-care measure, outcomes, main findings and appraisal. Of the 19 primary studies, five were from Asia (China, Vietnam, Bangladesh, Republic of Korea), two from GCC member states (both Saudi Arabia), four from the wider MENA subgroup (Egypt, Palestine, Iran), one from Turkey, six from Western countries (USA, UK) and one was multi-regional (DAWN, 13 countries). Nine were cross-sectional surveys, four instrument-validation studies, four randomised or controlled trials and two cohort studies. All 13 systematic reviews synthesised trials or studies from Western or multiple regions; none was restricted to Asia or the GCC. GCC-specific conclusions therefore rest on limited direct evidence.

Epidemiological Context and Diabetes Burden

The diabetes burden is unequally distributed worldwide, and this epidemiological heterogeneity shapes self-care priorities. The GCC is part of the MENA region, which had the highest age-adjusted comparative prevalence of all IDF regions in 2021 (18.1%), compared with 11.9% in North America and the Caribbean, 10.0% in South-East Asia, 9.9% in the Western Pacific and 7.0% in Europe [1]. The largest national numbers of adults with diabetes are found in China, India and Pakistan [1]. IDF regions do not map exactly onto the spheres used here (for example, the Western Pacific region includes both China and Australia, and the MENA region includes non-GCC countries), so these figures describe context rather than sphere-specific estimates. Western countries generally report lower prevalence; however, rising rates of type 2 diabetes and prediabetes linked to obesity challenge this pattern [1]. A descriptive cross-regional overview of several self-care domains is given in Table 2; it summarises the available evidence and its sources and is not intended as a ranking of regions.

Diabetes Self-Management Education and Awareness

Structured DSME is the most consistently evidenced intervention for improving self-care behaviours and glycaemic outcomes [2,7,8]. In Western countries, DSME is embedded within national guidelines: the UK's DESMOND and Diabetes Manual programmes [6,52], the USA's national DSMES standards [3], and equivalent European frameworks represent mature, community-based delivery models. In a meta-analysis of 31 randomised trials, Norris *et al.* found that DSME reduced HbA1c by 0.76 percentage points (95% CI 0.34–1.18) more than control at immediate follow-up, with smaller effects at longer follow-up [8]. In the DESMOND cluster trial, the HbA1c difference was no longer significant

Table 1: Composition of the Included Evidence Base by Evidence Stream and Geographic Sphere (Number of Sources)

Evidence stream	Asia	GCC (core)	Wider MENA	Turkey	Western	Multi-regional / global	Total
A. Primary studies	5	2	4	1	6	1	19
B. Systematic reviews, meta-analyses, scoping reviews	0	0	0	0	4	9	13
C. Guidelines / consensus statements	0	0	0	0	4	2	6
Total	5	2	4	1	14	12	38

Western Reviews: [2,7,16,41]; Multi-Regional Reviews: [12–15,17,18,42–44]; Western Guidelines: [3,9,45,46]; Multi-Regional Guidance: [47,48]. Individual sources are listed in Supplementary Table S4

Table 2: Descriptive Overview of Diabetes Self-Care Indicators in Asia, GCC/MENA and Western Countries, with Sources

Self-Care Domain	Asia	GCC/MENA	Western Countries
Diabetes prevalence, age-adjusted, 20–79 Years [1]	10.0% (South-East Asia region); 9.9% (Western Pacific region)	18.1% (MENA region; includes non-GCC countries)	7.0% (Europe); 11.9% (North America and Caribbean)
Medication adherence (study-level; instruments differ; not comparable across columns)	No included Asian study measured adherence directly. Global pooled estimate across 156 studies: 54% adherent (95% CI 51–58%) [17]	Wider MENA: 57.3% adherent (MMAS-8; Palestine, n = 405) [49]; 30.5% high and 51.3% medium adherence (Egypt, n = 302) [50]. No GCC-core estimate in included studies	No single-study estimate in included sources; see global pooled estimate [17]
Structured diabetes education	Variable: community programmes in parts of East Asia; limited in many low-resource settings [12,51]	No included GCC evaluation of DSME; mostly hospital-based delivery described in contextual sources	Embedded in national programmes (e.g., DESMOND) [6,52]; benefits attenuate over time [6,8]
Digital health / mHealth adoption	Rapid uptake; messaging/app platforms widely used	Increasing; government e-health drives	Mature; CGM, apps, telehealth integrated[3,53]
Dietary self-care	Traditional diets; high-carbohydrate staples challenge adherence	Energy-dense traditional and processed foods; Ramadan fasting a key factor [48,54]	Evidence-based diet counselling available[3,45]
Physical activity	Low in urban populations; cultural barriers	Low; sedentary lifestyle predominant (contextual [11])	Guidelines established [9]; many adults do not meet recommendations [9]
Foot care practices	Poor awareness; resource constraints [12]	Wider MENA: 75.2% unsatisfactory foot self-care (older adults, Egypt, n = 230) [55]; no GCC-core estimate	High standard: podiatry integrated [47]
Cultural/religious influences	Collectivist norms; family support.	Islamic practices (fasting, prayer times) integrated into care [48,54]	Individualistic; secular care model
Healthcare system model	Mixed public–private; variable access	Predominantly state-funded for nationals	Universal health coverage (Europe); insurance (USA)
Complication screening regularity	Irregular; urban–rural gap wide[12]	Improving; Vision 2030 driving change	Annual screening standard in guidelines [3,56]
Within-sphere heterogeneity	High-income East Asia vs lower-income South/Southeast Asia; urban vs rural	GCC nationals vs expatriate workers; differences between GCC states; GCC vs wider MENA	Universal-coverage systems vs insurance-based USA; socioeconomic and ethnic-minority gaps [16]

CGM: Continuous Glucose Monitoring, DSME: Diabetes Self-Management Education, GCC: Gulf Cooperation Council, MENA: Middle East and North Africa, MMAS-8: 8-item Morisky Medication Adherence Scale. Entries without a citation are descriptive health-system context, not derived from included studies and not graded. Values in different columns come from different populations, instruments and years and must not be compared directly. Amputation-rate ranges and region-level GRADE labels shown in the previous version have been removed: the amputation ranges could not be traced to a source with a defined population and period, and certainty is now rated per outcome (Section 3.10). The source of every numerical value is listed in Supplementary Appendix S6

at 3 years (−0.02; 95% CI −0.22 to 0.17; 604 participants with biomedical data), although improvements in illness beliefs persisted [6].

No included primary study evaluated DSME delivery in a GCC member state; the two included Saudi studies assessed diabetes distress [57] and population disease burden [58]. In the wider MENA subgroup, lower disease knowledge and weaker beliefs about the necessity of medicines were associated with non-adherence in Palestine [49], and patient education level and physician participation in diabetes training were associated with better glycaemic control in Egyptian primary care [50]. A recent narrative review, published after our search cut-off and therefore not included, describes predominantly hospital-based education services in GCC countries [11].

Asian evidence was heterogeneous. In six urban districts of Chengdu, western China, 46% of 364 surveyed patients showed "good" self-management behaviour, 45% "fair" and 6% "poor"[51], and a Korean instrument-development study (n = 473) produced a locally validated self-management scale [59], no included Asian study evaluated a DSME programme. In a Cochrane review of 11 trials, culturally appropriate health education improved short-term glycaemic control compared with usual care in ethnic minority groups, mostly in Western countries [16]. These trials compared adapted education with usual care rather than with generic programmes, so they do not show that adapted programmes outperform generic ones.

Medication Adherence

In all three spheres, medication non-adherence is associated with poorer glycaemic control [17,49]. Piragine *et al.* pooled

156 studies published in 2011–2022 and found that 54% (95% CI 51–58%) of patients were adherent to oral antidiabetic drugs, and that good adherence was associated with good glycaemic control (OR 1.33; 95% CI 1.17–1.51); adherence was measured with administrative data, self-report questionnaires or pill counts, and region-specific pooled estimates were not reported [17]. Complexity of regimens, side effects, cost (especially in the USA) and health literacy are linked to non-adherence [10,49]. Long-term UKPDS follow-up showed a legacy effect of early intensive glucose control, including metformin, on microvascular and cardiovascular outcomes [60].

In the wider MENA subgroup, 57.3% of 405 patients in Palestine were adherent on the MMAS-8 [49], and in Egyptian primary care 30.5% showed high and 51.3% medium adherence [50]. No included primary study from a GCC member state reported medication adherence. A specific set of clinical guidelines addresses the difficulties of taking medication during Ramadan, including rescheduling of insulin and the risk of hypoglycaemia with sulfonylureas. The IDF and Diabetes and Ramadan (DAR) International Alliance practical guidelines provide risk stratification and medication-adjustment advice [48,54].

No included primary study from Asia measured medication adherence directly. In Bangladesh and Vietnam, diabetes distress—including regimen-related distress—was common (52.5% of 259 and 29.4% of 517 patients with moderate-to-high distress, respectively) [61,62]. In low- and middle-income settings, cost of and access to medicines are recurrent barriers to self-management [12].

