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Towards National Health Strategy for the Prevention and Control of Diabetes by 2030

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ABSTRACT

Improving diabetes management and prevention strategies is a critical public health priority in Saudi Arabia. With a rising prevalence of diabetes, understanding the key factors affecting its incidence is essential for both healthcare providers and the community. Current methods of diabetes screening often rely on basic approaches, such as blood sugar testing and physical examinations, which may overlook early clinical signs. There is a pressing need to integrate advanced techniques, such as digital health tools and community-based interventions, to enhance disease detection and management. Traditional methods may fail to identify subtle cases or those without prominent symptoms, resulting in late diagnoses and increased complications. By adopting a more comprehensive approach that includes educational initiatives and innovative health technologies, we can better address the diabetes epidemic and improve health outcomes across the population.

Keywords: Diabetes management, public health, Screening strategies, Digital health, and Early diagnosis.

INTRODUCTION

Early detection and accurate diagnosis of diabetes are not only critical for improving patient outcomes and quality of life but also essential for reducing the long-term complications associated with the disease. Traditional diagnostic methods, although well-established and familiar to healthcare professionals, often rely on basic techniques such as blood glucose testing and physical examinations. These approaches can fall short in identifying early-stage diabetes, particularly in cases where symptoms are subtle or absent. Vision: To transform diabetes management in Saudi Arabia by significantly reducing its prevalence and enhancing patient care through innovative strategies. Mission: To implement effective diabetes prevention and management strategies that empower individuals and communities to take control of their health. Values: Commitment to Public Health Prioritizing the health and well-being of the community, Integrity Ensuring transparency and accountability in all health initiatives., Collaboration Working with healthcare providers, government bodies, and community organizations to achieve common goals. And Innovation Embracing new technologies and methods to improve diabetes care and education. Imagine a future where diabetes management evolves into a proactive landscape, utilizing advanced diagnostic methods and digital health tools. This shift aims not only to enhance diagnostic accuracy but also to develop personalized treatment plans tailored to everyone's unique health profile. By examining the strengths and weaknesses of current diagnostic practices, we can uncover new opportunities for substantial improvements in diabetes care and potentially reduce morbidity and mortality rates. This study seeks to enhance diabetes management by integrating advanced diagnostics and health technologies, ensuring better early detection and more effective interventions. By employing a structured methodology, we will identify and define key processes within diabetes care, as illustrated in Figure 1 below. Our approach will draw on insights from recent literature, highlighting advancements in technology and community health strategies that are revolutionizing diabetes management. After identifying existing processes, we will conduct a comprehensive analysis to evaluate their effectiveness and pinpoint areas for improvement. This iterative process will involve redesigning current strategies based on best practices and conducting simulations to assess the impact

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of proposed enhancements. Should further adjustments be necessary, we will continue refining our strategies to optimize outcomes for patients with diabetes.

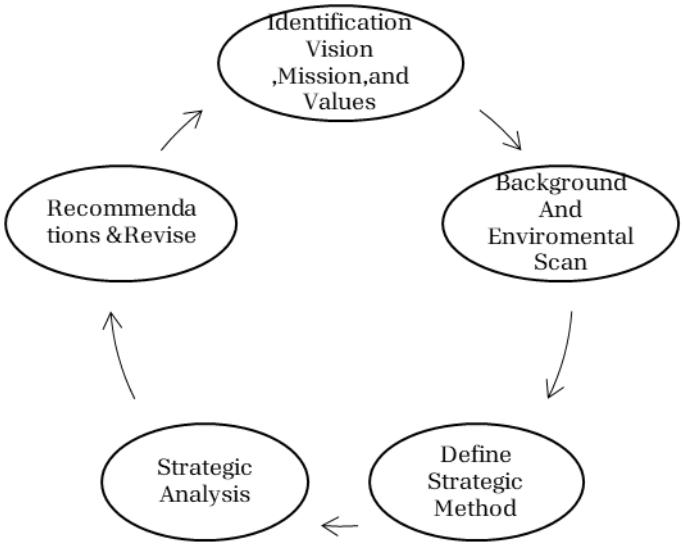

Fig 1 .Stages of the strategic planning process

BACKGROUND AND RELATED WORK

Diabetes is a major public health concern worldwide, specifically in Saudi Arabia, with an increasing prevalence and significant health and economic burdens. This section brings insights from important studies, showcasing Disease Prevalence, Diabetes Preventive Strategies, Public Health Interventions, and Diabetes Management.

