Introduction

Diabetes mellitus is approaching epidemic proportions worldwide. Currently, there are 537 million adults, from ages 20-79, living with diabetes, predicted to rise to 643 million by 2030 and 783 million by 2045 (IDF diabetes atlas). Diabetes mellitus is a chronic medical condition characterized by elevated blood sugar levels; this occurs when the pancreas does not make enough or any insulin, a hormone that helps glucose get into one's cells for energy and regulate blood sugar. Furthermore, Type 2 diabetes mellitus (T2DM), where diminished insulin response classifies as insulin resistance, has grown into a serious health issue among South Asians, individuals in or with ancestry from the Indian subcontinent, as they hold one of the highest percentages of Type 2 diabetics around the world.

There is a lack of care and attention around self-monitoring, shown by the complex medication regimen, problems with motivation, and stigma among families while battling type 2 diabetes. This problem has negatively impacted the Indian community of America, especially immigrants, by forcing a change in their dietary habits, furthering misconceptions, and creating a lack of resources attuned to their cultural practices in preventive care and self-management, becoming determinantal to their health (Sohal et al., 2015). A possible cause for this disparity is the lack of attention to barriers and a lack of an investigation into the attitudes and awareness of diabetic patients regarding how their daily lifestyle and culture are affected by living with type 2 diabetes as an Indian American.

Furthermore, although there is a higher association between type 2 diabetes and the Asian Indian diaspora in comparison to other ethnic populations in the United States, there is a discrepancy in health literacy and T2DM knowledge about self-management and glycemic

control, specifically with the different modes of monitoring such as glucose meters, electrochemical biosensors, and wearable devices, in the American South Asian community. A biological response transforms into a quantifiable signal using biosensors, analytical instruments integrating a biological element, and a physicochemical detector. The biological component, the bioreceptor, can be whole cells, nucleic acids, enzymes, or antibodies. By interacting with the target analyte, such as particular molecules or compounds, this bioreceptor produces a signal that can be detected. The physicochemical detector converts this biological response into a measurable output, typically thermal, optical, or electrical signals. Biosensors can potentially revolutionize diabetics' blood glucose monitoring in the future, thanks to current biotechnology advancements. Still, the interpersonal attitudes and opinions on these devices lack investigation.

Literature Review

Cultural Influences on T2DM Self-Care

In reviewing the present literature in the field, personal cultural beliefs are vital in actively shaping decision-making beyond the genetic pre-markers, external environment, and lifestyle choices that can be considered the basis for one's relationship with self-care for T2DM. For example, the study by Misra & Khurana (2009) explored how the prevalence of obesity and metabolic syndrome is increasing within the South Asian population due to Type 2 Diabetes Mellitus (T2DM) and cardiovascular disease (CVD). The study explored how rapid urbanization, changing lifestyles, phenotypic features, correlations between determinants, subclinical inflammation, psychological stress, genetic and perinatal factors, migration, and socioeconomic factors contribute to preventing and controlling metabolic syndrome in South Asians. The results from this showed a high prevalence of metabolic syndrome and associated cardiovascular risk factors in economically disadvantaged people located in urban slums and rural areas due to

nutrition, lifestyle, and socioeconomic transitions, which in turn increases affluence, urbanization, mechanization, and migration. More importantly, the psychological stressing factors of urban setting, genetic predisposition, the environment, and "catch-up" obesity, alongside physical traitors, are predominant in the South Asian community. The findings showed that increasing awareness of type 2 diabetes and the associated risk factors could help with prevention strategies in the South Asia community due to the high cardiometabolic risk associated with the Southeast Asian demographic (Misra & Khurana, 2009).

Given the apparent awareness of one's health due to hereditary issues, personal perceptions, and evolving cultural attitudes shape one's relationship with one's health and how one approach self-care when treating chronic illnesses. Imran et al.'s study (2015) showcases this by exploring how South Asian perceptions and cultural views influence the self-management of type 2 diabetes in America. This study focused on perceptions, cultural factors, and practical constraints. The study found that the main barriers to healthy behaviors were regular physical exercise, consuming low-glycemic foods, attending physician's appointments, difficulty adapting to dietary changes, and poor understanding of disease severity and complications. The presence of cultural factors complicating self-care and adherence to traditional social roles also influences South Asian's management of diabetes and its associated complications. The most concerning responses in this qualitative study were the lack of knowledge and perceptions associated with diabetes, coupled with difficulties due to cultural practices and religious obligations (Imran et al., 2015).

Beyond oneself, interactions and relationships with family and caregivers actively shape one's case and reveal gaps in providing comprehensive T2DM support. Similarly, Sohal et al.'s 2015 study systematically reviews studies exploring South Asian diabetic patients' perspectives

on barriers and facilitators to glucose management. Specifically, the study explored why diabetes management was so poor in South Asians, despite being a leading demographic in the diagnosis of type-2 diabetes mellitus, by investigating attitudes on interactions with health care workers, diet, exercise, and medication adherence, core components of diabetes management. The method used a literature search of over 208 abstracts using OVID, CINHAL, and EMBASE databases; 20 studies were evaluated based on qualitative synthesis for their interactions with health care providers, diet, exercise, and medication adherence. The sampling process for the 20 studies out of the 500 was the identification and assessment of the quality and risk of bias of qualitative studies using CASP (Critical Appraisal Skills Program). The studies identified language and communication discordance as a significant barrier, an inconsistency in wellness to following physicians' guidance in self-management, a lack of adaption to curate a South Asian diabetic diet, social responsibilities and stigma, and misconceptions. Moreover, the overarching theme was a lack of understanding and knowledge over diabetes medication management, which itself was not adapted to fit the needs of South Asians culturally (Sohal et al., 2015).