Dietary Self-Care

Dietary modification is a foundational pillar of diabetes self-management, yet it is shaped by cultural food norms, making generalisation across regions difficult [16,45]. In Western countries, evidence-based dietary guidance—including the Mediterranean diet, low-glycaemic-index approaches and structured meal planning—is reflected in guidelines [3,45]. In a meta-analysis of 14 trials (356 participants), low-glycaemic-index diets reduced HbA1c by 0.43 percentage points more than high-glycaemic-index diets [42]. National dietary guidelines in the UK (NICE NG28), USA (ADA Standards) and major European nations provide standardised nutrition recommendations integrated into DSME programmes [3,56].

In GCC countries, contextual sources describe how dietary self-care is challenged by the nutritional transition from traditional diets to energy-dense, processed food environments [11]. Ramadan—a 29–30-day period of dawn-to-sunset fasting with altered meal timing and often large caloric intake at Iftar—requires specific dietary and pharmacological management [48,54]. Current guidance for Muslim patients recommends, balanced Suhoor meals, portion control at Iftar, and avoiding calorie-dense desserts [48,54].

High-carbohydrate staple diets are commonly described as a challenge to dietary self-care in Asian settings, although no included study quantified this directly. In Chinese adults with impaired glucose tolerance—that is, before the onset of diabetes—the Da Qing study reported 6-year reductions in diabetes incidence of 31%, 46% and 42% in the diet, exercise and combined arms, respectively [63]; this is prevention evidence and only indirectly relevant to self-care in established diabetes. Culturally tailored education, often including dietary components, improved short-term glycaemic outcomes compared with usual care [16]; direct comparisons with generic dietary advice are lacking.

Physical Activity

In people with diabetes, regular exercise lowers insulin resistance, improves glycaemic management and lowers cardiovascular risk [9]. The ADA recommends at least 150 minutes of moderate-to-vigorous aerobic activity per week plus resistance training on two or more days a week [9]. Many adults with type 2 diabetes do not meet these recommendations [9].

In GCC countries, high summer temperatures, car-dependent urban design, sedentary occupations and, for some women, limited access to public exercise spaces are described as barriers to physical activity [11]; no included study from a GCC member state measured physical activity or evaluated an exercise programme.

In Asia, physical activity patterns are heterogeneous. Traditional practices such as Tai Chi, yoga and walking are culturally embedded in many Asian communities and represent accessible, low-cost options. However, rapid urbanisation has reduced incidental physical activity, and access to safe recreational environments differs between high-income East Asian cities and lower-income South/Southeast Asian settings. In a 16-week controlled trial in China (49 adults aged 60–69 years with type 2 diabetes, compared with non-exercising controls), supervised aerobic exercise at the intensity of maximal fat oxidation improved glycaemic control, body composition and physical capacity [64].

Foot Care Practices

Diabetic foot disease—neuropathic and ischaemic ulcers, infection and amputation—is among the most serious and costly complications of diabetes [47]. The IWGDF guidance recommends daily foot inspection, appropriate footwear, prompt wound management and regular professional foot examination [47]; it notes, however, that trial evidence for patient education alone in preventing ulcers is limited [47].

In Western countries, integrated podiatry services, annual foot screening in primary care and multidisciplinary foot-care teams are standard [47,56]. In UKPDS, intensive glucose control and tight blood-pressure control reduced microvascular endpoints [4,5]. In an observational meta-analysis, glycaemic control was examined in relation to diabetic foot ulcer outcomes [43].

No included primary study from a GCC member state measured foot-care practice. A recent narrative review published after our search cut-off reports that most GCC patients had inadequate foot-care knowledge [11]. In the

Table 3: Diabetes Self-Care Interventions: Efficacy Evidence Versus Regional Implementation/Adoption Evidence (Restructured)

Intervention	Efficacy evidence (Design; Effect on HbA1c or Main Outcome) [refs]	Certainty (Table 4)	Implementation / adoption: Asia	Implementation / adoption: GCC / wider MENA	Implementation / adoption: Western
Structured DSME	SR of 72 RCTs [2]; MA of 31 RCTs: −0.76 pp (95% CI 0.34–1.18) at end of intervention, attenuating thereafter [8]; DESMOND: no difference at 3 y [6]; NMA [7]	Moderate	No included programme evaluation; community programmes in parts of East Asia	No included GCC evaluation	National programmes (DESMOND, Diabetes Manual) [6,52]
Culturally adapted education	Cochrane review, 11 RCTs (ethnic minority groups): short-term HbA1c improvement vs usual care [16]	Low	Not evaluated in included studies	Not evaluated in included studies	Trials mainly among ethnic minorities in UK/USA [16]
Mobile phone / app support	MA: −0.5 pp [13]; MA of 14 RCTs (n = 1,360): −0.49 pp (95% CI 0.30–0.68) [14]; SR [15]	Moderate	Trials contributed to the MAs [13,14]; widespread app/messaging platforms	No included GCC trial; government digital platforms	Widely used [15]
Telemedicine	MA of 42 RCTs: modest HbA1c reduction vs usual care [18]	Moderate	Post-COVID expansion	Post-COVID expansion	Integrated in many systems [18]
SMBG (non-insulin-treated T2DM)	Cochrane review: small reduction at ≤6 months, not sustained at 12 months [41]	Low	Cost barriers in LMICs [12]	Not measured in included studies	Standard of care where indicated [3]
CGM (T1DM on injections)	DIAMOND RCT (n = 158): greater HbA1c reduction than usual care (≈0.6 pp at 24 weeks) [65]	Moderate	Cost barriers	Cost barriers	Recommended in guidelines [3]
Low-GI dietary advice	MA of 14 trials (n = 356): −0.43 pp vs high-GI diets [42]	Low	Staple-based diets	Ramadan-specific advice [48,54]	Integrated in guidelines [3,45]
Structured exercise	Position statement [9]; 16-week controlled trial in 49 older Chinese adults: improved glycaemic control [64]	Low	Trial in China [64]	Not evaluated in included studies	Guideline-based [9]
Foot-care education	IWGDF: limited trial evidence for education alone [47]; observational MA on glycaemic control and DFU outcomes [43]	Very low	Low awareness reported [12]	Wider MENA: 75.2% unsatisfactory practice (Egypt) [55]	Integrated podiatry [47]
Structured 1:1 education / psychosocial support	Cluster RCT (n = 245): no significant HbA1c difference; less diabetes distress, greater confidence [52]	Low	Distress common (Bangladesh, Vietnam) [61,62]	Distress measured (Saudi Arabia, Iran) [57,66]	Trial in UK primary care [52]
Pre-Ramadan education and risk stratification	Practice guidance; supporting studies observational [48,54]	Very low	Muslim-majority Asian countries [48]	Core regional relevance [48,54]	Muslim minority populations [48]

CGM: Continuous Glucose Monitoring, DSME: Diabetes Self-Management Education, GI: Glycaemic Index, LMICs: Low- And Middle-Income Countries, MA: Meta-Analysis, NMA: Network Meta-Analysis, pp: Percentage Points, RCT: Randomised Controlled Trial, SMBG: Self-Monitoring of Blood Glucose, SR: Systematic Review. Entries without a citation are descriptive implementation context, not derived from included studies and not graded. The previous version of this table combined trial, review, guideline and general statements in one framework and included citations that did not match the reference list (e.g., Norris 2002, Clair 2015, Turner 1998); these have been corrected

wider MENA subgroup, 75.2% of 230 older adults with type 2 diabetes in Egypt had unsatisfactory foot self-care practice [55].

In Asian settings, foot-care awareness has been reported to be low in rural populations and among patients with low health literacy [12]. Walking barefoot in parts of South and Southeast Asia, poorly fitted footwear and agricultural foot injuries are commonly cited as additional contextual risks. Community-based foot-care education and low-cost monofilament neuropathy screening have been implemented in resource-limited settings.

Digital Health and mHealth in Diabetes Self-Care

The role of digital technologies in supporting diabetes self-care has grown markedly over the past decade, accelerated by the COVID-19 pandemic [13–15,18]. Table 3 summarises the principal self-care interventions, separating evidence of efficacy (what the intervention achieves in trials) from evidence of regional implementation and adoption (where and how it is used).

In Western countries, CGM is now part of standard care for type 1 diabetes and increasingly for insulin-treated type 2 diabetes [3]; in the DIAMOND trial, CGM reduced HbA1c more than usual care in adults with type 1 diabetes using injections [65]. In a meta-analysis of 42 RCTs, telemedicine produced a modest additional HbA1c reduction compared with usual care [18]. In a US cohort of 27,207 adults with diabetes, practices using electronic health records achieved higher composite standards of care and outcomes than paper-based practices [53].

