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Abstract

Background: Exercise plays a critical role in managing diabetes, improving glycemic control, and reducing the risk of cardiovascular complications. However, personalizing exercise prescriptions (PEPs) to address individual characteristics and preferences is challenging, particularly in an environment with a global shortage of exercise professionals. While digital tools hold promise for improving personalized care, many existing systems rely on generalized guidelines or expert consensus, lacking the ability to provide highly individualized and evidence-based recommendations. To address this gap, we developed PEP-DSS-DBC1.0, a knowledge-based digital decision support system for generating tailored PEPs in diabetes care.

Objective: The aim of this study was to create a digital, knowledge-based decision support tool for personalized exercise prescriptions that incorporates individual characteristics and preferences. PEP-DSS-DBC1.0 was designed to enhance the precision and usability of PEPs for people with diabetes while ensuring alignment with evidence-based principles.

Methods: The development of PEP-DSS-DBC1.0 was informed by an extensive review of the literature. A working group, including experts in exercise medicine, diabetes care, and informatics, was formed to establish a decision support framework. The PubMed database served as the primary resource for knowledge extraction, covering studies published between January 1975 and May 2023. Data from 938 studies were annotated, resulting in 1,171 exercise protocols, 10,316,497 patient records, and 2,904 additional entries, totaling 13,263 data points. The web-based tool was built using a browser/server architecture and the WIMA (Windows, IIS, MySQL, ASP.NET) web stack. Validation and comparative analysis of the tool were performed against ChatGPT4o and sports physicians, using multiple metrics and two rating scales: the System Usability Scale (SUS) and the Net Promoter Score (NPS).

Results: PEP-DSS-DBC1.0 provides personalized exercise prescriptions based on the newly developed “FITT-VP-WC” principles, which include frequency, intensity, time, type, volume, progression, warning, and contraindication. The tool demonstrated superior performance compared to ChatGPT4o and sports physicians, achieving a total performance score of 100%

compared to 48% for ChatGPT4o and 12% for sports physicians (?2=853.3, P<.001). Usability assessments showed that the average SUS score was 77.25 ± 6.06, indicating above-average usability, while the NPS score was 68.75%, reflecting high user loyalty and satisfaction. The tool is freely accessible at http://PEP-DSS-DBC.sysbio.org.cn/.

Conclusions: PEP-DSS-DBC1.0 represents a significant advancement in diabetes care, providing a knowledge-based system for generating highly individualized exercise prescriptions. While the tool has demonstrated superior performance and usability, future randomized controlled trials are essential to further validate its clinical utility and broader application in diabetes management.

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Keywords: Decision Support System; Exercise; Non-Drug Prescription; Diabetes Mellitus; Knowledge Bases

Introduction

Engaging consistently in physical activity (PA) plays a critical role in preventing and slowing the progression of diabetes mellitus (DM). This proactive approach is promising for improving health outcomes, particularly through optimizing glycemic control and reducing the risk of cardiovascular disease (CVD).[1, 2] Although current guidelines provide varied recommendations and precautions regarding PA for different types of diabetes,[3-10] they often apply a general framework that can lead to low adherence.[11-13] Emerging evidence highlights the need for personalized exercise prescriptions rather than one-size-fits-all approaches. For instance, different exercise modalities show distinct benefits for diabetes management, particularly in terms of energy expenditure and glucose reduction. Walking is associated with lower energy expenditure and a lower risk of hypoglycemia, while activities like cycling and running/jogging involve higher energy expenditure and more significant glucose depletion.[14] Among middle-aged and elderly individuals with prediabetes, the prevalence of complications, comorbidities, and physical limitations is notable.[15] Like the general population, individuals with diabetes face barriers to PA, including time, resources, and energy constraints, which are among the most frequently cited obstacles.[16] Additionally, hypoglycemia and the fear of it impose a substantial burden on those living with diabetes.[17] While reducing basal insulin doses during exercise to lower the risk of post-exercise nocturnal hypoglycemia is a standard recommendation, prior guidance may have lacked the specificity needed to foster better practices and adherence.