Insights into T2DM Management: Present Solutions and Challenges

Current T2DM treatments include glucometers, lifestyle changes such as a healthy diet and increased physical activity, and pharmacological interventions such as metformin, insulin, and other medications. However, any solution to living with a chronic illness will have its limitations and setbacks.

The study by Chittem et al. (2022) significantly contributes to understanding the challenges faced by Type 2 diabetic Indian patients. It delves into the inhibiting factors to self-monitoring blood glucose (SMBG) and managing medication, comparing patients'

experiences, their primary family members (PFMs), and physicians. The study identifies three main issues: confusion in the complex medication regimen, alternative therapies recommended by the family due to social stigma, and financial stress of the illness. The findings emphasize the importance of training physicians' emotional connectedness and communication, empowering patients to communicate concerns, and educating patients on managing Type 2 diabetes to reduce the negative implications. The study also sheds light on the shared ideals of the Indian immigrants in the United States with Type 2 diabetes, explaining their behavior and response in SMBG, which is furthered by discrepancies in the care presently available in the field, impacting the social stigma, cultural attitudes, and lifestyle choices (Chittem et al., 2022).

The discrepancies hurt improving the standard of one's health, as shown by Bhurji et al. (2016), who delved into the management intervention systems for Type 2 diabetes patients of South Asian origin from Pakistan, Bangladesh, and India in both the Western and Eastern realms. The study revealed a significant disparity in diabetes control within the South Asian population, a finding that should raise concern and prompt urgent action. The research also highlighted how lifestyle and knowledge influence this gap, drawing from a comparative analysis of randomized controlled trials (RCT), a systemic review of prospective pre-post-test observational studies, and differences in data collection of blood pressure, lipid levels, and anthropometric measures from the studies. Bhurji et al. (2016) found a disparity in the number of articles conducted in each hemisphere: only seven in the UK, while sixteen in India. The intervention studies included seven mixed, eight educational-based, and three exercise-based, which reflected themes of culturally specific educational practices and resources in the ones from the UK, while the Indian ones focused on yoga, resistance exercise, and dietary education. These findings expressed that diabetes management interventions for South Asian patients were varied because of the limited

success in HbA1c reduction, which differed by region and intervention. Studies in India based on exercise interventions reduced HbA1c levels. In contrast, blood pressure, lipid levels, and knowledge levels were higher in European and Indian studies, yet BMI remained stagnant. The results highlighted the meta-analyses of RCTs to showcase that culturally adapted diabetes management significantly improves HbA1c, extending consideration to the surface (superficial characteristics of a population including people, language, places, and food) and deep (integration of the sociocultural concepts, historical context, and psychological factors unique to a population) structural, cultural adaptations (Bhurji et al., 2016).

Moreover, Saboo et al. 2019 explored the limitations of currently available glucose monitoring, glycosylated hemoglobin/self-monitoring of blood glucose, and glycemic variability, a predictor of poor glycemic control. Specifically, the study examined the Indian population, continuous glucose monitoring, and its potential benefits. It highlighted the importance of glucose variability and pathophysiology in diabetes complications, the role of software in glucose monitoring, and clinical applications of continuous glucose monitoring. The findings from this study not only recommend continuous glucose monitoring for type 2 diabetic patients on basal insulin therapy to address hyperglycemia in long-term treatment but also underline the transformative potential of continuous glucose monitoring in diabetes management. This revelation should inspire healthcare professionals and researchers, providing them with the knowledge to set target metrics, use data to analyze and adapt insulin dosage and meal plans, and deal with hyperglycemia and hypoglycemia effectively (Saboo et al., 2019). The prevalence of technology in transforming the performance of the present solutions is evolving into a necessary course of action according to the field.

Biosensors: Advantages and Setbacks

In exploring non-invasive blood glucose monitoring technologies, researchers have delved into various approaches and their potential impact on diabetes management. Bolla and Priefer (2020) explored how non-invasive devices and prospects perform in blood glucose monitoring. Specifically, the study looked into how blood glucose monitoring and its role in medication dosage adjustment can aid in managing burdens and adherence while checking glucose levels. The study compared the non-invasive blood glucose monitoring technology and devices such as urine, breathalyzer, finger detection, Metabolic heat conformation (MHC), Near-infrared spectroscopy (NIR), Mid-infrared spectroscopy (MIRS), earlobe, ultrasound, electromagnetic sensors, thermal emission spectroscopy (TES), hand, tears, optical polarimetry system, and retina pigmentation. The findings from the study showed that a significant amount of effort has been put into researching non-invasive technology. However, adherence to blood glucose monitoring can be accredited to the current methods that are considered painful, expensive, and a hassle. The market can be modified to accommodate the approaches to be more accessible, less expensive, and accurate to improve the quality of life for diabetic patients.