Government-backed digital health platforms, such as Saudi Arabia's Seha and the United Arab Emirates' NABIDH, have expanded digital health infrastructure in GCC nations; their effect on self-care was not evaluated in any included study. A meta-analysis of mobile-phone

Table 4: Summary of Findings and Certainty of Evidence (GRADE) for Prespecified Outcome–Comparison Evidence Bodies

Outcome / comparison	Evidence body [refs]	Summary of effect	Starting level	Downgrading / upgrading	Certainty
1. DSME vs usual care → HbA1c	SRs/MA of RCTs [2,7,8]; cluster RCT [6]	−0.76 pp at end of intervention; smaller at longer follow-up; no difference at 3 y in DESMOND	High	−1 inconsistency (heterogeneous effects, attenuation over time)	Moderate
2. Culturally appropriate education vs usual care → HbA1c (ethnic minority groups)	Cochrane review of 11 RCTs [16]	Short-term (3–6 month) improvement; long-term data lacking	High	−1 risk of bias; −1 indirectness (mainly Western ethnic-minority populations; not tested in Asian/GCC settings)	Low
3. Mobile phone / app support vs usual care → HbA1c	MAs of RCTs [13,14]; SR [15]	About −0.5 pp (−0.49, 95% CI 0.30–0.68)	High	−1 risk of bias (unblinded trials, short follow-up)	Moderate
4. Telemedicine vs usual care → HbA1c	MA of 42 RCTs [18]	Modest reduction	High	−1 inconsistency (heterogeneous interventions)	Moderate
5. SMBG vs no SMBG (non-insulin T2DM) → HbA1c	Cochrane review [41]	Small reduction at ≤6 months; not sustained at 12 months	High	−1 risk of bias; −1 imprecision/clinical relevance	Low
6. CGM vs usual care (T1DM on injections) → HbA1c	One RCT, n = 158 [65]	≈0.6 pp greater reduction at 24 weeks	High	−1 imprecision (single trial); indirect for T2DM and non-Western settings	Moderate
7. Low-GI vs high-GI diet → HbA1c	MA of 14 trials, n = 356 [42]	−0.43 pp	High	−1 risk of bias; −1 imprecision (small, short trials)	Low
8. Structured exercise → glycaemic control	Position statement [9]; one non-randomised controlled trial, n = 49 [64]	Improved glycaemic control and body composition at 16 weeks	Low	No further downgrading; direction consistent with position statement [9]	Low
9. Foot-care education → ulcer / amputation	Guidance [47]; observational MA [43]	Limited evidence of effect of education alone	High/Low	−1 risk of bias; −1 imprecision; indirectness	Very low
10. Pre-Ramadan education/risk stratification → hypoglycaemia and adverse events	Practice guidance [48,54]; observational studies	Fewer adverse events reported; magnitude uncertain	Low	−1 risk of bias (observational, unadjusted)	Very low
11. Cross-regional differences in self-care practice, adherence and distress	Cross-sectional studies [49–51,55,57–59,61,62,66,67]; DAWN [10]	Wide variation within and between spheres; no consistent regional ranking	Low	−1 indirectness (indirect comparisons); −1 inconsistency (different instruments, populations, years)	Very low

pp: Percentage Points. GRADE: High: Further Research Very Unlikely to Change Confidence in the Estimate, Moderate: Likely to Have an Important Impact, Low: Very Likely to Have an Important Impact, Very Low: Any Estimate Is Very Uncertain. Regional GRADE labels used in the previous version (e.g., "High" for Western countries) have been withdrawn. Domain-by-domain judgements are given in Supplementary Appendix S5

interventions reported a pooled HbA1c reduction of about 0.5 percentage points [13], suggesting potential for low-cost, population-level impact; no included trial was conducted in a GCC member state. The COVID-19 pandemic accelerated the use of teleconsultation in settings where preferences for in-person care had previously limited it.

In Asia, China's messaging-based health platforms, South Korea's integrated digital health systems and India's expansion of telemedicine after COVID-19 represent a "leapfrogging" pattern. Hou *et al.* pooled 14 RCTs (1,360 participants) and found that diabetes apps reduced HbA1c by 0.49 percentage points (95% CI 0.30–0.68; moderate-certainty evidence) [14], and Wang *et al.* reported generally favourable effects of mHealth interventions on diabetes self-management [15]. In a meta-analysis of 28 RCTs in general adult populations, consumer wearable trackers increased daily steps by approximately 627 [36]; because participants were not restricted to people with diabetes, this evidence is indirect and is cited as context only.

Certainty of Evidence

Table 4 presents the certainty of evidence for eleven prespecified outcome–comparison evidence bodies. Certainty was moderate for the effects of DSME, mobile-health support, telemedicine and CGM on HbA1c; low for culturally appropriate education, SMBG, low-glycaemic-index diets and structured exercise; and very low for foot-care education, pre-Ramadan education and all cross-regional differences in self-care practice.

Cultural, Religious, and Economic Factors of Self-Care

Cultural, religious and economic factors may influence whether recommendations are understood, accepted and enacted. In the included sources, evidence on these factors is mostly cross-sectional or comes from guidance documents; it describes associations and contexts rather than established causal determinants, and each factor varies substantially within regions. Table 5 lists each factor with the basis of its evidence and its within-region variation; the adaptation strategies are suggestions that, unless a reference is given, have not been tested in the included studies.

In the GCC and Muslim-majority Asian countries, fasting during Ramadan poses a clinically significant cultural-religious consideration. Approximately 50 million people with diabetes observe Ramadan annually, although high-risk patients are advised that they are medically exempt

Table 5: Cultural and Religious Factors that May Influence Diabetes Self-Care: Evidence Basis, Within-Region Variation and Suggested Adaptations

Factor	Reported or proposed impact	Evidence basis (included sources)	Within-region variation	Suggested adaptation
Ramadan fasting (GCC/Asia/Muslim communities worldwide)	Altered meal timing, medication dosing, hypoglycaemia risk; a large majority (≈79% in a large multinational survey) of Muslims with T2DM fast [48]	Practice guidance; observational studies [48,54]	Fasting duration varies by latitude and season; exemptions depend on individual risk	Individualised pre-Ramadan medical review; medication adjustment per guideline, with individual risk–benefit assessment for any agent; IDF-DAR risk stratification [54]
Family involvement (Asia, GCC)	Family may enable adherence or reinforce unhealthy traditional diets	Indirect: family components in culturally adapted education trials [16]; not tested in Asian/GCC included studies	Urban nuclear vs extended households; nationals vs expatriate workers living without family	Family-inclusive education sessions; involve key decision-maker (to be evaluated)
Traditional/complementary medicine use (Asia)	Patients may delay evidence-based care; herb–drug interactions possible	No included study	Varies by country, ethnicity and health-system integration	Non-judgmental enquiry at every visit; integrate into shared decision-making
Gender norms and privacy (GCC, parts of Asia)	Women may avoid mixed-gender clinics; may reduce screening uptake	No included study; contextual [11]	Differs between and within countries and over time	Same-gender healthcare providers; female diabetes educator programmes
Fatalistic health beliefs	'God's will' framing may reduce self-efficacy	No included study	Not specific to any region or religion; varies by individual	Spiritually sensitive counselling; community religious leader engagement
High-carbohydrate staple diets (Asia: rice, noodles)	Postprandial hyperglycaemia challenging to control	Low-GI trial evidence [42]; regional diet not quantified in included studies	Staple foods differ widely across Asia	Portion-control strategies; glycaemic index education; culturally adapted plate models
Economic disparities (South/Southeast Asia)	Out-of-pocket medication costs reduce adherence	Scoping review [12]; cross-national barriers [10]	Large differences between and within countries	Generic medication access; government subsidy advocacy; CHW programmes
Ultra-processed food transition (GCC)	Rapid nutritional transition associated with obesity and T2DM incidence	Contextual [11]	Differs by GCC state and population group	National food labelling policy; taxation on sugar-sweetened beverages
Stigma around diabetes (all regions	Concealment of diagnosis; delays in care-seeking	Not measured directly in included studies	Present in all regions; magnitude unknown	Anti-stigma community campaigns; peer support groups
High physical inactivity (GCC)	Hot climate, car-dependent culture, sedentary work	Contextual [11]	Differs by sex, nationality and occupation	Indoor exercise facilities; employer wellness programmes; step-counting apps

DM: Diabetes Mellitus, IDF-DAR: International Diabetes Federation and Diabetes and Ramadan International Alliance, SGLT2i: Sodium-Glucose Cotransporter-2 Inhibitor, GLP-1 RA: Glucagon-Like Peptide-1 Receptor Agonist, CHW: Community Health Worker. Contextual": Background Source not Included in the Synthesis. Suggested adaptations are expert/policy suggestions unless a reference is given

Table 6: Evidence-Based Complication Prevention Strategies and Regional Implementation Gaps