A. Disease Prevalence

The first study examines the prevalence of diabetes in Saudi Arabia and identifies key demographic, genetic, and lifestyle factors [1]. It finds that diabetes is strongly associated with obesity, sedentary lifestyles, and low educational attainment. It also focuses on the most important strategies that help reduce diabetes, such as early screening and awareness campaigns that can help expand screening programs in the early detection of diabetes, as well as behavioral interventions encouraging healthy eating habits and increasing physical activity, which can reduce the risk of diabetes. Among the most important findings and recommendations, the study calls for lifestyle interventions based on national health policies and campaigns to reduce the prevalence of diabetes. and [2]The paper highlights the role of lifestyle changes and environmental factors in the progression of diabetes, and public health policies to manage the increasing prevalence of the disease. The paper primarily reviews the existing literature on diabetes and considers different issues such as the types of diabetes, health consequences, and risk factors. Highlighting the need for targeted therapies and diabetes self-care education, Moreover, the importance of preemptive actions, and health promotion activities. This study was taken from an ongoing household health survey conducted by the General Authority for Statistics in Saudi Arabia in 2017 [3]. The sample size included 24,012 Saudi households. The sample was divided according to the 13 administrative regions of Saudi Arabia a. Key findings: Men had a higher prevalence (10.3%) than women (9.9%). The group with the lowest prevalence was the under-40s (15.3%). There are regional differences from 7.3% in Najran to 11% in Makkah. The study [4] focused on evaluating the effectiveness of the community screening program in Qunfudhah in detecting diabetes and prediabetes. Among the strategies used to evaluate the reduction of diabetes are community screening programs, where early detection initiatives targeting rural areas help prevent the development of diabetes. Also, educational interventions, where awareness campaigns in remote communities, can improve understanding of diabetes risks. And promoting diet and exercise. Among the most prominent findings and recommendations, the high prevalence of diabetes indicates that early interventions are of paramount importance. The study recommends expanding the scope of community screening nationwide. [5] The study utilized the data collected through structured online questionnaires distributed via social media. The study collected data from 2,056 participants, providing a robust dataset for analysis. Many respondents showed poor

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mastery of managing diabetes in terms of nutrition, Logistic regression analysis found a strong diabetes association with the following variables: age, sex, level of physical activity, and eating habits.[6] Discussed the impact of oral health parameters, such as gum bleeding, active dental caries, tooth mobility, and tooth loss, on diabetes prevalence. It also explains the moderating impact of socio-demographic and lifestyle variables on this relationship. Data were taken from the Hungarian European Health Interview Survey datasets, including 11,429 participants. In the future,[7] will assess trends in the prevalence of diabetes and its associated risk factors in Saudi Arabia. Diabetes reduction strategies are taken with nationwide lifestyle modification programs and the implementation of large-scale campaigns to promote physical activity and healthy eating. Government-led diabetes prevention initiatives to promote policies to address risk factors for obesity and diabetes.

B. Diabetes Preventive Strategies

This study explores strategies to reduce diabetes [8] with comprehensive treatment approaches and integration of mental and physical health care for diabetics. Personalized diabetes management plans and tailored interventions based on the individual patient's needs. They agreed that diabetes significantly reduces quality of life, which necessitates a more comprehensive care approach. As for the age groups, this study [9] highlights the increasing prevalence of type 1 diabetes, especially among children and young people. The most important strategies to reduce diabetes in this age group are child screening programs, early diagnosis, and intervention to prevent complications. Advanced treatment options are also needed to improve access to insulin therapy and diabetes management education. It focused on the urgent need to improve healthcare services to support young diabetics.[10] The study encompassed adult patients diagnosed with type 2 diabetes who were referred to diabetes educator clinics over six months. In multiple diabetes education sessions, which emphasized self-management and collaborative care. The study found remarkable improvements in glycemic control and cardiovascular risk factors among participants. At six months, 58.5% of patients showed improved HbA1c levels. Significant reductions in the prevalence of obesity and abnormal HbA1c were noted.[11]This study assessed the type 2 diabetes prevention program by using motivational interviewing techniques, the program's launch, 10 coaches and 14 clients participated in semi-structured interviews 9 months after the program's implementation and Qualitative analysis using a process evaluation approach with recorded interviews and data analysis, The study includes perspectives from both clients and coaches and The interviews were only done once, which might have limited their comprehensiveness. The outcomes showed behavioral improvements and a high level of participant acceptance of the program. Several Researchers [12] the study aimed to assess the feasibility and effectiveness of a culturally and linguistically adapted text-message-based DPP for Spanish-speaking Latinos. It included 26 at-risk individuals who received daily messages for 6 months, reminders about the importance of healthy eating, physical activity, and lifestyle motivation. The results showed a significant weight reduction, with 45.8% of the participants losing 3% or more of body weight, and an increase in physical activity. [13] Review a structured online questionnaire survey in the Aseer region of Saudi Arabia. For a descriptive cross-sectional survey was done those aged 18 years and older. Data were analyzed using SPSS, Descriptive statistics, and Pearson's chi-square test. The use of a structured questionnaire allowed for detailed insights into knowledge and practices regarding diabetes management. Also, the analysis utilized appropriate statistical methods. Findings indicated 42.2% of respondents exercised regularly, 63.2% adherence to prescribed anti-diabetic medications, and 60.1% knew diabetes mellitus. this study [14] aimed to discuss the cost-effectiveness of diagnosing and treating early gestational diabetes mellitus The Data were collected from hospital records and self-reported questionnaires. Of the 43,721 women assessed in the research, 802 had an early GDM diagnosis conducted in several nations.