Building upon this foundation, Bruen et al. (2017) explored the recent advances in glucose monitoring for people with diabetes using non-invasive methods utilizing other biological fluids rather than blood. More specifically, the study focused on interstitial fluid, sweat, breath, saliva, and ocular fluid within the context of creating a biosensor for daily use, personalized to each patient in monitoring. The study critically reviewed each of the options, assessing their various versions, growth within the field, prospects, and comparisons in effectiveness and usage; the findings from the study showed that as wearable biosensors play an essential role in continuous non-invasive monitoring for diabetes, among other diseases, the findings showed further clinical evaluation is needed for it to go big in the market. At the same

time, the interest of significant companies attests to the marketability prospects of biomarkers. The findings recognize that the current options, such as fitness bands and smartwatches, are limited to a tangible impact on health and wellness, and there are no additional insights into clinical health practices that help promote a lifestyle that betters their state of day-to-day living.

Shifting from technological advancements to practical considerations, the study by Johnsten et al. (2021) explored the factors needing improvement in user biosensing technologies. It specifically looked into the precision, repeatability, wearability, and accessibility to end-users, among other challenges that affect the perspectives on developing biosensors for glucose monitoring. The study identified general challenges and perspectives for biosensors, such as high costs that limit accessibility, development setbacks, biofouling, sensor lifetime, and calibration. It outlined the ideal design for a continuous glucose monitoring biosensor as having a long sensor life and being accurate, accessible, and affordable to the community. This underscores the community benefits of such a biosensor design, making the audience feel involved in the development process and its potential impact on the diabetic community.

These studies demonstrate the growing interest and investment in non-invasive blood glucose monitoring technologies and the challenges and opportunities of their development and implementation in clinical practice.

Gap

Since Type 2 Diabetes Mellitus (T2DM) is becoming more common in the South Asian community, especially in the US, it is urgently necessary to address gaps in health literacy, cultural perceptions, and self-management practices. Diabetes is a condition specific to each culture and individual, and exploring non-invasive biosensors is crucial to bridging this gap. There is a lack of culturally attuned monitoring and intervention practices that take into account

the various factors such as the stress of "catch up" obesity, lack of awareness of their history, difficulty in adapting to dietary changes, poor understanding of disease severity and complications, the social stigma of having diabetes, and cultural practices and religious obligations as shown by Misra et al., Imran et al., and Sohal et al.'s studies. They are not tailored to the diverse cultural and ethnic groups of India; the disparity is furthered with immigration to Western nations, as shown by Bhurji et al. However, technological advances showcase how biosensors hold a promising alternative to current solutions, given the emerging technology's prospective efforts and advances in continuous glucose monitoring. The gap is that there is a lack of research or effort put into how biosensors can be culturally congruent to the American urban South Asian community as an emerging technology while being mindful of cultural perceptions, as the current research focuses on cultural congruency with intervention methods, medications, and lifestyle changes in areas that are in rural settings such as India.

Thesis

The intricate interplay of cultural perceptions, healthcare strategies, and evolving biosensor technologies significantly influences the monitoring preferences of South Asians regarding T2DM. These technologies can potentially enhance health literacy, self-management, and glycemic control among South Asians living with T2DM in the United States. Understanding these cultural nuances is crucial as it reveals an inclination for monitoring characterized by social acceptability, discretion, and minimal disruption to their daily routines rooted in tradition, culture, and religion. However, adopting biosensors may cause apprehension due to perceived costs, novelty, and reliance on technology, which contrasts with the familiarity of conventional glucometers and routine medical assessments. The aim of investigating these components is to develop a comprehensive understanding of the barriers

hindering effective T2DM management within the South Asian community and to propose strategies for more culturally sensitive and technologically advanced approaches to enhance health outcomes.

Method

In order to assess the cultural perceptions and South Asian attitudes towards biosensors in T2DM blood glucose management, a mixed approach of analyzing quantitative and qualitative data, combining an ethnographic and needs assessment, was designed to target the lack of knowledge on diabetes management when it comes to newer alternatives, such as biosensors, within the South Asian community. The basis for the lack of awareness is investigated through ethnography, exploring cultural attitudes, religious beliefs, dietary customs, physical activities, and traditions to discover the causative factors of certain habits of the South Asian population and come up with accurate explanations for these behaviors. Moreover, a needs assessment will help address how the issues within self-care Diabetes Type 2 management can evolve and help to curate a solution for them based on their needs and habits by pinpointing areas that necessitate additional research, funding, and support; the needs assessment facilitates the formulation of targeted interventions aimed at enhancing diabetes management practices within the community.

Through a voluntary response survey published at churches, temples, and other religious establishments with a high South Asian population attending, the survey questions, answer choices, and sections in Appendix A was provided through either a link or a QR Code.

Logical Defense

Through a mixed data collection approach, both quantitative and qualitative, this study can assess various aspects of life with T2DM. The first section of my survey had four questions to be answered for participation: informed consent, of South Asian origin, from the Greater

Houston Area, and living with T2DM. Therefore, all the responses helped me target the gap between being from an urban/suburban and getting various socioeconomic backgrounds. Then, there were demographic questions on age, how many years they have had diabetes, current medications, average A1C levels, blood sugar mg/dL, and how often they check their blood glucose with a glucometer per day, aggregated and a generalization for my study population.

Next, the perceptions section addressed the cultural, social, mental, and physical issues that come with T2DM, identifying the factors that play into their decision-making by exploring any diets, natural remedies, and Likert scale questions, based on the typical beliefs from Imran et al.'s 2015 study. This can expand on the current literature in the field, reflect on the habits and attitudes of the Greater Houston Area, and note any differences to what exists.