Customizing exercise prescriptions to fit individual patient preferences and health profiles can address the unique needs of each patient. However, the demand for efficient solutions in developing exercise prescriptions that target multiple risk factors and comorbidities presents significant challenges for clinicians. In a global context where healthcare professionals are in short supply,[18] digital health decision support systems show considerable promise in enhancing personalized exercise regimen planning. The European Association of Preventive Cardiology recently introduced a digital training and decision support system to optimize exercise prescriptions for patients with CVD.[19] Following this, a new clinical decision support tool, P3-EX, was developed to tailor exercise recommendations based on guidelines from the American College of Sports Medicine (ACSM) and the American Heart Association, specifically for patients with multiple CVD risk factors.[20] A growing body of research supports the effectiveness of digital technologies in improving diabetes management and decision support.[21] Personalized exercise programs based on remote assessments of motor fitness have demonstrated that digital tools can effectively guide tailored, home-based exercise regimens, resulting in high adherence and enhanced fitness outcomes in adults over 65.[22] However, many endorsements for digital technologies rely on expert consensus, grounded more in experience and knowledge than in data-driven methodologies, limiting the traceability and transparency of decision-making processes. Additionally, the development of digital tools specifically designed for exercise prescriptions in diabetes remains an underexplored area in the literature.

To bridge these gaps in diabetes care, we conducted a study to develop a digital decision support system for personalized exercise prescription (PEP). By leveraging an extensive diabetes PA knowledge database, our tool enables the creation of customized exercise plans tailored to the unique profiles of individuals with diabetes.

Methods

Working Group Setting

The interdisciplinary working group included endocrinologists, sports physicians, healthcare practitioners, computer scientists, and medical informatics specialists, collectively responsible for the comprehensive design and execution of the study. Each group member received structured training in exercise prescription for diabetic patients through the Chinese Sports Rehabilitation Medicine Training Project, aligned with the Chinese instructor training course from the American College of Sports Medicine’s Sports Prescription Physician Certification Program.

Data Resource and Collection

We conducted a systematic search of the PubMed database to identify peer-reviewed studies published in English up to May 1, 2023, as the primary source for knowledge extraction. The search strategy employed in the PubMed database was defined as follows: "(diabetes*[ti]) AND (Physical activit*[ti] OR Sport*[ti] OR exercise*[ti] OR physical training*[ti] OR build up*[ti]) 1900:2023/05/01*[pdat]". Subsequently, a manual review of 938 articles led to the identification and organization of pertinent knowledge bases. The flowchart for the collection of studies can be found in Multimedia Appendix 1.

Based on our team's Exercise Medicine Ontology and in-depth discussions, we selected information specific to diabetes and exercise prescriptions to develop a comprehensive knowledge base. This base includes nine tables: Reference information, DM information, Health baseline information, Laboratory testing information, Exercise risk assessment, Physical fitness evaluation, PA intervention protocol, PA effect evaluation, and PA adverse events. These tables cover 111 variables, each accompanied by a detailed definition and standardization protocol. For more information, please refer to the help page on the designated website. In line with classification standards from the ACSM and expert consensus,[23] we categorized exercises into five types: aerobic (cardiorespiratory endurance), resistance, flexibility (stretching), neuromotor, and combination exercises (which involve two or more types).

Knowledge Base Design

The database web platform is built on a browser/server architecture using the WIMA (Windows, IIS, MySQL, ASP.NET) web stack. This architecture is organized into three layers: the data layer, the business layer, and the presentation layer. The data layer utilizes the MySQL database management system for efficient data storage and retrieval. The business layer, developed with the ASP.NET MVC framework in C#, manages all system functions, including search engines, data visualization, and PEP recommendation tools. The presentation layer, implemented with HTML, JavaScript, and the Bootstrap framework, ensures a user-friendly interface. For a visual overview of the system's structure, please refer to Multimedia Appendix 2.

Generation of Personalized Exercise Prescription

The PEP-DSS-DBC1.0 platform includes five main pages: "Home," "Browse," "Search," "Personalized Exercise Prescription," and "Help" (Figure 1). The "Personalized Exercise Prescription" page (Figure 2) provides access to a digital decision support system tailored for diabetes care. Following the ACSM's exercise prescription framework, our system evaluates user-input information across four steps (Figure 2A): "Health Baseline Information", "DM and Cardiovascular Risks Information", "Exercise Preparticipation Health Screening Questionnaire"[24] and "Desired Health Outcomes/Exercise Goals". Based on this evaluation, a knowledge-guided PEP is generated to support informed decision-making.