C. Public Health Interventions

[15] The systematic literature review followed PRISMA, and the guidelines for medical research. In addition, databases such as PubMed, MEDLINE, CINAHL, and the JBI Critical Appraisal Checklist to assess the quality of included studies. The study highlights both strengths and gaps in the primary healthcare system, which can inform future reforms and improvements. The review focuses solely on studies conducted in Saudi Arabia. Identified strengths in patient access and healthcare infrastructure and gaps in service quality and patient satisfaction were highlighted.[16] The study employed an interview-based cross-sectional design involving adult patients with diabetes. Data was analyzed using GraphPad Prism, with various statistical tests. The Michigan Diabetes Knowledge

Test (MDKT) provides a reliable measure of diabetes knowledge. They found that the type of diabetes was significant in terms of differences between the groups, which stated that patients with T2DM have better knowledge than patients with T1DM. In terms of encouraging health initiatives [17], the Council of Health Insurance, an analysis of diabetes trends among private health insurance beneficiaries in the Kingdom of Saudi Arabia. Benefit from health insurance for prevention, as well as expanding coverage for diabetes screening and management. And employer-sponsored wellness programs encourage workplace-based health initiatives, where private insurance companies can play a crucial role in diabetes prevention by providing better coverage for screenings and lifestyle programs. Focusing on the psychological aspect and the impact of diabetes and other chronic diseases on quality of life. Recent reviews [18] have summarized and explained current treatment approaches, including medication, for mitigating elevated blood glucose levels in T2DM. This review highlights the critical role primary care plays in the delivery of diabetes care and provides insights about current clinical management, Collection and comparison of modern treatment strategies, and Discussion about future treatment that can develop innovative new therapeutic strategies. [19] The study employed a questionnaire consisting of sociodemographic variables and a Knowledge, Attitude, and Practice (KAP) assessment with 61 questions, Data was analyzed using R software. In this study, KAP scores were associated with the socio-demographic characteristics of the patients. The findings from this study will be useful for decision-makers and healthcare professionals in developing strategies to improve health outcomes in T2DM patients and The Mean degree of knowledge was 8.89, the attitude was 79.03, and the practice was 15.81. As for how socioeconomic factors affect the prevalence of diabetes, the study focused [20] and highlighted disparities based on income, education, and geographic location. Among the strategies used to reduce diabetes are first expanding access to health care and targeted health care programs for disadvantaged communities. Among the most important findings and recommendations is that diabetes disproportionately affects rural and low-income populations, which requires government-supported healthcare reforms [1]. Also, improvements in the healthcare system improve access to diabetes care for at-risk populations through national prevention programs.

D. Diabetes Management.

[21] This systematic review also focused on evaluating different interventions for diabetes, including technology-based, lifestyle-based, and psychosocial approaches. It focused on the use of technology-based interventions and the promotion of mobile phone applications and wearable devices for self-monitoring; behavioral and lifestyle programs, structured physical activity, and dietary plans to prevent the development of diabetes; and psychosocial support systems to emphasize the role of family and community support in diabetes management. It demonstrated that multifaceted interventions that combine technology, education, and lifestyle changes are most effective in diabetes management. Recent research [22] has explored the evolving role of technology in diabetes care. The review indicates that diabetes technologies, including continuous glucose monitoring systems and AI pancreas systems, improve patient outcomes and reduce complications, but it didn't mention the practical difficulties of implementing and adopting technology in clinical settings.[23] In this study, the methodology involved conducting a cross-sectional investigation where a questionnaire was administered to 204 male and female diabetic patients in Saudi Arabia. The emphasis on self-management in diabetes care is critical, given the rising prevalence of diabetes in Saudi Arabia. The findings of this study showed that patients with DM have knowledge and awareness about their disease, but they did not perform self-management appropriately, despite the popularity and ease of glucometer use. Several Researchers [24]. This study has reviewed the attitudes and understanding of the general people in Jeddah, Saudi Arabia, about the impact of lifestyle changes on managing type 2 diabetes, by using an online survey consisting of 22 questions to evaluate the knowledge and behaviors related to diabetes. Participants in the study came from different backgrounds, and no significant variations in knowledge and behaviors between males and females.[25] explored the impact of ethnic differences in lifestyle factors on the risk of type 2 diabetes using data from the UK Biobank. It focuses on differences in lifestyle, adiposity, and sex between different ethnic groups. 500,000 participants from the UK Biobank study. Diabetes was more common in men than in women in all ethnic groups and South Asians (Bangladeshis, Pakistanis, and Indians). also contributed [26] A cross-sectional self-administered survey study in a university teaching hospital in Riyadh. Descriptive and inferential statistics were performed using SPSS with KAP scores. The emphasis on KAP regarding diabetes offers valuable insights into patient education needs and provides an overview. Study findings could not be applied since glycemic control parameters such as HbA1c levels were not available to the researchers. The results were at the Knowledge Levels: 37.6% had "good" knowledge, while 62.4% had "poor"