For the section on biosensors, the survey first gathered preliminary knowledge of biosensors before presenting a definition. This was followed by a section with a Likert scale for pictures and descriptions of 5 different biosensors: a skin patch, glasses, mouthguard, wristbands, and implant from Johnston et al.'s 2021 study, as well as Likert scale questions relating to social discomfort, technology, and logistics. Given the generalized nature of the studies, the survey's responses can be compared against similar assessments of wearable technology and biosensors present in the field and the South Asians' attitudes and perceptions of the technology as a baseline foundation. Through the Likert Scale, responses will be quantified for the questions to gauge which biosensors are favored and what aspects or characteristics are preferred by the South Asian population of the Greater Houston area.

Ethics

The proposed method complies with ethical research practices with the approval of the IRB application for permission to collect and publicly present data from human subjects.

Additionally, I safeguarded participants' privacy by ensuring confidentiality and anonymity to comply with the CollegeBoard Privacy Policy. To safeguard participants' privacy and ensure the confidentiality of data obtained, no identifying information was obtained nor published, as the reported information will be an analysis of responses to the questions. After the project's completion, all responses and any data were destroyed in any form within six months. Informed consent was signed before the survey, which records an individual's participation agreement.

Discussion

Results

Faced with the everyday use of traditional glucometers, this study questions how cultural perceptions and interpersonal attitudes shape urban American South Asians' view on Type 2 diabetes management, specifically in which ways these perceptions and attitudes affect continuous glucose monitoring habits within the community, especially with wearable technology and biosensors as an alternative to glucometers. This study focuses on the South Asian diaspora of the Greater Houston Area, as opposed to the rural settings of the Indian subcontinent as in many other studies within the field, shedding new light on the differences in attention to care and self-monitoring with differences in socioeconomic status. This study also expands on the notions and perceptions previously found in the field to drive the conversation of this research by utilizing them to conclude what cultural aspects affect South Asians' perceptions of biosensors. This study further fills the gap by presenting various biosensors and aggregating the opinions of these South Asians, exploring intervention practices, social relations, and lifestyle choices as done previously in the field.

Data Analysis

I collected 77 responses, 17 of which fulfilled my requirements: being of South Asian origin (India, Pakistan, Bangladesh, Nepal, Bhutan, Sri Lanka, and Maldives), from the Greater Houston area (Harris, Fort Bend, Montgomery, Brazoria, Chambers, Galveston, Liberty, and Waller Counties), and if they have T2DM. For the demographics, I aggregated the results, the average age of the survey participants was 51.29 years. Additionally, the average duration of living with T2DM is 6-10 years, with the most common medications taken that were reported were Metformin and Genuvia, taken on average for 3.97 years. Participants, on average, had an A1C level of 4.825, checking their blood glucose on average once a day with a glucometer.

The participants' self-management strategies were diverse and reflective of their cultural backgrounds. Approximately 70.6% of the participants followed a specific diet for their diabetes, with variations such as "low carb," "keto," "restricting sugar and carbs," "less rice," and "chicken, egg, and vegetables." A significant majority, 76.5%, reported trying natural remedies and treatments, including "cinnamon," "walking exercise," and "fenugreek water." These findings underscore the influence of cultural perceptions on diabetes management and highlight the need for culturally sensitive healthcare approaches.

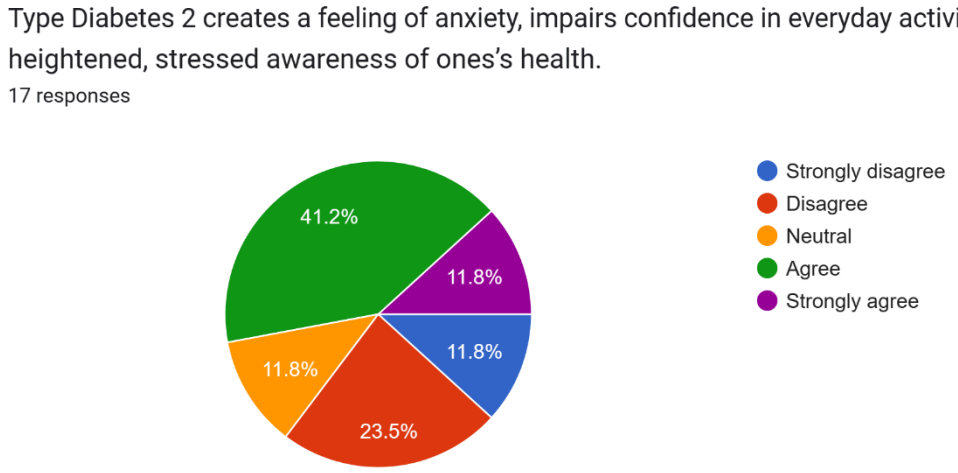
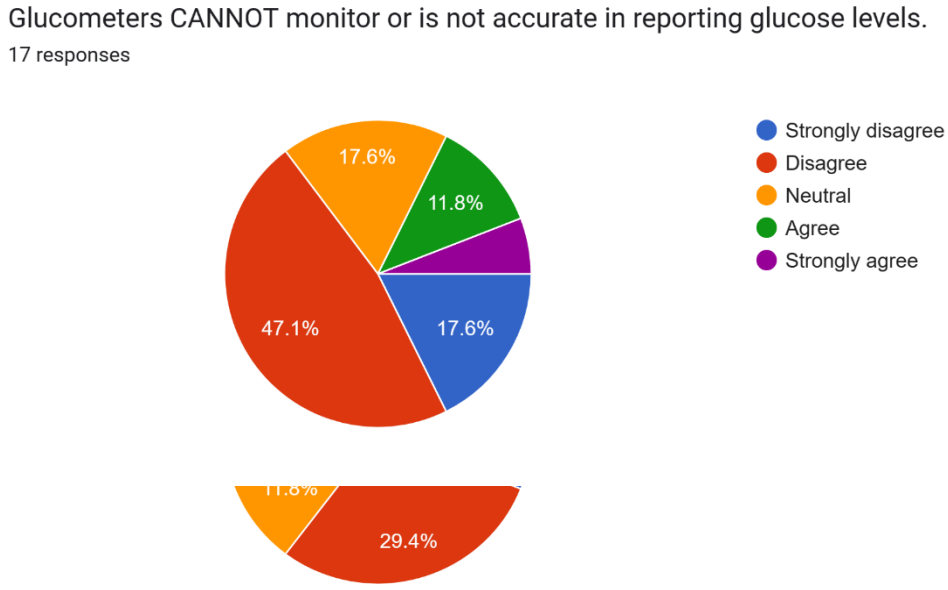