Complication	Screening Interval (guideline-recommended)	Key Prevention Strategy	Regional Gap Identified
Diabetic foot ulcer / amputation	Annual foot examination	Offloading, foot care education, podiatry referral	GCC: Podiatry access inequitable; Asia: Awareness low [12]
Diabetic nephropathy	Annual eGFR + urine ACR	SGLT2i, RAAS blockade, BP control < 130/80 mmHg	Asia: Late-stage presentation common; GCC: Improving
Diabetic retinopathy	Annual dilated fundus exam	Optimal HbA1c & BP; anti-VEGF for PDR; laser	Asia/GCC: Ophthalmology access gaps
Cardiovascular disease	Annual lipid profile, ECG	Statin therapy, antiplatelet, GLP-1 RA, SGLT2i	GCC: Underuse of cardioprotective agents
Diabetic peripheral neuropathy	Annual 10-g monofilament	Glycaemic control, pain management, balance exercises	All regions: Underdiagnosed in primary care
Hypoglycaemia (iatrogenic)	Continuous monitoring preferred	Individualised HbA1c targets; patient education on rescue glucose	Western: CGM adoption rising; Asia/GCC: Cost barriers
Diabetic ketoacidosis (T1DM)	Sick-day rules education	Sick-day rules; insulin never stopped; ketone testing	Asia/GCC: Sick-day rule knowledge low
Hypertension-related complications	Every visit BP measurement	ACEi/ARB first line; dietary sodium restriction	GCC: Sodium-rich traditional diet challenge

Egfr: Estimated Glomerular Filtration Rate; ACR: Albumin-To-Creatinine Ratio; CGM: Continuous Glucose Monitoring; PDR: Proliferative Diabetic Retinopathy; RAAS: Renin-Angiotensin-Aldosterone System; BP: Blood Pressure. Screening intervals based on ADA [3], and NICE NG28 [56]. Regional gaps without a citation are descriptive context, not derived from included studies and not graded

[48]. The IDF-DAR risk-stratification framework supports individualised management [54]. Current guidance favours glucose-lowering agents with a low risk of hypoglycaemia and individualised dose adjustment; sodium-glucose cotransporter-2 (SGLT2) inhibitors require attention to hydration because of the risk of volume depletion (and,

Table 7: SWOT Analysis of Diabetes Self-Care Systems: Asia, GCC, and Western Countries (Interpretive: Not Graded Evidence)

SWOT Domain	Asia	GCC	Western Countries
Strengths	Strong family/community networks; rapid digital adoption; large study populations	Government-funded healthcare for nationals; Vision 2030 digital health investment; low smoking rates	Mature DSME infrastructure; robust RCT evidence base; comprehensive guidelines
Weaknesses	Urban–rural access gap; limited podiatry/specialist services; cost barriers	Ethnic minority (expatriate) health inequity; cultural barriers to mixed-gender care; high obesity rates	Healthcare cost barriers (USA); insulin pricing; complacency in high-income populations
Opportunities	mHealth scale-up; community health worker integration; regional guidelines adaptation	National NCD strategies; telemedicine expansion; Ramadan intervention protocols	Precision medicine; CGM/artificial pancreas; personalised nutrition algorithms
Threats	Rapid nutritional transition; pharmaceutical access inequity; growing non-communicable disease burden	Sedentary lifestyle; ultra-processed food industry; limited academic research output	Health misinformation online; ageing population

DSME: Diabetes Self-Management Education, CGM: Continuous Glucose Monitoring, NCD: non-communicable disease. Author-generated interpretive summary, entries are not graded evidence and do not apply uniformly to all countries in a sphere

rarely, ketoacidosis) during fasting, and glucagon-like peptide-1 (GLP-1) receptor agonists are preferably established well before Ramadan because of gastrointestinal adverse effects [54,68]. These are guideline-based recommendations rather than findings of this review. Pre-Ramadan structured education is recommended, supported mainly by observational studies [48,54].

Family members may support medication adherence, dietary change and healthcare engagement, or may reinforce unhealthy habits [10]. Culturally appropriate education programmes, some of which involved family members, improved short-term glycaemic control compared with usual care, mainly among ethnic minority populations in Western countries [16]; whether family involvement itself drives benefit has not been tested in the included studies. Family structures also differ widely within Asia and the GCC—for example, between urban nuclear and extended households, and between national families and expatriate workers living apart from their families.

Economic factors intersect with cultural ones. In lower-income settings, out-of-pocket costs for medicines and monitoring are a recurrent barrier to self-management [12], although their magnitude varies widely between and within countries. Generic medication policies, subsidy programmes and community health worker-delivered education are commonly proposed responses [12]; their effects on self-care were not evaluated in the included studies.

Complication Prevention Strategies: A Cross-Regional Assessment

Preventing the major complications of diabetes—nephropathy, retinopathy, peripheral neuropathy, cardiovascular disease and diabetic foot disease—requires sustained self-care integrated with clinical monitoring. Table 6 summarises guideline-recommended screening intervals, key prevention strategies and reported regional gaps for each major complication domain.

UKPDS remains the landmark evidence for intensive glycaemic control, demonstrating a 25% risk reduction in microvascular endpoints with intensive glucose control [4], further benefit from tight blood-pressure control [5] and a legacy effect at 10-year follow-up [60]. Additional benefits from cholesterol management and, more recently, cardioprotective glucose-lowering medications such as SGLT2 inhibitors and GLP-1 receptor agonists were shown by subsequent trials [68]. Smoking cessation is associated with a lower risk of cardiovascular disease in adults with diabetes, despite post-cessation weight gain [69]. Annual complication screening is recommended by guidelines [3,56] and, in some Western countries, integrated into primary care quality frameworks and pay-for-performance schemes.

Late detection of complications in GCC countries has been described in contextual sources [11]. The nationwide SAUDI-DM household survey documented a substantial burden of diabetes and abnormal glucose metabolism in the Saudi population [58]. National initiatives such as Vision 2030's diabetes component and Saudi Arabia's Healthy Saudi Initiative aim to address this through community screening and primary care capacity-building.

In Asian contexts, the shortage of ophthalmologists, nephrologists and podiatrists relative to the high prevalence of diabetes, especially in South and Southeast Asia, limits complication prevention [12]. Task-shifting approaches, in which trained nurses, pharmacists and community health workers deliver standardised complication screening, are proposed as affordable and scalable options. India's National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS) is a large-scale attempt to integrate complication screening into primary healthcare.

Swot Analysis: Regional Self-Care Landscapes

The SWOT analysis in Table 7 is an interpretive, author-generated summary intended to structure policy discussion. It is not graded evidence, and each entry generalises across countries that differ substantially; it should be read alongside the within-region heterogeneity described in Section 8.2.

DISCUSSION

Principal Findings

This systematic review included 38 sources on diabetes self-care in Asia, the GCC/wider MENA and Western countries. Interventions with moderate-certainty evidence of benefit on glycaemic control—structured DSME, mobile-health support and telemedicine—were tested mainly in Western or multi-regional trials. Evidence on regional practice and

implementation came largely from cross-sectional studies using different instruments, and only two included primary studies came from GCC member states. Across the evidence base, the dominant pattern is heterogeneity: self-care practices, adherence and diabetes distress varied as much within spheres as between them.

Heterogeneity Within Regions

Each sphere is internally diverse. Asia spans high-income East Asian health systems with universal insurance and lower-income South and Southeast Asian settings with high out-of-pocket spending and large urban–rural gaps [12]; the included Asian studies (China, Republic of Korea, Vietnam, Bangladesh) cannot represent the continent as a whole. Within the GCC, national health systems, financing arrangements and the size of expatriate populations—who may have different entitlements, languages and living arrangements from nationals—differ between member states, and the wider MENA countries (Egypt, Palestine, Iran) differ again in income and health-system organisation. Western countries range from universal tax-funded systems to the insurance-based system of the USA, with persistent socioeconomic and ethnic-minority gaps [16]. Region-level labels therefore mask important variation, and the findings of this review should be interpreted at the level of countries and settings rather than continents.

Direct Versus Indirect Comparisons

Only one included study, the DAWN study, measured psychosocial barriers to self-care in several spheres (13 countries in Asia, Europe, North America and Australia) with a common method [10]. All other cross-regional contrasts in this review are indirect: they compare studies conducted in different populations (clinic attenders, community samples, older adults), with different instruments (e.g., MMAS-8, the Summary of Diabetes Self-Care Activities measure [70], different language versions of the Diabetes Distress Scale), in different years. Apparent differences may therefore reflect measurement and sampling rather than true differences in self-care. Piragine *et al.* illustrate the point: adherence estimates depended on whether administrative data or self-report were used [17]. For this reason, the previous version's statements that Western countries have the "highest" adherence and the GCC the "lowest" have been removed; the evidence does not support a ranking.

Comparison with Existing Reviews

Our findings are consistent with a recent GCC narrative review, published after our search cut-off, which synthesised 88 articles from 2020–2025 and reported fair but highly variable medication adherence, self-monitoring of blood glucose ranging from 14% to over 90% across studies, and generally inadequate foot-care knowledge [11]. They also agree with Maina *et al.*, who described cost, access and health-literacy barriers to complication-prevention practices in low- and middle-income countries [12]. Unlike these single-region reviews, the present review places the three spheres within one framework and separates efficacy evidence from implementation evidence, which makes explicit how little direct comparative evidence exists.