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diabetes, and the Attitude: Only 30.9% showed "positive", the Practices: 47.9% had "good" whereas 52.1% demonstrated "poor" to diabetes care. In the field of evaluating and innovating the non-invasive .diabetes risk assessment tool AUSDRISK to predict diabetes in the Kingdom of Saudi Arabia, the study evaluated it [27], The study showed the wider use of noninvasive risk tools to reduce diabetes by encouraging national adoption of the AUSDRISK risk prediction tool, directing resources towards high-risk individuals based on AUSDRISK scores, encouraging self-monitoring, and educating individuals about personal risks and lifestyle modifications. Among the most important results and recommendations, the AUSDRISK tool has proven to be highly effective and should be integrated into routine primary health care. To reduce common barriers that prevent diabetes patients from engaging in appropriate self-care practices identified in [28], promote diabetes education to empower patients to self-care. Health literacy programs and improved access to health care are needed to address financial and geographic barriers to diabetes management. Low health literacy is a major challenge, requiring government-supported education and support programs. [29] aimed to explain the impact of epigenetic modifications on type 2 diabetes mellitus, focused on how these modifications influence processes related to the disease, such as DNA methylation, and non-coding RNAs about T2DM pathogenesis and management.

After looking at many research papers, we found five main ideas that helped us conduct our survey. This survey aims to check how much people know about diabetes in Saudi Arabia, find out the big problems patients deal with, look at how easy it is to get healthcare and rehab services, and see how new tech is used in taking care of the illness.

Below is Table 1 with the five key ideas of our study, and a short note on each idea from the reviewed scientific literature we read.

CONCEPTS	REVIEWED SCIENTIFIC LITERATURE	SOURCE
Analyzing the general level of awareness	about diabetes, its causes, and complications.	[3],[9],[10], [13],[16]
Evaluating healthcare services	The adequacy of rehabilitation and support centers for patients	[1],[2],[8], [24]
Understanding barriers and challenges	faced by diabetes patients, both medically and socially.	[1],[12],[20], [27]
Measuring the use of technology	such as glucose monitoring devices, insulin pumps, and smart applications for diabetes management	[21],[22]
Enhancing health initiatives	by providing recommendations based on the insights and experiences of survey participants.	[4],[8],[15], [28]

Tabel 1. key ideas of our study

METHODS

A. Suitable Methodology

Since the survey contains both quantitative and qualitative data, the most suitable approach is a Mixed-Methods Approach, which consists of:

- Quantitative Analysis: Used to measure trends in diabetes awareness, lifestyle habits, and healthcare access.
- Qualitative Analysis: Used to analyze open-ended responses regarding barriers and recommendations for diabetes prevention.
- Cross-Sectional Study Design: Since data was collected at one point in time, this approach helps understand the current state of diabetes prevalence and awareness in Saudi Arabia.

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- Comparative Analysis: Comparing survey responses across different demographics (age, gender, education, region) to identify patterns.

B. Data Gathering Technique

In this study, a structured survey was distributed via Google Forms to collect primary data. The survey targeted different demographic backgrounds across Saudi Arabia with a diverse range of participants. Rich insights into habits, public awareness, prevention, and Perceptions surrounding diabetes have been collected from 393 replies that were received. Additional data was collected from an extensive literature review to support the survey results. Such as analysis of published academic research, statistical data from the Ministry of Health (MOH) in Saudi Arabia, and World Health Organization (WHO) reports.

In this study, both qualitative and quantitative methodologies were used. Qualitative data was provided by the survey's open-ended questions, which collected participants' suggestions, difficulties, and perspectives on diabetes prevention. To make comparisons among different demographics, Quantitative data was analyzed statistically via frequency distributions, cross-tabulations, and percentage breakdowns. For better organization, the survey questions were categorized into five sections.

C. Data Analysis

1) Quantitative Analysis (Statistical Findings from the Survey)

Section 1: Demographic information

The demographic characteristics of the survey participants are distributed across all categories. The results showed that younger participants were more engaged, with the highest participation (30.5%) from the 18–29 age group, followed by 23.9% from the 30–39 age group, as shown in Figure 2

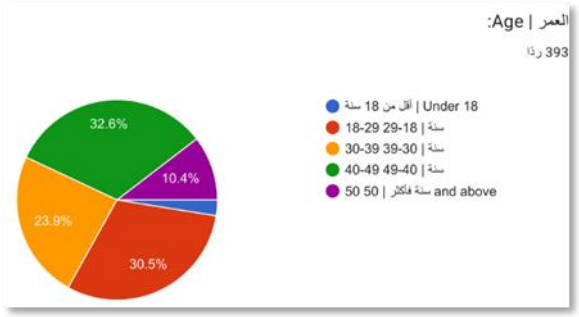

Fig 2. Demographic information age

The majority of respondents were female (86.3%), compared to only 13.7% male, indicating greater interest from females in health-related topics like diabetes. Geographically, it is represented in Figure 3