Figure 1

In the Likert section, the stimulus questions revealed that each individual's definition of living with T2DM varies from individual to individual, as found in previous studies in the field.

When exploring the relationship between the individual and T2DM, two perspectives were addressed: the obvious social, mental, and physical issues that come with T2DM serve as a factor that plays into their decision-making and journey with T2DM. In Figures 1 & 2, 63% both



agreed with the feeling of anxiety, impaired confidence in everyday activities, and a heightened, stressed awareness of one's health and physical discomfort in monitoring, furthered by any side effects and interference with daily activities for long periods or physical activities with T2DM.

However, there seems to be a sense of dependence and trust in glucometers, showcasing that the South Asians of the Greater Houston Area are willing to use glucometers for regular monitoring, as shown in Figure 3.

The most prevalent personal beliefs that participants reported were "There is wrong information about curing diabetes… in my family, lifelong, and therefore I have to live with it," and "I have to avoid junk food." There were also optimistic responses such as "I believe that it potentially helps in personal growth and resilience in the face of challenges, including those related to diabetes management," revealing that each individual's definition of living with T2DM varies from individual to individual, as found in previous studies in the field. This question helped shed light on the sense of finality that came with the genetic

Figure 3

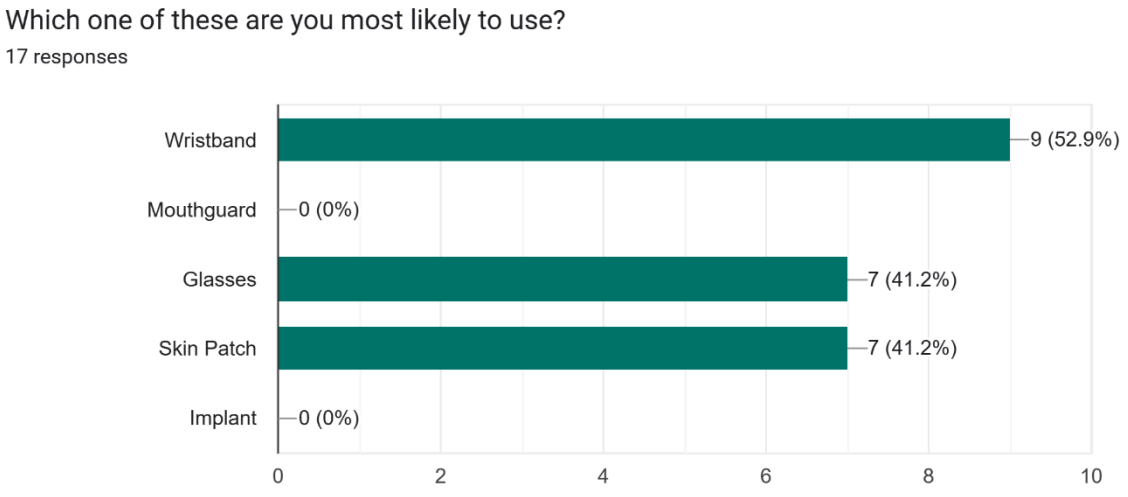


Figure 4

and permanent nature of living with diabetes, expressing how they verbalize their personal beliefs surrounding it.

When the participants were asked about biosensors and any preliminary knowledge, 52.9% responded yes, sharing that they knew of its "role in continuous monitoring of blood sugar," "painless as it checks blood sugar without poking," and the Dexcom. In rating each of the five choices of biosensors presented to the participants, dislike was expressed for options that