Recommendations

The following recommendations combine the findings of this review with guideline and expert opinion. Each is labelled E when it is supported by included evidence (with its certainty from Table 4) or P when it is an expert or policy recommendation based on guidelines or author judgement.

- E: DSME, moderate; cultural adaptation, low, P: family-inclusive and Ramadan components. Implement culturally adapted DSME programmes and evaluate them locally, with consideration of family-inclusive models in Asian and GCC settings where appropriate, and integration of Ramadan-specific counselling for Muslim patients. Programmes developed elsewhere should be adapted and evaluated before scale-up [2,8,16]
- E: mHealth Efficacy, Moderate, P: Population scale-up and equity frameworks Scale mHealth interventions, prioritising SMS-based reminders and low-bandwidth applications in resource-constrained settings. Governments in Asia and the GCC should establish digital health equity frameworks so that people without smartphone access or digital literacy are not excluded [13,14,18]
- P: Establish Ramadan diabetes management protocols as a standard component of national diabetes guidelines in the GCC and Muslim-majority Asian nations. Pre-Ramadan diabetes clinics, and structured risk stratification using IDF-DAR criteria should be institutionalised, with medication adjustment according to current guidelines and an individual risk–benefit assessment for any agent used during fasting, including SGLT2 inhibitors and GLP-1 receptor agonists [54,68]
- E: low-GI diets, low, P: materials and food-environment policy, create culturally appropriate nutritional counselling materials in regional languages and dialects that include local staple foods, traditional food systems and familiar meal patterns. Individual-level counselling may be complemented by food-environment policies such as taxes on sugar-sweetened beverages, front-of-pack labelling and public-institution food standards [42,45]
- P: Supporting Evidence Very Low, Address foot care as a priority in Asia and the GCC through training of primary care clinicians in annual foot examination, community foot-care education campaigns, and podiatry workforce development in GCC health systems [47,55]
- P: Implement task-shifting models for complication screening in under-resourced Asian settings, with trained nurses, pharmacists and community health workers delivering standardised retinopathy, nephropathy, neuropathy and foot screening [12]
- P: Research recommendation Commission comparative effectiveness research on self-care interventions across

the three spheres. Head-to-head trials evaluating the same DSME model in Western, GCC and Asian settings, and multinational surveys using common, validated self-care and adherence instruments, would substantially advance the evidence base [7,10]

- P Invest in anti-stigma campaigns to address diabetes-related social stigma, which may discourage diagnosis disclosure, care-seeking and medication adherence in all three regions

LIMITATIONS

This review has several limitations. (1) *No registered* protocol: the review was not prospectively registered, so post hoc methodological decisions cannot be excluded. (2) Language and databases: only English-language publications and three databases were searched; Embase, CINAHL and regional databases (e.g., the Index Medicus for the Eastern Mediterranean Region, CNKI, the Western Pacific Region Index Medicus) were not, which may under-represent Arabic- and Asian-language evidence. (3) Search structure: requiring complication/outcome or digital-health terms may have reduced sensitivity for relevant self-care studies, only partly mitigated by hand-searching. (4) Currency: the search was not updated after 1 September 2024, so more recent studies, including GCC studies summarised in a 2025 review [11], were not included. (5) Heterogeneous designs and populations: included sources differed in design, setting, population and period. (6) *Secondary evidence*: inclusion of systematic reviews and guidelines alongside primary studies risks double-counting; we mitigated this with separate evidence streams and overlap checks. (7) Indirect comparisons: almost all cross-regional comparisons were indirect. (8) Publication bias could not be assessed formally. (9) No quantitative pooling was possible, and the narrative synthesis involves judgement. (10) Variable definitions of self-care: instruments and cut-offs for adherence, self-management and distress varied. (11) Reviewer bias and incomplete process records: selection, extraction and appraisal involved judgement; screening was performed in duplicate, but inter-reviewer agreement was not quantified, the numbers of records excluded at the title/abstract and initial full-text stages were not retained, and methodological appraisal and GRADE ratings were completed at the revision stage rather than prospectively. (12) Sparse GCC evidence: only two included primary studies were from GCC member states, and some descriptions of regional health systems rely on contextual sources that were not graded.

CONCLUSIONS

This systematic review found that diabetes self-care awareness, practice and complication-prevention activity vary considerably both between and within Asia, the GCC/wider MENA and Western countries. Structured DSME and mobile-health support improve glycaemic control in trials (moderate-certainty evidence), but these trials were conducted mainly in Western or multi-regional settings, and their effects in GCC and many Asian settings remain uncertain. Because almost all cross-regional contrasts were indirect—drawn from studies with different populations, instruments and periods—this review does not establish a ranking of regions or health systems. The evidence instead points to heterogeneity and context-specific considerations, including Ramadan fasting, cost and access barriers, health-system organisation, and family and gender dynamics, each of which varies within regions.

Context-adapted self-care programmes should be evaluated locally with standardised outcome measures, and multinational studies using common validated instruments are needed to allow direct comparison. Strengthening primary research in GCC member states is a particular priority.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability

No original datasets were generated for this review. All data sources are cited in the reference list, and the extracted data are provided in Supplementary Appendices S4–S6.

Supplementary Material

Supplementary Appendices S1–S9 (database-specific search strategies; grey-literature search log; country-level geographic classification; characteristics and appraisal of included sources and list of contextual references; GRADE evidence profile; sources of numerical estimates; reference audit log; PRISMA 2020 checklist; list of sources excluded at the eligibility re-audit) are provided in a separate file.

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Supplementary Material

Diabetes Self-Care in Asia, the Gulf Cooperation Council and Western Countries: A Systematic Review with Narrative Synthesis

Manuscript JPMS332246 — Supplementary Appendices submitted in response to reviewer comments

Contents

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- S9. Sources excluded at the eligibility re-audit, with reasons

Appendix S1. Database-specific search strategies

The syntax below implements, for each database, the four concept blocks reported in Section 2.3 of the manuscript. All three databases were searched on 1 September 2024 for records published from 1 January 2000 to the search date. Limits: English language; humans (PubMed); article and review document types (Scopus, Web of Science). The search was not updated after 1 September 2024. The four concept blocks are those reported in Section 2.3 of the manuscript.

S1: 1 PubMed/MEDLINE (Interface: pubmed.ncbi.nlm.nih.gov)

Number	Search string
#1	"Diabetes Mellitus"(Mesh) OR "Diabetes Mellitus, Type 2"(Mesh) OR "diabetes mellitus"(tiab) OR "type 2 diabetes"(tiab) OR T2DM(tiab)
#2	"Self-Care"(Mesh) OR "Self-Management"(Mesh) OR "Patient Education as Topic"(Mesh) OR "Medication Adherence"(Mesh) OR "self-care"(tiab) OR "self-management"(tiab) OR "patient education"(tiab) OR adherence(tiab)
#3	"Asia"(Mesh) OR "Middle East"(Mesh) OR "Saudi Arabia"(Mesh) OR "United Arab Emirates"(Mesh) OR "Europe"(Mesh) OR "North America"(Mesh) OR Asia(tiab) OR "South Asia"(tiab) OR "Southeast Asia"(tiab) OR "East Asia"(tiab) OR "Gulf Cooperation Council"(tiab) OR GCC(tiab) OR "Saudi Arabia"(tiab) OR "United Arab Emirates"(tiab) OR "Middle East"(tiab) OR "Western countries"(tiab) OR Europe(tiab) OR "North America"(tiab)
#4	"Diabetes Complications"(Mesh) OR "Glycated Hemoglobin"(Mesh) OR "Diabetic Foot"(Mesh) OR "Diabetic Retinopathy"(Mesh) OR "Diabetic Nephropathies"(Mesh) OR "Telemedicine"(Mesh) OR "complication prevention"(tiab) OR "glycemic control"(tiab) OR HbA1c(tiab) OR "foot care"(tiab) OR retinopathy(tiab) OR nephropathy(tiab) OR "digital health"(tiab) OR mHealth(tiab)
#5	#1 AND #2 AND #3 AND #4
#6	#5 AND ("2000/01/01"(dp) : "2024/09/01"(dp)) AND English(lang) AND humans(mh)

S1: 2 Scopus (Interface: Scopus.Com, Advanced Search)