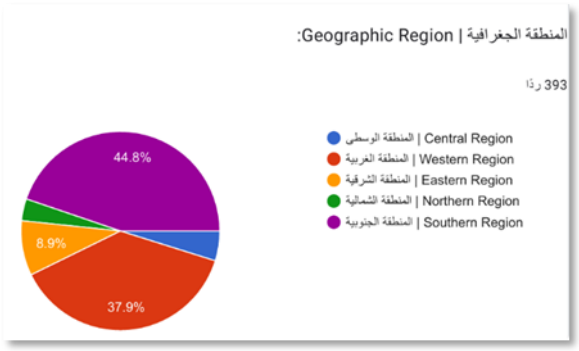

Fig 3.Demographic information geographic region

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Most responses came from the southern region (44.8%), followed by the western region (37.9%), suggesting higher engagement in these areas, which reflects his great interest and concern, or perhaps reflects their suffering with misconceptions about the disease. Regarding education, 67.2% of participants held a bachelor's degree, reflecting a generally well-educated sample. The survey included a diverse range of community members, such as students, employees, doctors, and retirees, indicating widespread interest in the topic. In terms of diabetes-related experience, 16.3% were diabetic patients, while 18.1% expressed interest in diabetes awareness and prevention. Worryingly, 22.9% reported not knowing whether specialized centers were available, while 25.4% confirmed that there were no specialized diabetes rehabilitation centers, as shown in Figure 4

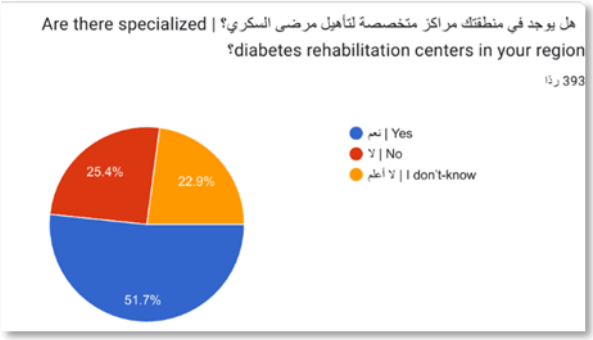

Fig 4. Demographic information rehabilitation center of diabetes

This highlights a gap in healthcare services. As shown in Figure 5

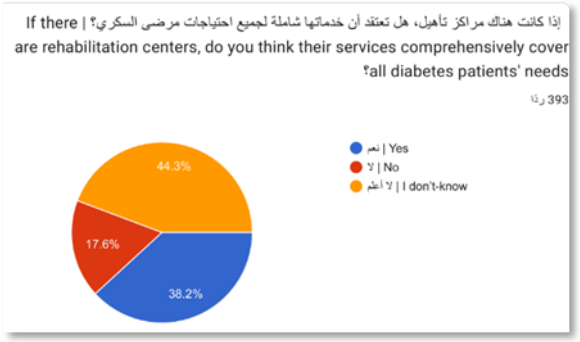

Fig 5. Demographic information on rehabilitation center service

A very large percentage confirmed that they did not know whether services were comprehensive to the needs of diabetics, while another group confirmed that the services were not comprehensive at all.

Section 2: knowledge and awareness of Diabetes

The data collected showed a high level of awareness. 99% of participants reported having heard of diabetes before, and as Figure 6 shows,

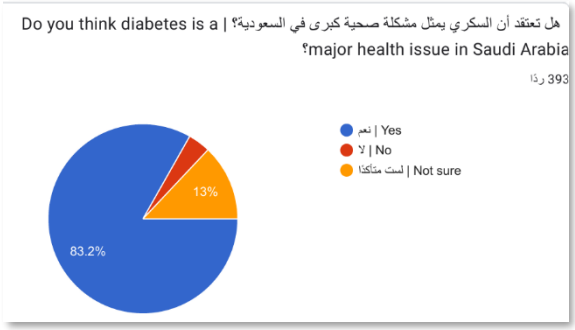

Fig 6. knowledge and awareness of Diabetes

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83.2% of them indicated that diabetes is a major health problem in Saudi Arabia, demonstrating a strong awareness of its seriousness. What's truly striking, as Figure 7 indicates,

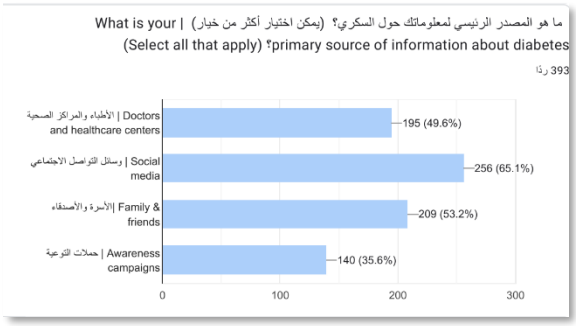

Fig 7. Source of inforamation about Diabetes

is that the largest percentage relied on social media as their primary source of information (65.1%), followed by doctors and healthcare centers (49.6%). This means there's a significant risk that information may be misleading. Awareness campaigns were undoubtedly an important source (35.6%). These results demonstrate the effectiveness of awareness campaigns and social media in spreading health knowledge, in addition to the role of personal and professional relationships.