The PEP reference page (Figure 2B) includes three sections: "Personalized exercise prescription (Reference list)", "Personalized exercise prescription" and "Adverse events and prevention protocol". Within the "Personalized exercise prescription" section, there are four key components: "Base Information", "10-Year Risk of Coronary Heart Disease", "Medical Clearance" and "Recommended Personalized Exercise Prescription". The "Base Information" encompasses key demographic variables such as sex, age, height, weight, basal metabolic rate (BMR),[25] maximum resting heart rate (HRmax),[26] reserve heart rate (HRR), target heart rate (THR). The "Hard-Coronary-Heart-Disease-10-Year-Risk" section applies the Framingham Heart Study algorithm to user-provided data to calculate an individual's 10-year risk of hard coronary heart disease.[27] The

"Medical Clearance" segment adheres to the professional sports risk screening guidelines outlined by the ACSM.[23] The "Recommended Personalized Exercise Prescription" exhibitions the top 3 personalized exercise reference protocols for users based on $Score_{total}$. A description of the scoring algorithm for $Score_{total}$ can be found in the Multimedia Appendix 3.

The Validation and Comparison of the Tool

A total of 49 adults with diabetes were recruited from the outpatient department of the Health Management Center at West China Hospital, with informed consent obtained from each participant. Health data were sourced from their medical records of physical examinations. Four sports physicians provided verbal exercise instructions on-site, simultaneously collecting the patients' exercise expectations.

We organized the core patient data within the PEP-DSS-DBC1.0 and ChatGPT-4o frameworks. Questions, such as "exercise prescription for patient (male, xx years old, xx cm, xx kg, BMI: xx, overweight, HRrest: xx beats/min, T2DM, No DM complications, Duration of diagnosed T2DM: xx years, TC (mg/dL): xx, HDL (mg/dL): xx, SBP: xx mmHg, Smoker, Sedentary: No)," were used to query ChatGPT-4o. The exercise prescriptions generated by sports physicians, PEP-DSS-DBC1.0, and ChatGPT-4o were then compared and evaluated.

In addition, the same four sports physicians, along with 16 students from the West China School of Public Health at Sichuan University, evaluated the usability, user loyalty, and satisfaction of the PEP-DSS-DBC1.0. The modified System Usability Scale (SUS)[28, 29] and Net Promoter Score (NPS)[30] were utilized for assessing the platform's usability and user loyalty. The reporting of this study follows the guidelines in.[31]

Statistical Analysis

Descriptive statistics were employed to analyze the annotation data. Proportions were calculated to represent the coverage ratio of each demographic subgroup, with results expressed as percentages, medians (interquartile range, IQR), or minimum and maximum values. Comparisons among PEP-DSS-DBC1.0, sports physicians, and ChatGPT-4o were conducted using $R \times C$ χ^2 test or Fisher's exact test. Means between two groups were compared using independent sample t-tests.

Equity, diversion and inclusion statement

The validation and comparison of the tool, conducted in 49 adults with diabetes, 4 sports physicians and 16 students. However, we acknowledge that we did not evaluate the effects of race/ethnicity and marginalized groups as we did not obtain these data. The author team includes both junior and senior researchers and both men and women.

Ethics approval

The validation and comparison of the tool received approval from the Ethics Committee of West China Hospital, Sichuan University, in 2022 (Approval No. 1999).

Results

Applicable Population Characteristics

PEP-DSS-DBC1.0 comprises data from 938 studies, covering 1,171 physical activity (PA) protocols, 10,316,497 patient records, and 2,904 additional entries, amounting to a total of 13,263 data points. Female-only data accounts for 6.01%, male-only data for 3.93%, and data covering both genders for 90.06%. Most of the data pertains to adults (64.95%), followed by older adults (30.00%) and children/adolescents (5.05%). In terms of BMI, overweight individuals represent the largest group (40.53%). Among cardiovascular risk factors, age-related risks are present in 73.76% of cases, with smoking (15.46%), hypertension (23.21%), sedentary lifestyle (2.38%), and lipid metabolism disorders (39.02%) also noted. Type 2 diabetes is the most prevalent condition (60.17%), with 6.95% of individuals having diabetes-related complications. The majority of patients have been diagnosed for 2 to 9 years (43.47%), followed by those with 10 or more years since diagnosis (38.00%), and newly diagnosed individuals (≤1 year) (18.53%). The demographic characteristics of the population in PEP-DSS-DBC1.0 are summarized in Table 1.

Table 1. Applicable population characteristics.