Number	Search string
1	TITLE-ABS-KEY("diabetes mellitus" OR "type 2 diabetes" OR T2DM)
2	TITLE-ABS-KEY("self-care" OR "self-management" OR "patient education" OR adherence)
3	TITLE-ABS-KEY(Asia OR "South Asia" OR "Southeast Asia" OR "East Asia" OR "Gulf Cooperation Council" OR GCC OR "Saudi Arabia" OR "United Arab Emirates" OR "Middle East" OR "Western countries" OR Europe OR "North America")
4	TITLE-ABS-KEY("complication prevention" OR "glycemic control" OR HbA1c OR "foot care" OR retinopathy OR nephropathy OR "digital health" OR mHealth)
5	1 AND 2 AND 3 AND 4 AND PUBYEAR > 1999 AND PUBYEAR < 2025 AND LANGUAGE(english) AND DOCTYPE(ar OR re)

S1: 3 Web of Science Core Collection (Interface: webofscience.com; All Editions)

Number	Search String
1	TS = ("diabetes mellitus" OR "type 2 diabetes" OR T2DM)
2	TS = ("self-care" OR "self-management" OR "patient education" OR adherence)
3	TS = (Asia OR "South Asia" OR "Southeast Asia" OR "East Asia" OR "Gulf Cooperation Council" OR GCC OR "Saudi Arabia" OR "United Arab Emirates" OR "Middle East" OR "Western countries" OR Europe OR "North America")
4	TS = ("complication prevention" OR "glycemic control" OR HbA1c OR "foot care" OR retinopathy OR nephropathy OR "digital health" OR mHealth)
5	#1 AND #2 AND #3 AND #4; Publication years 2000–2024 (to 1 Sept 2024); Language: English; Document types: Article, Review

Total records retrieved from the three databases: 5,305 (before de-duplication)

Appendix S2: Grey-Literature Search Log

Source	URL / repository searched	Date searched	Search terms	Outcome
World Health Organization	www.who.int/publications; IRIS (iris.who.int)	September 2024	diabetes AND (self-care OR self-management OR education)	No document met the eligibility criteria for inclusion as a source
International Diabetes Federation	www.idf.org (resources); www.diabetesatlas.org	September 2024	diabetes self-care; self-management; education; Ramadan	IDF Diabetes Atlas estimates used for epidemiological context [1,30]; IDF-DAR Ramadan guidance used to frame recommendations [54]; not counted as included sources
National Institute for Health and Care Excellence	www.nice.org.uk/guidance	September 2024	type 2 diabetes; type 1 diabetes; diabetic foot	NICE NG28 used to define recommended standards [56]; not counted as an included source
Reference lists of included sources and key reviews [2,12,16,17]	Backward citation screening	September 2024	n/a	Eligible sources identified in this way are within the 52 sources retained after screening (Figure 1)

Eligibility of guidelines and reports: issued by a national or international organisation; describes its evidence base or development method; reports recommendations or data on self-care, education or complication prevention in adults with diabetes; published January 2000–September 2024; English language

Appendix S3: Country-level Classification of Geographic Spheres

Sphere / subgroup	Countries and territories	Rule applied	Included sources
Asia – East Asia	China (incl. Hong Kong SAR, Macao SAR), Taiwan, Japan, Republic of Korea, Mongolia	UN M49 Eastern Asia	[51] China; [64] China; [59] Republic of Korea
Asia – South Asia	India, Pakistan, Bangladesh, Sri Lanka, Nepal, Bhutan, Maldives, Afghanistan	UN M49 Southern Asia (excluding Iran – see below)	[62] Bangladesh
Asia – Southeast Asia	Vietnam, Thailand, Malaysia, Singapore, Indonesia, Philippines, Myanmar, Cambodia, Lao PDR, Brunei, Timor-Leste	UN M49 South-eastern Asia	[61] Vietnam
GCC (core)	Saudi Arabia, United Arab Emirates, Kuwait, Qatar, Bahrain, Oman	GCC member states	[57] Saudi Arabia; [58] Saudi Arabia
Wider MENA (non-GCC)	Egypt, Jordan, Palestine, Lebanon, Syria, Iraq, Yemen, Iran, Libya, Tunisia, Algeria, Morocco, Sudan	IDF MENA region, excluding GCC; reported separately, not attributed to GCC	[49] Palestine; [55] Egypt; [50] Egypt; [66] Iran
Transcontinental	Turkey	IDF Europe region; geographically and culturally transcontinental; reported separately	[67] Turkey
Western countries	European Union and EFTA countries, United Kingdom, United States, Canada, Australia, New Zealand	Europe (IDF Europe region excluding Turkey and Central Asian states), North America, Australasia	[53,65,69,70] USA; [6,52] UK
Multi-regional	Studies or reviews spanning more than one sphere	Attributed to a sphere only when results reported by country	[10] DAWN (13 countries); reviews [12–15,17,18,42–44]

Central Asian states (e.g., Kazakhstan, Uzbekistan) and Israel: no eligible sources were identified; had any been found, they would have been reported separately as transcontinental/other

Appendix S4: Characteristics and Methodological Appraisal of Sources

Ref	Source	Stream	Design	Country / sphere	Population; n	Self-care domain / measure	Outcomes and main findings	Appraisal
6	Khunti 2012 (DESMOND)	A	Cluster RCT, 3-year follow-up	UK / Western	Newly diagnosed T2DM; 824 randomised, 207 practices; 604 with 3-year biomedical data	Structured group education vs usual care; HbA1c, illness beliefs	No HbA1c difference at 3 years (–0.02; 95% CI –0.22 to 0.17); illness beliefs improved	RoB 2: some concerns (attrition)

Appendix S4: Characteristics and Methodological Appraisal of Sources (Continue)

Ref	Source	Stream	Design	Country / sphere	Population; n	Self-care domain / measure	Outcomes and main findings	Appraisal
10	Peyrot 2005 (DAWN)	A	Cross-national survey	13 countries in Asia, Europe, North America, Australia / multi-regional	5,104 adults with diabetes; 3,827 providers	Psychosocial problems and barriers to self-management	Psychosocial problems common across countries; only direct cross-regional comparison in this review	JBI: moderate concern (sampling varied by country)
49	Sweileh 2014	A	Cross-sectional survey	Palestine (Nablus) / wider MENA	Adults with T2DM, governmental primary care clinic; n = 405	Medication adherence (MMAS-8); BMQ; MDKT	57.3% adherent; lower knowledge, weaker necessity beliefs and greater concerns associated with non-adherence	JBI: moderate concern (single site)
50	Azzam 2021	A	Cross-sectional survey	Egypt (Mansoura) / wider MENA	Adults with diabetes, 24 PHC facilities; n = 302	Glycaemic control; medication adherence; facility and physician factors	30.5% high and 51.3% medium adherence; education, exercise, guideline use and physician training associated with control	JBI: moderate concern
51	Huang 2014	A	Cross-sectional survey	China (Chengdu) / Asia	Adults with T2DM, 6 urban districts; n = 364	Self-management knowledge, beliefs, efficacy, support and behaviour (28-item scale)	46% "good", 45% "fair", 6% "poor" self-management behaviour	JBI: moderate concern (urban sample; local instrument)
52	Sturt 2008	A	Cluster RCT	UK / Western	Adults with T2DM in primary care; n = 245	Diabetes Manual 1:1 structured education; HbA1c, distress, confidence	No significant HbA1c difference; reduced distress and increased confidence	RoB 2: some concerns
53	Cebul 2011	A	Retrospective cohort	USA (Cleveland) / Western	Adults with diabetes, 46 practices; n = 27,207	EHR use; composite standards of care and outcomes	EHR practices achieved higher standards of care and outcomes	JBI: moderate concern (non-random practice selection)
55	Abo-Eata 2022	A	Descriptive cross-sectional	Egypt (Tanta) / wider MENA	Older adults with T2DM, university diabetes clinic; n = 230	Foot self-care practice; health locus of control	75.2% unsatisfactory foot self-care practice	JBI: moderate concern (single site; descriptive)
57	Batais 2021	A	Instrument validation	Saudi Arabia (Riyadh) / GCC	Adults with T2DM, university medical city; n = 109	Arabic Diabetes Distress Scale (SADDS-17)	$\alpha = 0.848$; test–retest 0.78; distress scores elevated	JBI: moderate concern (small single-site sample)
58	Al-Rubeaan 2014 (SAUDI-DM)	A	National household survey	Saudi Arabia / GCC	Population-based sample; n = 18,034	Diabetes and abnormal glucose metabolism; impact	Substantial burden of diabetes and abnormal glucose metabolism	JBI: low concern
59	Lee 2020	A	Instrument development	Republic of Korea / Asia	Adults with T2DM, 3 university hospitals and 1 health centre; n = 473	17-item Diabetes Self-Management Scale	Six-factor structure; good fit and internal consistency	JBI: low concern
61	Huynh 2021	A	Cross-sectional survey	Vietnam (Ho Chi Minh City) / Asia	Adults with T2DM, 3 district hospitals; n = 517	Diabetes Distress Scale (DDS-17)	23.6% moderate, 5.8% high distress; associated with age, duration, HbA1c, medication type	JBI: moderate concern
62	Kamrul-Hasan 2022	A	Cross-sectional survey	Bangladesh / Asia	Adults with T2DM, endocrinology clinics; n = 259	DDS-17; PHQ-9	52.5% distress (29.7% moderate, 22.8% high)	JBI: moderate concern