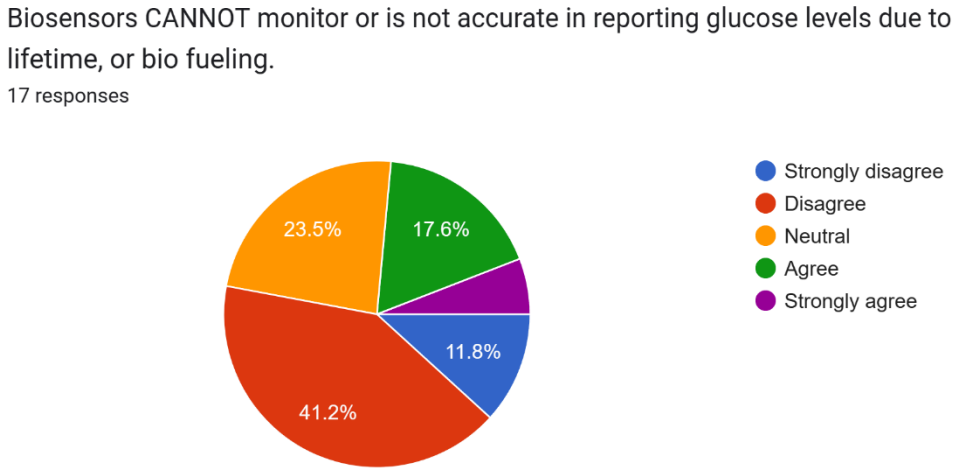


Figure 5

seemed socially uncomfortable or would cause discomfort despite being non-invasive, such as the mouthguard. Yet, some more minimally invasive options were shown as interesting, such as the skin patch, with the most preferred biosensors being practical, such as the wristband and the glasses.

When analyzing biosensors, the same participants shared similar sentiments; 63% agreed that this alludes to a sense of dependence and trust in biosensors, showcasing that the South Asians of the Greater Houston Area are willing to use biosensing for regular monitoring per Figure 5, as compared to the sentiment surrounding the glucometers.

The 41.2% who said that they are neutral on the costs, user-friendliness, and effectiveness of biosensors showcases the discrepancies in their knowledge of biosensors despite knowing the baseline of what they do for monitoring for T2DM per Figure 6.

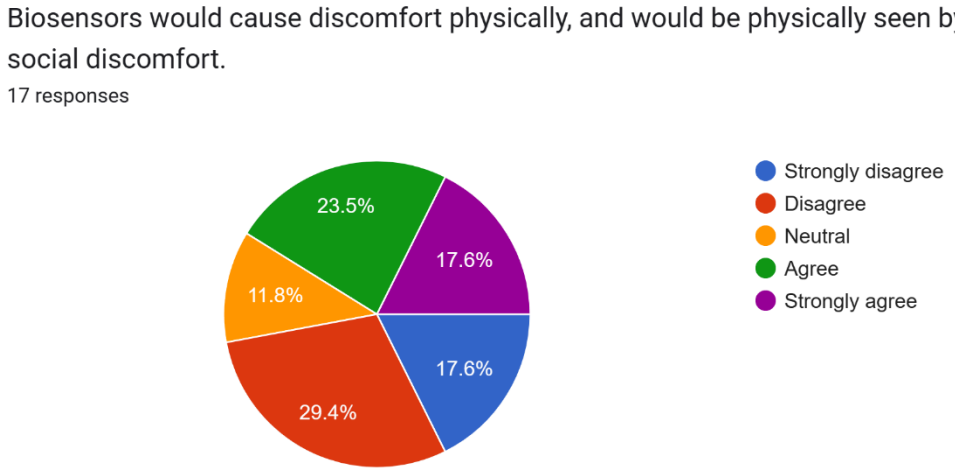


Figure 7

The same sentiment surrounding the social discomfort appears less significant with biosensors than glucometers, as around 47% disagreed with the statement. Therefore, this showcases there more of sense of comfort and assuredness with using biosensors compared to using glucometers, in which they would be comfortable to monitor diabetes and overcome the feeling of anxiety, impaired confidence in everyday activities, and a heightened, stressed awareness of one's health per Figure 7.

New Understanding

This study unveils a novel perspective on cultural attitudes toward biosensors after thorough data analysis. It reveals that these attitudes are primarily influenced by the chronic nature and perceived finality of T2DM, mainly due to its genetic component among South Asians in the greater Houston Area. Illness is established as permanent, and the idea of being "sick" or presenting as so creates a stigma for South Asians among their families and others, adding nuance to the beliefs beyond social acceptability, discretion, and minimal disruption to

daily routines. The study also sheds light on the perception of biosensors in terms of cost, user-friendliness, and effectiveness, with a notable preference for specific models like wristbands, glasses, and skin patches over implants or mouthguards among South Asians with T2DM in the area that align with their personal values and social expectations.

Implications

This research may serve as the foundation for a future strategy to address the South Asian population's inadequate management of Type 2 diabetes. The study clarifies how important it is to consider culture when creating interventions that work. Cultural traditions or fear of being judged can cause many South Asians to feel stigmatized or uneasy while discussing their T2DM status in public. To ensure that T2DM management tools are accepted and used within the community, it is essential to identify biosensor options consistent with these cultural norms. Using this knowledge as a foundation, intervention and prevention strategies can be built to produce a complete T2DM management system suited to South Asians' requirements and preferences.

The study highlighted preferred biosensor alternatives for frequent blood glucose monitoring. Culturally sensitive educational programs, community-based support initiatives, and access to resources that encourage healthy living practices are some examples of these interventions. Studies of this nature, encompassing diverse ethnicities, can pave the way for a comprehensive, inclusive approach to living with type 2 diabetes, thereby enhancing the quality of life for all. Moreover, by understanding the preferences of different ethnic groups regarding biosensor models, businesses can tailor their product offerings to meet the specific needs of these demographics, thereby enhancing market penetration and revenue generation. This targeted

approach benefits businesses and ensures that individuals from diverse backgrounds can access technology that promotes their health and well-being.