Characteristics	Percentage
Sex	
Female-only	6.01%
Male-only	3.93%
Female and male	90.06%
Age group	
Children and adolescents	5.05%
Adults	64.95%
Older adults	30.00%
BMI group	
Underweight (<18.5 kg/m2)	1.46%
Healthy weight (18.5–24.99 kg/m2)	22.05%
Overweight (25–29.99 kg/m2)	40.53%
Obese (≥30 kg/m2)	35.96%
Cardiovascular risk factors	
Age (male≥45, female≥55)	73.76%
Smoke (current smoker or the quit smoking time less than 6 months or second smoking)	15.46%
Hypertension (SBP≥140 mmHg or/and DBP≥90 mmHg)	23.21%
Sedentary	2.38%
Lipid metabolism disorder (TC, TG, LDL-C, HDL-C)	39.02%
Diabetes mellitus type	
IFG	1.05%
IGT	2.29%
GDM	4.68%
non-DM	9.65%
T1DM	22.16%
T2DM	60.17%
Diabetes mellitus complication	6.95%
Duration of diagnosed years	
Newly diagnosed (≤1 years)	18.53%

2 - 9 years	43.47%
≥10 years	38.00%
Using continuous glucose monitoring devices	5.89%

Abbreviations: BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; TC, total cholesterol; TG, triglyceride; LDL-C, low-density lipoprotein cholesterol; HDL-C, high-density lipoprotein cholesterol; IFG, impaired fasting glucose; IGT, impaired glucose tolerance; GDM, gestational diabetes mellitus; non-DM, non-diabetes mellitus; T1DM, type 1 diabetes mellitus; T2DM, type 2 diabetes mellitus.

Characteristics of PA protocols

A total of 1,171 PA protocols were extracted from articles, each containing 23 elements, with detailed information accessible on the website's "Help" page. Of these protocols, 157 (13.41%) required an exercise risk assessment prior to implementation, 800 (68.32%) required medical supervision during implementation, and 494 (42.19%) involved exercise intensity monitoring. The majority of PA protocols focused on aerobic (cardiorespiratory endurance) exercises (68.49%), followed by resistance (14.44%), combined (15.14%), flexibility (stretching) (0.77%), and neuromotor exercises (1.16%).

This study introduced the "FITT-VP-WC" principles for PA protocols, covering Frequency, Intensity, Time, Type, Volume, Progression, Warning, and Contraindications—eight of the 23 protocol elements. The knowledge base includes 512 records of PA contraindications and 409 of special considerations. PA outcomes were divided into two primary groups: beneficial health outcomes (13 types) and adverse event prevention (6 types). The most commonly beneficial health outcome was "better glycemic control" (26.17%), followed by "improved physical fitness" (24.16%) and "enhanced prevention and control of diseases or complications" (10.91%), among others. The main focus of adverse event prevention was the management of glucose metabolism disorders, such as hypoglycemia, hyperglycemia, and ketonemia (70.59%). Additional characteristics of PA protocols in this knowledge base are detailed in Table 2.

Table 2 Characteristics of physical activity protocols in PEP-DSS-DBC1.0.

Characteristics	Results
General descriptive information	
Number of physical activity protocols, n	1171
Number of physical activity protocols' elements, n	23
Physical activity protocols which needing exercise risk assessment, n (%)	157 (13.41%)
Physical activity protocols which needing medical supervision, n (%)	800 (68.32%)
Physical activity protocols which needing exercise intensity monitoring, n (%)	494 (42.19%)
Physical activity protocols for patients with diabetic complications, n (%)	129 (11.02%)
Physical activity protocols for patients with 1 cardiovascular risk, n (%)	648 (61.25%)
Physical activity protocols for patients with 2 cardiovascular risk, n (%)	327 (30.91%)
Physical activity protocols for patients with 3 cardiovascular risk, n (%)	192 (18.15%)

Physical activity protocols for patients with 4 cardiovascular risk, n (%)	30 (2.84%)
Classification of physical activity protocols	
Neuromotor exercise, n (%)	1.16%
Flexibility (stretching), n (%)	0.77%
Combined, n (%)	15.14%
Resistance, n (%)	14.44%
Aerobic (cardiorespiratory endurance), n (%)	68.49%
Frequency (times or days per week), Median (IQR), Min, Max	3 (2, 5), 1, 7
Intensity	
Very light, n (%)	2.65%
Light, n (%)	10.21%
Moderate, n (%)	43.48%
Vigorous, n (%)	35.82%
Near-maximal to maximal, n (%)	3.02%
FITT-VP-WC principles of physical activity protocols	
Time (min), Median (IQR), Min, Max	30 (25, 60), 5, 120
Type (number of mode), n	298
Volume (min per week), Median (IQR), Min, Max	150 (90, 180), 14, 720
Progress (Yes), n (%)	361 (30.83%)
Warning (Yes), n (%)	409 (34.93%)
Contraindication (Yes), n (%)	512 (43.72%)
The outcomes of physical activity	
Beneficial health outcomes	
Improve cognitive function	0.30%
Improve immune function	0.60%
Improve neural function	1.54%
Improve gestational diabetes outcomes	2.21%
Improve health-related quality of life	2.35%
Improve mental health	2.89%
Improve inflammatory response	3.22%
Promote cardiovascular benefits	5.44%
Improve metabolism	9.70%
Reduce cardiovascular risk factors	10.50%
Better disease or complication prevention and control	10.91%
Improve physical fitness	24.16%
Better glycemic control	26.17%
Adverse events	
Prevent renal dysfunction	1.18%
Prevent adverse respiratory events	2.35%
Prevent environment induced negative events	3.53%
Prevent cardiovascular negative events	7.07%
Prevent musculoskeletal injury	15.29%
Prevent glucose metabolism disorder	70.59%