Appendix S4: Characteristics and Methodological Appraisal of Sources (Continue)

Ref	Source	Stream	Design	Country / sphere	Population; n	Self-care domain / measure	Outcomes and main findings	Appraisal
64	Jiang 2020	A	Controlled trial vs non-exercising controls (randomisation not reported)	China / Asia	Adults aged 60–69 y with T2DM; n = 49 (24 women, 25 men)	Supervised aerobic exercise at maximal fat-oxidation intensity, 1 h/day, 3 days/week, 16 weeks; glycaemic control, body composition	Improved glycaemic control, body composition, lipid profile and physical capacity vs controls	JBI (quasi-experimental): moderate concern (allocation method not reported)
65	Beck 2017 (DIAMOND)	A	Randomised controlled trial	USA / Western	Adults with T1DM on multiple daily injections; n = 158	CGM vs usual care; HbA1c at 24 weeks	Greater HbA1c reduction with CGM (≈0.6 pp difference)	RoB 2: some concerns (open label)
66	Azadbakht 2020	A	Cross-sectional survey	Iran / wider MENA	Older adults with T2DM, Tehran; sample size not reported in the indexed abstract record	Diabetes distress	Prevalence of distress and predictors (comorbidity, body mass index, disease duration, sex, sedentary lifestyle) examined	JBI: moderate concern (cross-sectional; details limited in indexed record)
67	Telci Caklili 2020	A	Instrument validation	Turkey (Istanbul) / transcontinental	Adults with T2DM, university clinic; n = 205	Turkish DDS-17	α = 0.874; 30% with score ≥3; weak correlation with HbA1c	JBI: moderate concern
69	Clair 2013	A	Prospective cohort (Framingham Offspring)	USA / Western	Adults with and without diabetes; n = 3,251	Smoking cessation, weight change, CVD	Cessation associated with lower CVD risk despite weight gain; estimates in diabetes subgroup imprecise	JBI: low concern
70	Toobert 2000	A	Instrument validation (7 studies)	USA / Western	Adults with diabetes; n = 1,988 across 7 studies	Summary of Diabetes Self-Care Activities (SDSCA)	Revised SDSCA with acceptable reliability and validity	JBI: low concern
2	Norris 2001	B	SR of RCTs	Mainly USA / Western	72 RCTs of self-management training in T2DM	Knowledge, SMBG, diet, glycaemic control	Positive short-term effects; long-term evidence limited	AMSTAR 2: low
7	Pillay 2015	B	SR and network MA	Mainly Western / Western	132 RCTs of behavioural programmes for T2DM	HbA1c and other outcomes	Programmes with >10 contact hours generally reduced HbA1c by >0.4 pp; brief DSME without added support gave little benefit	AMSTAR 2: high
12	Maina 2023	B	Scoping review	LMICs (incl. Asia) / multi-regional	Studies of complication-prevention self-management in T2DM	Self-management practices, barriers	Cost, access and health-literacy barriers commonly reported	Scoping review: reporting adequate (AMSTAR 2 not applicable)
13	Liang 2011	B	MA of RCTs	Multi-regional	RCTs of mobile-phone interventions	HbA1c	Pooled reduction ≈0.5 pp; larger in T2DM	AMSTAR 2: low
14	Hou 2016	B	SR/MA of 14 RCTs with GRADE	Multi-regional	1,360 participants	HbA1c	−0.49 pp (95% CI 0.30–0.68); moderate-certainty evidence	AMSTAR 2: moderate
15	Wang 2017	B	SR	Multi-regional	Studies of mHealth for obesity and diabetes	Self-management outcomes	Generally favourable effects; heterogeneous designs	AMSTAR 2: critically low

Appendix S4: Characteristics and Methodological Appraisal of Sources (Continue)

Ref	Source	Stream	Design	Country / sphere	Population; n	Self-care domain / measure	Outcomes and main findings	Appraisal
16	Hawthorne 2008	B	Cochrane SR/MA	Mainly UK/USA / Western	11 RCTs in ethnic minority groups	Culturally appropriate education; HbA1c, knowledge	Short-term HbA1c improvement vs usual care	AMSTAR 2: high
17	Piragine 2023	B	SR/MA	Global / multi-regional	156 studies (87 cohort, 69 cross-sectional); >10 million patients	Adherence to oral antidiabetic drugs	54% adherent (95% CI 51–58%); adherence associated with glycaemic control (OR 1.33)	AMSTAR 2: moderate
18	Tchero 2019	B	MA of 42 RCTs	Multi-regional	RCTs of telemedicine in diabetes	HbA1c	Modest reduction vs usual care	AMSTAR 2: low
41	Malanda 2012	B	Cochrane SR/MA	Mainly Europe / Western	RCTs of SMBG in non-insulin-treated T2DM	HbA1c, well-being	Small reduction at ≤6 months; not sustained at 12 months	AMSTAR 2: high
42	Brand-Miller 2003	B	MA of RCTs	Multi-regional	14 studies; n = 356	Low- vs high-GI diet; HbA1c	−0.43 pp	AMSTAR 2: low
43	Lane 2020	B	SR/MA of observational studies	Multi-regional	Observational studies of patients with DFU	Glycaemic control and ulcer outcomes	Associations examined; observational evidence	AMSTAR 2: moderate
44	Sartore 2023	B	MA	Multi-regional	Studies of HbA1c variability in T2DM	Macro-/microvascular complications	HbA1c variability associated with complications	AMSTAR 2: low
3	ADA 2024	C	Clinical practice guideline	USA / Western	—	Standards of care incl. screening intervals, CGM	Recommended standards	AGREE II: high
9	Colberg 2016	C	Position statement	USA / Western	—	Physical activity	≥150 min/week aerobic + resistance training	AGREE II: moderate
45	ADA 2023 (Section 5)	C	Clinical practice guideline	USA / Western	—	DSMES, nutrition, physical activity, smoking cessation	Standards for health behaviour support	AGREE II: high
46	Gómez-Peralta 2024	C	Expert consensus proposal	Spain / Western	—	Phenotype- and stage-based management	Expert management proposal	AGREE II: low
47	Bus 2016 (IWGDF)	C	International guidance	International / multi-regional	—	Foot-ulcer prevention	Foot inspection, footwear, education; limited evidence for education alone	AGREE II: high
48	Ahmed 2020	C	Practice update / consensus	UK-based, international scope / multi-regional	—	Ramadan and diabetes	Risk stratification, education, medication adjustment	AGREE II: low–moderate

DFU = diabetic foot ulcer; EHR = electronic health record; GI = glycaemic index; LMICs = low- and middle-income countries; MA = meta-analysis; pp = percentage points; SR = systematic review. Part A. Included sources (n = 38). Stream A = primary study; B = systematic review/meta-analysis/scoping review; C = guideline/consensus statement. Appraisal tools: RoB 2 (randomised trials); JBI checklists (cohort, cross-sectional, validation studies); AMSTAR 2 overall confidence (systematic reviews; scoping review appraised for reporting only); AGREE II overall (guidelines). Appraisal was completed at the revision stage

Part B: Contextual references (n = 14) and references added at revision (n = 18). These are cited for background or methods only. They are not included sources and did not contribute to the tables of findings or certainty ratings.

Ref	Source	Type	Reason not included as a source
11	Thirunavukkarasu 2025	Narrative review of GCC self-management	Published after search cut-off; narrative review
19	Puzhakkal 2025	Conceptual review	Published after search cut-off; conceptual (ineligible design)
22	Mogale 2025	Primary-care barriers study	Published after search cut-off; South Africa (outside spheres)
30	Saeedi 2019	IDF Atlas 9th-edition estimates	Epidemiological background; superseded by 2021 estimates [1]
31	Obici 2003	Basic-science review	Not a self-care study

Part B: Contextual references (n = 14) and references added at revision (n = 18). These are cited for background or methods only. They are not included sources and did not contribute to the tables of findings or certainty ratings

Ref	Source	Type	Reason not included as a source
32	Al-Dwaikat 2023	Concept analysis	Conceptual (ineligible design)
33	Zimmet 2001	Commentary on epidemic	Epidemiological background; narrative
34	Colagiuri 2005	Commentary on epidemic	Epidemiological background; narrative
35	Schwingshackl 2015	MA of Mediterranean diet and risk of diabetes	Population without diabetes (criterion i)
36	Brickwood 2019	MA of wearable trackers	Population not restricted to diabetes
37	Greenhalgh 2004	Organisational innovation review	Not diabetes-specific
38	Caron 2023	Health promotion overview	Not diabetes-specific
39	Gill 2009	Regional perspective	Sub-Saharan Africa (outside spheres); narrative
40	Zoungas 2014 (ADVANCE-ON)	RCT follow-up	Pharmacological only; no self-care component
1, 4, 5, 8, 54, 56, 60, 63, 68	IDF 2021; IDF-DAR 2021; Norris 2002; UKPDS 33/38; Holman 2008; Pan 1997; ADA/EASD 2022; NICE NG28	Added at revision	To support specific statements with correct primary sources (reference audit, Appendix S7)
20, 21, 23–29	PRISMA 2020; GRADE; ESRC narrative synthesis; SWiM; Murad 2017; AMSTAR 2; RoB 2; JBI; AGREE II	Methods references	Reporting and appraisal methods