Limitations

The sample size was smaller than anticipated, given the resistance to talking about T2DM, which was expected. Since the sample size was less than 30, statistically significant conclusions cannot be made. Since the sample size of participants was South Asians with T2DM from the Greater Houston Area, the findings of this study are limited to the population of South Asians in this area. Furthermore, this study can only draw conclusions about biosensors' perceptions and not the performance and feedback of the South Asian community.

Conclusion

To address these, further studies need to be done on a larger urban population from the immigrant population of the South Asian population, expanding onto other entities and adding a component of testing out the preferred biosensor, and receiving feedback on its performance and integration into daily life. With emerging technology of this caliber, medicine, management, and, wellness can evolve to raise the standard of living. This multidisciplinary approach holds the potential to revolutionize healthcare delivery and enhance outcomes for populations affected by T2DM and other chronic conditions.

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Appendix A: The structure and questions of my survey

AP Research Study: Type 2 Diabetes and Biosensors

I am conducting a research study on Type 2 diabetes in the South Asian community of the Greater Houston Area and would appreciate it if you could answer the following questions for my research. Thank you.

* Indicates required question

You are invited to participate in a research project about Type 2 Diabetes management. This online survey should take about 5-10 minutes to complete. Participation is voluntary, and responses will be kept anonymous and/or confidential to the degree permitted by the technology being used. You have the option to not respond to any questions that you choose. Submission of the survey will be interpreted as your informed consent to participate.

*

I understand and I wish to proceed. I consent to participating in this study.

I DO NOT wish to proceed. I DO NOT consent to participating in this study.

Requirements

Requirements to participate in the survey.

Are you of South Asian origin?

(India, Pakistan, Bangladesh, Nepal, Bhutan, Sri Lanka, Maldives)

Yes

No

Would you say you live in the Greater Houston Area?

(Harris County, Fort Bend County, Montgomery County, Brazoria County, Chambers County, Galveston County, Liberty County, and Waller County)

Yes

No

Other:

Do you have Type 2 Diabetes?

Yes

No

Demographics

How old are you?

Your answer

How long have you had Type 2 diabetes?

Less than 1 year

1 year

2-5 years

6-10 years

11-15 years

16-20 years

21-25 years

26-30 years

31-35 years

36-40 years

41-45 years

46-50 years

51-55 years

56-60 years

60+ years

Please list all medication you take for Type 2 diabetes:

Your answer

How long have you been the medication listed above?

Your answer

What is your last A1C level? Enter a number.

Your answer

How often do you check your blood glucose with glucometer per day?

0 times

1 time

2 times

3 times

4 times

5 times

6+ times

What is your average blood sugar mg/dL per week?

Your answer

Perceptions and Attitudes

For the following statements, respond with one of answer choices that matches yours the best.

Do you follow a diet for your diabetes?

Yes

No

Other:

If you do follow a diet, please elaborate:

Your answer

Do you try natural remedies and treatments for your diabetes?

Yes

No

Other:

If you do, please elaborate:

Your answer

Type 2 diabetes is not life-threatening.

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

Glucometers CANNOT monitor or is not accurate in reporting glucose levels.

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

Sufficient information is provided on self-monitoring and options for managing Type 2 diabetes besides glucometers from primary care providers.

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

Type Diabetes 2 creates a feeling of anxiety, impairs confidence in everyday activities, and creates a heightened, stressed awareness of ones's health.

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

Type 2 diabetes causes physical discomfort in monitoring, furthered by any side effects, and interferes with daily activities for long periods of time or physical activities.

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

What other personal beliefs influence your decision-making when it comes to diabetes management?

Your answer

Introduction into Biosensors

Have you heard of biosensors?

Yes

No

If so, what do you know about biosensors?

Your answer

Biosensors

Biosensors are analytical devices that combine a biological component with a physicochemical detector to convert a biological response into a measurable signal.

For the following questions, answer with the following scale:

1: I will definitely use this.

2: I might use this.

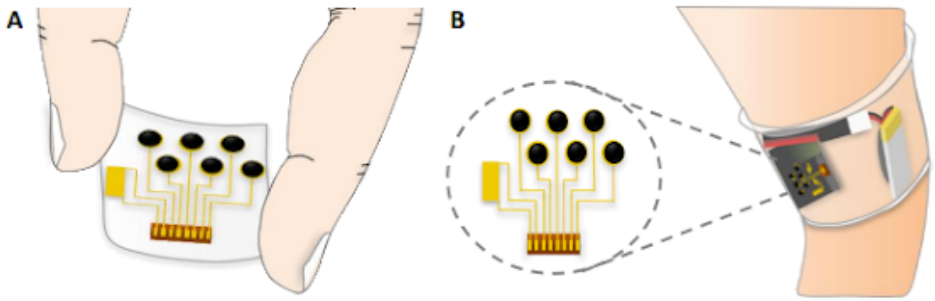
3: I do not care for it.

4: I will not use this.

5: I will definitely not use this.

Wristband: This device takes the form of a Bluetooth-enabled wristband integrating various sensors, a non-invasive wearable device designed for continuous monitoring of glucose levels through sweat analysis. These sensors can detect not only glucose concentrations but also skin

temperature, sodium, potassium, and lactate levels in sweat. The incorporation of multiple sensors and the complexity of sweat composition necessitates the use of multiple sensors, allowing for a more thorough understanding and cross-comparison of data, providing a comprehensive profile of the wearer's sweat composition for improved health monitoring.