Abbreviations: FITT-VP-WC, Frequency, Intensity, Time, Type, Volume, Progress, Warning, Contraindication; IQR, interquartile range

Validation and Comparative Analysis Results

A total of 49 adults with diabetes were recruited and received verbal exercise instructions from four sports physicians on-site. Baseline patient information is provided in the Multimedia Appendix 4. Compared to ChatGPT-4o and sports physicians, PEP-DSS-DBC1.0 performed significantly better in several areas: “Not from a general guideline/advice”, “Exercise prescription incorporates fundamental principles of the FITT-VP framework”, “Exercise prescription incorporates the ‘Warning’ principle”, “Exercise prescription incorporates ‘Contraindications’”, “Exercise preparticipation health screening”, “10-year risk of coronary heart disease”, “Adverse events prevention protocol”, “Desired health outcomes/exercise goals”, and “Overall” (Table 3).

Table 3 The PEP comparison between PEP-DSS-DBC, sports physicians and ChatGPT4o

Items	PEP-DSS-DBC (N=49)	ChatGPT4o (N=49)	Sports physicians (N=49)	Statistics	*P* value
Recommended exercise prescription					
	49 (100%)	49 (100%)	49 (100%)	NA	NA
Three or more exercise prescriptions available for selection					
	49 (100%)	49 (100%) [a]	0 (0%)	Fisher	<.001
Have original research publication authenticity					
	49 (100%)	49 (100%) [a]	0 (0%)	Fisher	<.001
Not from general guidelines/advice					
	49 (100%)	0 (0%)	0 (0%)	Fisher	<.001
Incorporates fundamental principles outlined by the FITT-VP framework					
	49 (100%)	41 (84%)	0 (0%)	χ^2=118.8	<.001
Incorporates "Warning" principle					
	49 (100%)	48 (98%)	14 (29%)	χ^2=87.6	<.001
Incorporates "Contraindications" principle					
	49 (100%)	0 (0%)	0 (0%)	Fisher	<.001
Exercise preparticipation health screening					
	49 (100%)	0 (0%)	0 (0%)	Fisher	<.001
10-year risk of coronary heart disease					
	49 (100%)	0 (0%)	0 (0%)	Fisher	<.001
Adverse events prevent protocol					
	49 (100%)	0 (0%)	0 (0%)	Fisher	<.001
Desired health outcomes/exercise goals					
	49 (100%)	22 (46%)	0 (0%)	χ^2=98.5	<.001
Total	539 (100%)	258 (48%)	63 (12%)	χ^2=853.3	<.001

Abbreviations: PEP, personalized exercise prescription; PEP-DSS-DBC, personalized exercise prescription decision support system for diabetes care; ChatGPT4o, chat generative pre-trained transformer 4 omni; FITT-VP, Frequency, Intensity, Time, Type, Volume, Progress.
[a] Need to ask additional questions.

We engaged four sports physicians and 16 students to evaluate the usability, user loyalty, and satisfaction of the PEP-DSS-DBC1.0. The average System Usability Scale (SUS) score was 77.25 ± 6.06, and the Net Promoter Score (NPS) was 75.00%. The sports physicians had a significantly higher average SUS score compared to the postgraduate student group (84.38 ± 1.25 vs. 75.47 ± 5.42, *P*=.005). Similarly, the NPS for sports physicians was higher than that of the postgraduate student group (100% vs. 68.75%, *P*=.53) (Table 4).