Section 3: Lifestyle and Risk Factors

The results showed several worrisome habits among participants. 77.4% answered that having a family member with diabetes, only 35.1% had tested their blood sugar levels in the past year, and more than half (64.9%) had not. We can see in Figure 8

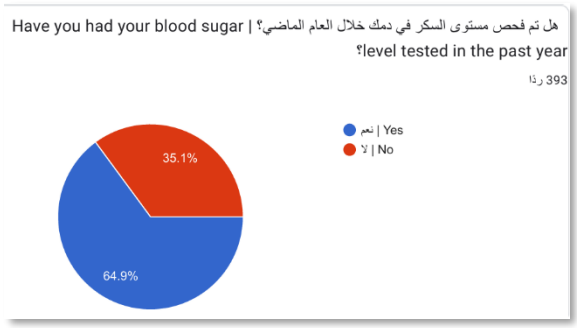

Fig 8. Risk factors and blood suger level

which may affect early detection. Physical activity levels were low, as shown in Figure 9 40.5% of respondents did not exercise at all, and only 16% exercised three times a week. When it comes to eating habits, just over half of the participants in Figure 10 (50.6%) described their diets as healthy and balanced, while 29.8% admitted to frequently consuming fast food, and 19.6% consumed large amounts of sugary drinks and sweets. These results point to the need for improved health habits and awareness campaigns focusing on regular screenings, healthier eating patterns, and physical activity.

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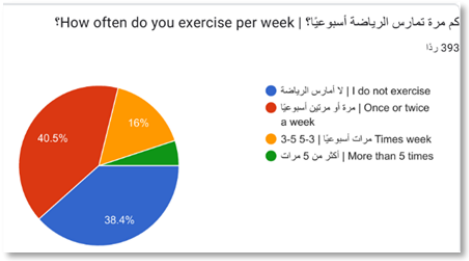

Fig 9. Lifestyle and Physical activity levels

Fig10. Lifestyle and health and balanced

Section 4: Use of Technology in Diabetes Management

Diabetes management is one of the biggest challenges facing diabetics, and technology is a key enabler, as detailed in Figure 11

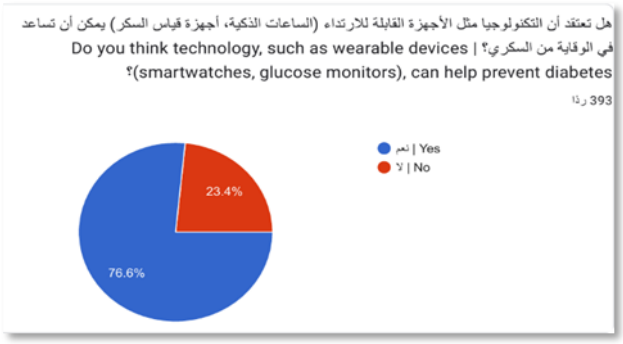

Fig 11. Technology in Diabetes Management

76.6% of participants believe that wearable devices can help prevent diabetes and showed a strong interest in adopting technology-based solutions, as Figure 12 below shows. 28.8% used health apps to monitor blood sugar and fitness.

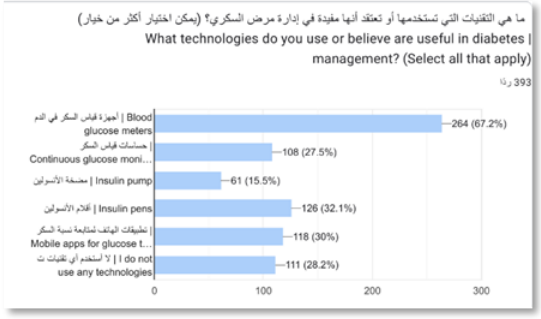

Fig 12. Health Apps for Diabetes Management

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Section 5: Challenges and Social Perception

The analysis of the participants' responses reveals a variation in their feelings towards society's perception. On the positive side, most patients (61.3%) feel supported and understood by society. Conversely, there are challenges and negative perceptions faced by another segment of patients. Approximately (9.9%) feel ignored and neglected, while (13.5%) face discrimination or negative perceptions from society. These results indicate that a significant portion of diabetic patients feel supported and appreciated by society, while there is still a segment that encounters challenges related to neglect, discrimination, or negative perceptions, as Figure 13

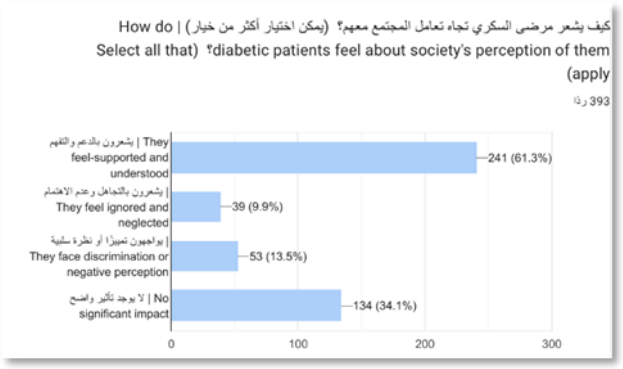

Fig 13. Challenges and Social Perception

2) Qualitative Analysis (Thematic Coding of Open-Ended Responses)

Common themes extracted from open-ended responses on improving diabetes prevention:

- Need for more public awareness campaigns targeting all age groups.
- Better nutritional education in schools and workplaces.
- Access to free diabetes screening in health centers, including mobile testing units.
- More physical activity programs for youth and adults to encourage exercise.
- Stronger regulations on unhealthy food advertising, especially targeting children.
- Affordable access to diabetes medications, glucose monitors, and digital health solutions.
- Employer-supported wellness programs that encourage healthier lifestyles.
- Community engagement programs to involve families and social groups in prevention efforts.