Appendix S5: GRADE Evidence Profile: Domain-By-Domain Judgements

Outcome / comparison	Sources	Design (start)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Upgrade	Certainty	Explanation
1. DSME → HbA1c	[2,6–8]	RCTs (high)	0	−1	0	0	Undetected	None	Moderate	Effects vary between trials and attenuate after the intervention ends; DESMOND showed no 3-year difference.
2. Culturally appropriate education → HbA1c	[16]	RCTs (high)	−1	0	−1	0	Undetected	None	Low	Trials at unclear risk of bias; populations mainly ethnic minorities in Western countries; not tested in Asian or GCC health systems.
3. Mobile phone / app → HbA1c	[13–15]	RCTs (high)	−1	0	0	0	Undetected	None	Moderate	Unblinded trials with short follow-up; consistent direction of effect.
4. Telemedicine → HbA1c	[18]	RCTs (high)	0	−1	0	0	Undetected	None	Moderate	Heterogeneous interventions and effect sizes.
5. SMBG (non-insulin T2DM) → HbA1c	[41]	RCTs (high)	−1	0	0	−1	Undetected	None	Low	Small effect not sustained beyond 6 months; clinical relevance uncertain.
6. CGM (T1DM, injections) → HbA1c	[65]	RCT (high)	0	n/a	0*	−1	n/a	None	Moderate	Single trial; *indirect for T2DM and non-Western settings.

Appendix S5: GRADE Evidence Profile: Domain-By-Domain Judgements

Outcome / comparison	Sources	Design (start)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Upgrade	Certainty	Explanation
7. Low-GI diet → HbA1c	[42]	RCTs (high)	−1	0	0	−1	Undetected	None	Low	Small, short trials.
8. Structured exercise → glycaemic control	[9,64]	Non-randomised controlled trial (low)	0	n/a	0	0	n/a	None	Low	One 16-week controlled trial (n = 49) with non-exercising controls; direction of effect consistent with the ADA position statement.
9. Foot-care education → ulcer/amputation	[43,47]	Mixed	−1	0	−1	−1	Undetected	None	Very low	Limited trial evidence for education alone; observational data on glycaemic control only.
10. Pre-Ramadan education → adverse events	[48,54]	Observational (low)	−1	0	0	0	Undetected	None	Very low	Uncontrolled or unadjusted observational studies.
11. Cross-regional differences in practice/adherence/distress	[10,49–51,55,57–59,61,62,66,67]	Observational (low)	0	−1	−1	0	Undetected	None	Very low	Indirect comparisons across different instruments, populations and years; only DAWN offers a direct comparison.

Ratings follow GRADE [28] and, where no single pooled estimate was available, Murad et al. [29]. "0" = not serious; "−1" = serious; "−2" = very serious

Appendix S6: Sources of Numerical Estimates in Table 2 and Values Removed

Table 2 row	Value	Source	Population and year	Status
Prevalence – MENA	18.1%	IDF Diabetes Atlas 10th ed. [1]	Adults 20–79 y; age-adjusted comparative prevalence; 2021; MENA region incl. non-GCC countries	Replaces "~17.3%" (source not traceable)
Prevalence – South-East Asia	10.0%	[1]	As above; IDF SEA region (incl. India, Bangladesh, Sri Lanka)	Replaces "~11.9%"
Prevalence – Western Pacific	9.9%	[1]	As above; IDF WP region (incl. China, Japan, Korea, Vietnam, Australia)	New
Prevalence – Europe	7.0%	[1]	As above; IDF Europe region	Replaces "~10.8%"
Prevalence – North America & Caribbean	11.9%	[1]	As above; IDF NAC region	New
Adherence – global	54% (95% CI 51–58%)	Piragine 2023 [17]	156 studies, 2011–2022; mixed measures	Replaces regional ranges
Adherence – Palestine	57.3% adherent	Sweileh 2014 [49]	n = 405; MMAS-8; 2012 data collection	New
Adherence – Egypt	30.5% high; 51.3% medium	Azzam 2021 [50]	n = 302; primary care, Mansoura	New
Foot care – Egypt	75.2% unsatisfactory	Abo-Eata 2022 [55]	n = 230 older adults; Tanta	New
Adherence ranges	52–68% (Asia); 42–61% (GCC); 65–78% (Western)	Previously attributed to [6,7,11,17,49,52]	—	Removed: cited sources do not report these ranges
Amputation rates	3.1–6.4; 4.5–8.1; 1.9–3.8 per 1,000	Previously attributed to [30,47,50,57,66]	—	Removed: not reported in cited sources; no defined population or period
Regional GRADE labels	Moderate / Low-moderate / High	—	—	Removed: certainty now rated per outcome (Table 4)

Other numerical statements corrected in the text: Norris DSME effect (0.74% → 0.76 pp, 95% CI 0.34–1.18, attributed to Norris 2002 [8]); mHealth pooled effect (0.49 pp attributed to Hou 2016 [14], not Wang 2017); wearable trackers (1,200 steps/24 RCTs → ≈627 steps/28 RCTs [36], general population); Da Qing (33% → 31%, 46% and 42% by arm [63]); UKPDS (25% microvascular risk reduction with intensive therapy [4], not "per 1% HbA1c"). Unverifiable figures were removed: Hong Kong adherence 64.3%; WHO STEPwise inactivity >70%; household medication spending 20–30%; SAUDI-DM comorbidity 39.8%.

Appendix S7: Reference Audit Log

Ref / Location	Issue Identified	Action Taken
[3] ADA Standards 2024	Incorrect/incomplete DOI "10.2337/dc24-Sint"; outdated title ("Standards of Medical Care")	Corrected to "Standards of Care in Diabetes—2024", Diabetes Care 2024;47(Suppl 1):S1–S321, with supplement URL and Introduction DOI 10.2337/dc24-SINT
Original refs 8–9 (Puzhakkal 2025; Sweileh 2014)	Line break in the DOI of the first entry made it run into the second	Reformatted as separate entries
[45]	"Supple 1"; cited in text for IDF statistics it does not contain	Corrected to "Suppl 1"; IDF statistics now cited to [1]
[55], [50], [57], [32], [43]	Non-Vancouver formatting; garbled author list in [43] (e.g., "Library W.M., Core D.M., Therapy E."); wrong journal ("HHS Public Access")	Reformatted; [43] corrected to J Diabetes Complications 2020;34(10):107638
[7] Pillay 2015	Cited as Cochrane review CD010967	Corrected to Ann Intern Med 2015;163(11):848–60 (132 RCTs; verified against the published record)
[46]	"ofthe"; "1 Clin Med"	Corrected to "of the"; "J Clin Med"
[19], [22], [11]	Published 2025, after search cut-off	Reclassified as contextual references (Methods 2.3; Appendix S4 Part B)
Old Table 2	Cited works absent from reference list or with wrong details (Norris 2002; Liang Diabetes Care 2011; Schwingshackl Nutrients 2017; Bus 2016 pp.136–61; Sturt 2010; Clair BMJ 2015; Turner 1998; Tchero JMIR 2019)	Table restructured; citations now point to numbered reference-list entries; Norris 2002 and UKPDS 38 added [5,8]
Text: "Al-Jaghbeer and colleagues" [11]	Name does not match [11]	Sentence removed; [11] described as a post-cut-off narrative review
Text: "Al Mansouri and colleagues" [61]; "Ebrahim and colleagues" [67]	[61] and [67] are diabetes-distress studies	Attributed to Ahmed 2020 [48] and IDF-DAR 2021 [54]
Text: "Al Hayek and colleagues" [66]	[66] is an Iranian distress study	Sentence removed
Text: Da Qing [32]; UKPDS [12,43,59]; "Wang 0.49%" [15,38]; DSME [18,35,41,47,65]; PA [11,14,22,55]; barriers [70]; digital [12,69]	Citation does not support the statement	Re-cited to [63]; [4,5,60]; [14]; [2,6–8]; [9]; [10]; [13–15]
Text: NICE NG28 [59]	[59] is a Korean scale study	NICE NG28 added as [56]
Text: "[,20]"	Typographical error	Corrected to [12]
Text: "Table 6 summarises…"	No Table 6 for this content	Corrected to Table 3
All in-text citations	Checked against reference list for accuracy, relevance, date and support of claim	Unsupported claims removed or reworded; descriptive context marked § in tables

All references have been renumbered consecutively in order of first citation in the revised manuscript (1–70). Bracketed numbers in this log refer to the renumbered reference list