Table 4 The SUS score and the NPS result of PEP-DSS-DBC

	All (n=20)	Sport physician (n=4)	Postgraduate student (n=16)	Statistics	*P* value
The SUS score	77.25 ± 6.06	84.38 ± 1.25	75.47 ± 5.42	*t*=-3.20	.005
NPS					
Promoters n (%)	16 (80.00%)	4 (100.00%)	12 (75.00%)		
Passives n (%)	3 (15.00%)	0 (0.00%)	3 (78.75%)		
Detractors n (%)	1 (5.00%)	0 (0.01%)	1 (6.25%)		
NPS score	75.00%	100.00%	68.75%	Fisher	.53

Abbreviations: SUS, system usability scale; NPS, net promoter score

Discussion

Principal Results

PEP-DSS-DBC1.0, a knowledge-based digital decision support system, was developed to generate personalized exercise prescriptions (PEPs) tailored to the individual characteristics and preferences of people with diabetes. The tool is built on data from 938 studies, resulting in 1,171 PA reference protocols, 10,316,497 patient records, and 2,904 additional entries, totaling 13,263 data points. PEPs are generated following the “FITT-VP-WC” principles, encompassing frequency, intensity, time, type, volume, progression, warning, and contraindication. The tool demonstrated superior performance compared to ChatGPT-4o and sports physicians across multiple metrics, achieving a total performance score of 100%, compared to 48% for ChatGPT-4o and 12% for sports physicians ($\chi2$=853.3, *P*<.001). Usability assessments yielded favorable results, with a System Usability Scale score of 77.25 ± 6.06 and a Net Promoter Score of 68.75%. The tool also incorporates cardiovascular risk assessments, offering valuable guidance for users. Furthermore, it provides comprehensive contraindications (512 records) and considerations (409 records) for diabetic patients, addressing specific precautions and limitations.

Limitations

Despite its innovations, PEP-DSS-DBC1.0 has several limitations. First, while the reference protocols are based on individual trait matching, their clinical utility and applicability beyond the populations described in the source literature remain unverified. Randomized controlled trials are essential to validate its effectiveness. Second, the current PEPs lack aggregation and synthesis of similar prescription paradigms, which limits the optimization of the recommendation process. Incorporating a knowledge fusion algorithm into the framework could advance the “personalization–commonality–personalization” paradigm. Third, the knowledge base has limited dimensionality and depth, failing to fully address the interplay between exercise, pharmacologic interventions, dietary adjustments, and lifestyle modifications. Additionally, the scope of adverse events and preventive actions included in the knowledge base is currently limited and requires further refinement in subsequent updates.

Comparison with Prior Work

PEP-DSS-DBC1.0 differs from previous tools, such as EXPERT[19] and P3-EX,[20], in several key ways. Unlike these tools, which rely primarily on guidelines and expert consensus, PEP-DSS-DBC1.0 derives its exercise prescriptions from manually annotated research, making it more knowledge-driven. It is also accessible to patients, whereas EXPERT and P3-EX are designed for professional physicians. PEP-DSS-DBC1.0 offers highly personalized recommendations, selecting reference plans that are peer-reviewed and published, ensuring suitability for diverse user groups. Compared to ChatGPT-4o, which provides generalized guidance with a focus on linguistic nuances, PEP-DSS-DBC1.0 delivers more specific and tailored exercise prescriptions with greater comprehensiveness and traceability.

Conclusions

PEP-DSS-DBC1.0 is the first manually labeled PA knowledge base and digital decision support system specifically designed for individuals with pre-diabetes and diabetes. It represents a significant advancement in diabetes care by providing evidence-based, interpretable, and highly personalized exercise prescriptions. Its ultimate goal is to recommend the most suitable exercise plan, balancing individual characteristics with user preferences. Future iterations of the tool will focus on expanding the knowledge base to include interactions between exercise, medication, dietary adjustments, and lifestyle changes, and improving the prediction and prevention of adverse events. Combining PEP-DSS-DBC1.0 with ChatGPT could further enhance its capabilities, leveraging the curated knowledge base to deliver a more adaptable and robust decision-support system for diabetes care.

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Authors' Contributions

B., X.L. and B.S. participated in conceptualization, data curation, formal analysis, investigation, methodology, project administration, supervision, validation, visualization and original draft & review & editing writing of the manuscript. K.Z., J.D., D.L. and B.L. reviewed and edited the manuscript. S.R., K.Z., J.D., D.L., B.L., J.F., X.L., R.W., E.W., C.Z., M.J., L.S. and C.B., Y.B. researched data and reviewed and edited the manuscript. W.G., K.Q., S.L., J.Z. and J.R. contributed to the discussion and reviewed and edited the manuscript. All authors approved the final version of the manuscript.