PESTEL Analysis (External Factors Affecting Diabetes Prevention in Saudi Arabia)

A PESTEL analysis is a framework or tool used to analyze and monitor the macro-environmental factors that have an impact on an organization, company, or industry. It examines the Political, Economic, Social, Technological, Environmental, and Legal factors in the external environment. A PESTEL analysis is used to identify threats and weaknesses, which are used in SWOT analysis.

Political factors include government policies, leadership, and change; foreign trade policies; internal political issues and trends; tax policy; regulation and deregulation trends.

- Government-led healthcare initiatives (Vision 2030 health goals) support diabetes prevention.
- Regulations on sugar content and food labeling to promote healthier choices.
- Subsidized healthcare programs help lower-income groups access diabetes treatment.
- Expanding diabetes research funding to develop more targeted interventions.

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Economic factors include current and projected economic growth, inflation and interest rates, job growth and unemployment, labor costs, the impact of globalization, the disposable income of consumers and businesses, and likely changes in the economic environment.

- Urbanization reduces access to natural exercise spaces like parks and walking areas.
- Air pollution and stress-related urban living may contribute to metabolic disorders.
- Need for more green spaces and recreational facilities to encourage physical activity.
- Expansion of cycling and walking-friendly infrastructure can promote active lifestyles.

Social factors include demographics (age, gender, race, family size); consumer attitudes, opinions, and buying patterns; population growth rate and employment patterns; socio-cultural changes; ethnic and religious trends; and living standards.

- Cultural dietary habits (high sugar & fast-food consumption) contribute to rising diabetes rates.
- Increasing sedentary lifestyles due to urbanization and technology use.
- Strong family support networks can aid in managing diabetes effectively.
- Need for education campaigns targeting all age groups, particularly children.

Technological factors affect marketing in (1) new ways of producing goods and services; (2) new ways of distributing goods and services; (3) new ways of communicating with target markets.

- Advancements in wearable devices for blood sugar monitoring improve self-care.
- Telemedicine and mobile health apps allow remote diabetes management.
- AI-powered predictive analytics help identify high-risk individuals early.
- Integration of smart healthcare systems can improve access to real-time patient data.

Environmental factors are important due to the increasing scarcity of raw materials, pollution targets, doing business as an ethical and sustainable company, and carbon footprint targets.

- Urbanization reduces access to natural exercise spaces like parks and walking areas.
- Air pollution and stress-related urban living may contribute to metabolic disorders.
- Need for more green spaces and recreational facilities to encourage physical activity.
- Expansion of cycling and walking-friendly infrastructure can promote active lifestyles

Legal factors include health and safety, equal opportunities, advertising standards, consumer rights and laws, product labeling, and product safety.

- Government regulations on food marketing and labeling can influence consumer behavior.
- Workplace policies promoting health screenings can increase early detection.
- Stronger anti-discrimination laws for diabetes patients in employment and insurance.
- Mandatory physical education programs in schools encourage active lifestyles.

SWOT Analysis (Strengths, Weaknesses, Opportunities, Threats)

A SWOT analysis identifies your organization's strengths and weaknesses (S-W), as well as broader opportunities and threats (O-T). Developing a fuller awareness of the situation helps with both strategic planning and decision-making.

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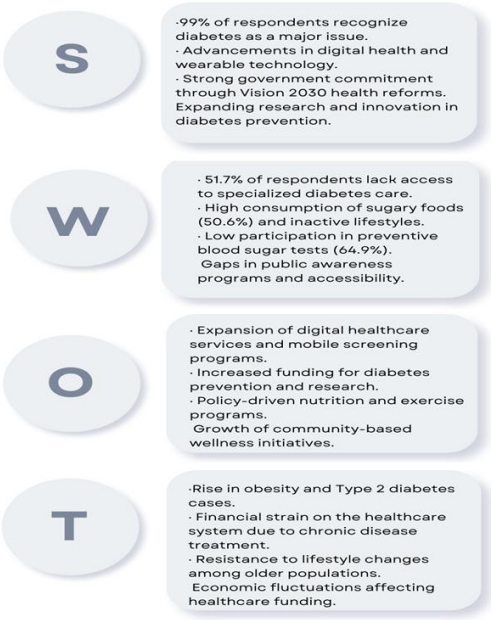

Fig 14. SWOT Analysis

Balanced Scorecard (BSC) for Diabetes Prevention Strategy in Saudi Arabia
The Balanced Scorecard (BSC) is a strategic tool used to measure performance and effectiveness across four key areas:

PERSPECTIVE	OBJECTIVE	MEASUREMENT (KPI)	TARGET	ACTION PLAN (INITIATIVE)	Linked to CSF
Financial	Reduce the financial burden of diabetes on the healthcare system	• % reduction in diabetes-related hospital admissions • % increase in government funding • Cost savings from early detection • % of patients receiving support	• ↓ 20% hospital admissions • ↑ 85% funding • 20% cost savings • 90% subsidy coverage	• Expand free screening • Government medication subsidies • Workplace health programs • Insurance partnerships	Efficient resource allocation, cost containment, and policy support
Customer (Public	Increase public awareness and engagement in diabetes prevention	• % increase in awareness campaign attendance • % population screened • % improvement in awareness • % of schools with health programs	• ↑ 50% campaign participation • 50% of population screened • 50% knowledge improvement • 85% school implementation	• Nationwide campaigns • School & workplace education • Mobile screening units • Influencer and professional engagement	Community involvement, behavior change, and preventive culture

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Internal Processes	Improve system efficiency and accessibility to diabetes care	• % increase in diabetes clinics • % reduction in wait time • % hospitals using AI-monitoring • % trained healthcare professionals	• ↑ 40% clinics • ↓ 50% wait time • 50% AI adoption • 85% trained staff	• Specialized rehab centers • Expand telemedicine • Supply chain optimization • PHC diabetes screening	Technology adoption, care accessibility, infrastructure expansion
Learning & Growth	Promote research, innovation, and workforce development	• % increase in research funding • % adoption of digital health tools • % trained staff annually • % of new prevention policies	• ↑ 70% R&D funding • 50% tech adoption • 80% staff training • 50% new policy implementation	• Invest in R&D • University partnerships • Continuous training • Promote smart health tools (e.g., wearables, apps)	Innovation, professional development, policy effectiveness

Table 2. Balanced Scorecard

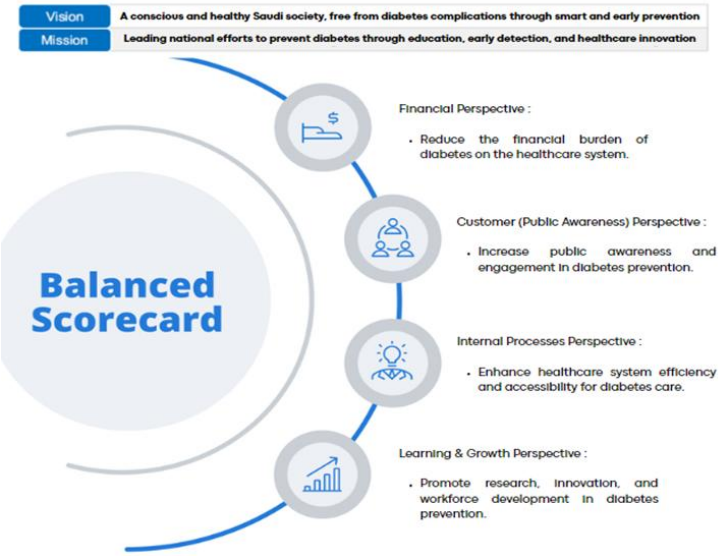

Fig 15. Balanced Scorecard

RESULTS

This study highlights the strategic importance of early diabetes screening, lifestyle interventions, increased healthcare accessibility, and the integration of digital health technologies in reducing the burden of diabetes in Saudi Arabia. This study highlights the strategic importance of early diabetes screening, lifestyle interventions, increased healthcare accessibility, and the integration of digital health technologies in reducing the burden of diabetes in Saudi Arabia. As shown in Figure 6, 83.2% of respondents recognize diabetes as a major health problem in Saudi Arabia.

The reviewed literature consistently supports the effectiveness of such multifaceted approaches in curbing diabetes prevalence and improving long-term health outcomes. The analysis of survey responses further supports this, revealing critical gaps, Figure 8 shows that 64.9% of individuals had not had their blood glucose tested in the past year, supporting the need for early screening. Figure 4 shows that 51.7% lack specialized diabetes care, confirming the recommendation to expand the geographical coverage of centers.

To address these challenges, the proposed strategy emphasizes the need for expanding free diabetes screening programs across schools, workplaces, and rural communities. It also calls for implementing school-based nutrition and fitness education, regulating food marketing to reduce sugar consumption, leveraging wearable technologies and AI-driven monitoring, and improving nationwide accessibility to specialized care. With sustained investment in

prevention and patient education, Saudi Arabia is positioned to achieve significant progress in reducing diabetes incidence and improving public health.

DISCUSSION

Future work should focus on scaling the national diabetes strategy by integrating mobile and digital health innovations into a centralized healthcare database. As Figure 11 indicates,

This would allow for personalized monitoring, data-driven policy interventions, and predictive analytics to support early detection. Furthermore, school-based education programs should evolve with gamified learning apps and AI tutors that engage students in lifestyle-based disease prevention, as mentioned in Figure 7. Policy reform could also expand into regulating digital food marketing and incentivizing healthy behavior through national wellness rewards programs. The majority view nutrition and exercise education as essential, supporting the recommendation to introduce them as mandatory subjects Figure 9-10.

Finally, the integration of telemedicine with AI-powered diagnostics may serve as a foundation for building virtual diabetes care centers, particularly in underserved or remote regions. These future directions hold promises in not only preventing diabetes but also empowering individuals to take active control over their health outcomes.

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