Conflicts of Interest

None declared.

Abbreviations

ACSM: American College of Sports Medicine
BMR: basal metabolic rate
CVD: cardiovascular disease
DM: diabetes mellitus
DSS: decision support system
HRmax: maximum resting heart rate
HRR: reserve heart rate
NPS: Net Promoter Score
PA: physical activity
PEP: personalized exercise prescription
SUS: System Usability Scale
THR: target heart rate

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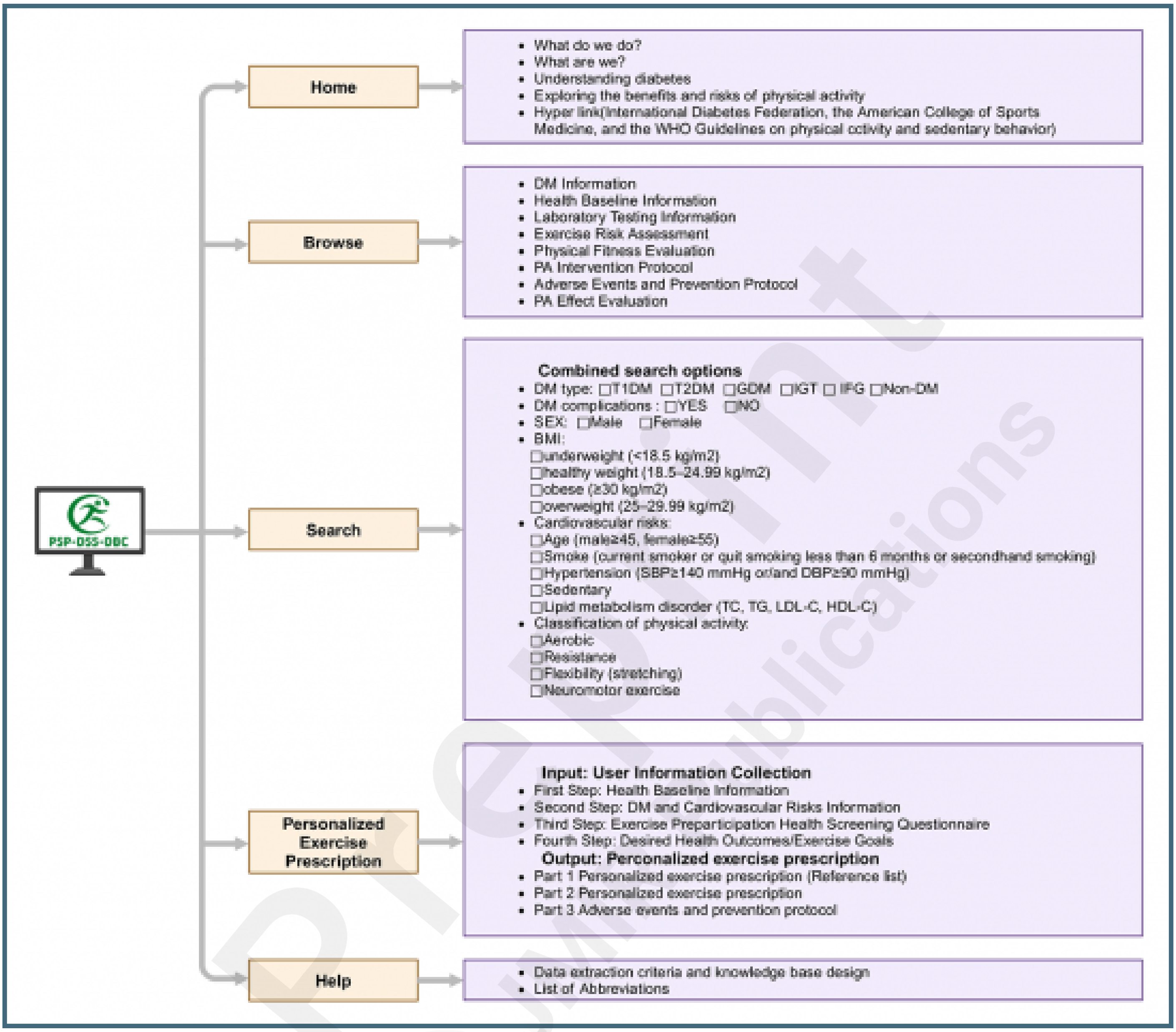
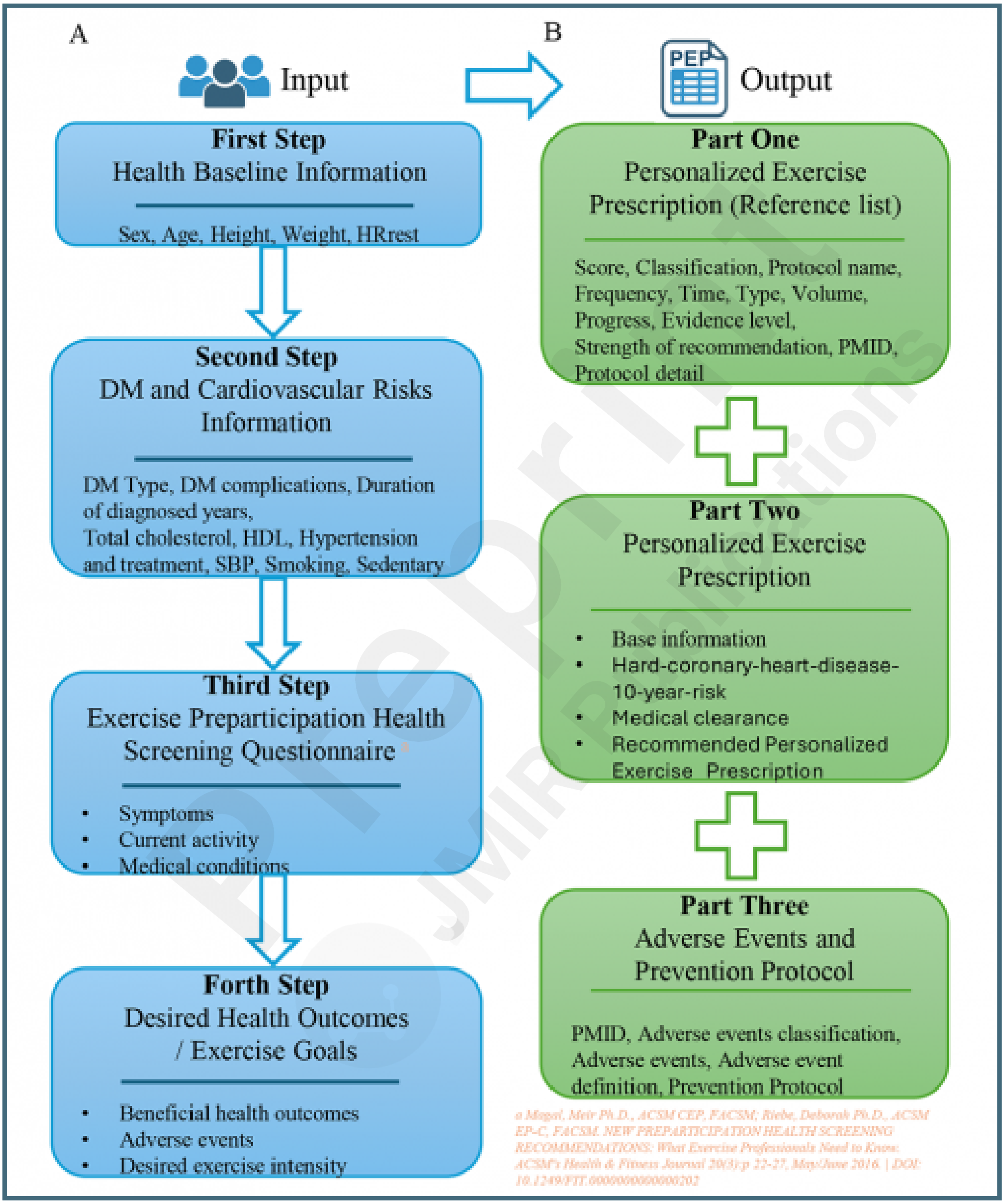
Supplementary Files

Figures

PEP-DSS-DBC1.0 interface structure.



Personalized exercise prescription decision support system interface. A. User information collection module. B. Generated personalized exercise prescription module.



Multimedia Appendixes

Flowchart for collection of studies.
URL: http://asset.jmir.pub/assets/c5062af2623472586fe8035fab4f759d.png

ER diagram.
URL: http://asset.jmir.pub/assets/0708728c8822380aa62aa79b097f512f.png

A description of the scoring algorithm for Score.
URL: http://asset.jmir.pub/assets/29a18c51bfd4d240a64fbb7c07f39a8c.doc

The baseline information of case test users.
URL: http://asset.jmir.pub/assets/c74853dc32b54536bfe5b2112a0e7e2e.doc