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1

2

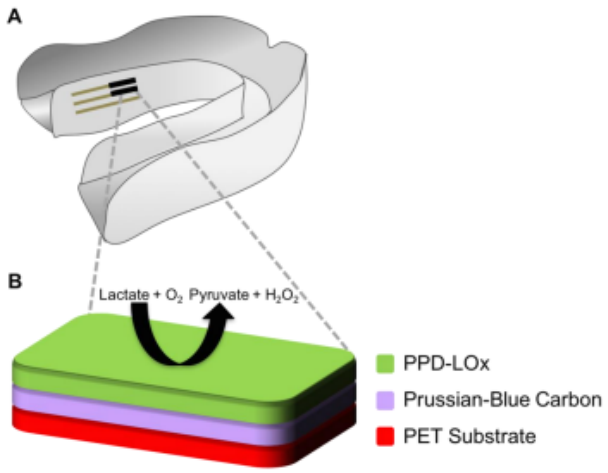
3

4

5

Mouth guard: A minimally invasive continuous monitoring platform utilizing metabolite sensing in saliva. This concept employs a printable enzymatic electrode. This involves a special sensor

on the mouth guard that can detect a specific substance called lactate in saliva. The sensor is highly sensitive and selective, providing accurate results. It works by using a special layer and a printable material that acts like an "artificial peroxidase" to detect another substance called hydrogen peroxide. The platform aims to provide accurate and stable results in human saliva samples, showcasing potential applications in continuous monitoring for various fields.



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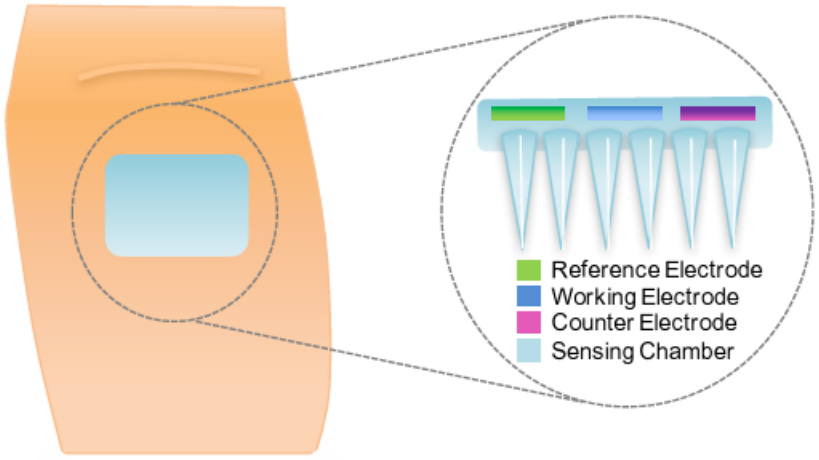
Skin patch: The device was designed in two compartments; the first containing the microneedle array and glucose biosensor with the second containing the electronics. The sensing device was attached to the skin by an adhesive layer contouring the perimeter of the sensing pod. The microneedle patch platform allows continuous access to interstitial fluid, operating for up to 72 hours with minimal impact on blood capillaries and nerve endings. The short microneedle length prevents reaching the dermis layer, minimizing damage and avoiding sweat contamination.



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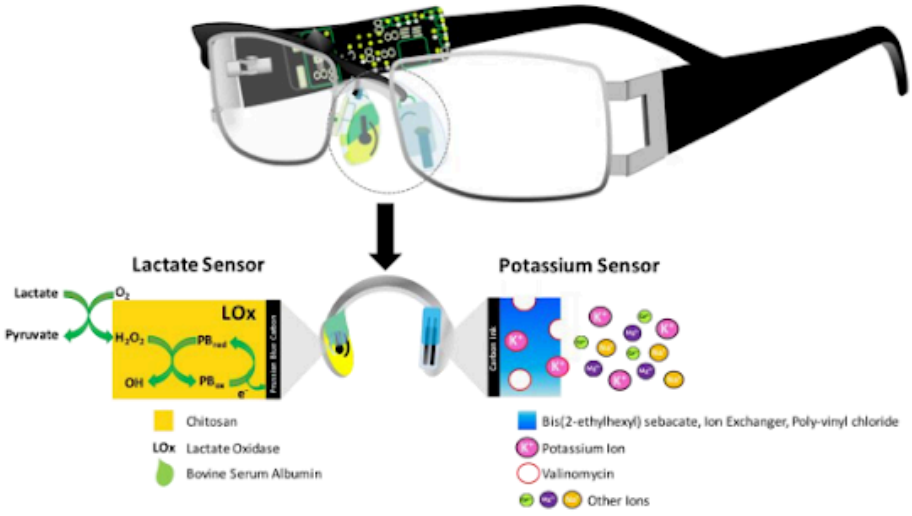
Glasses: The eyeglasses feature an amperometric lactate biosensor on one nose-bridge pad and a potentiometric potassium ion-selective electrode on the other. The positioning of the sensors on separate nose pads also minimizes crosstalk and facilitates separate fabrication and replacement. These instrumented eyeglasses were coupled by Bluetooth wireless data to a remote mobile host device for data analysis and visualization. This approach offers a seamlessly integrated solution for continuous monitoring of analytes in sweat that can easily fit into an individual's lifestyle.



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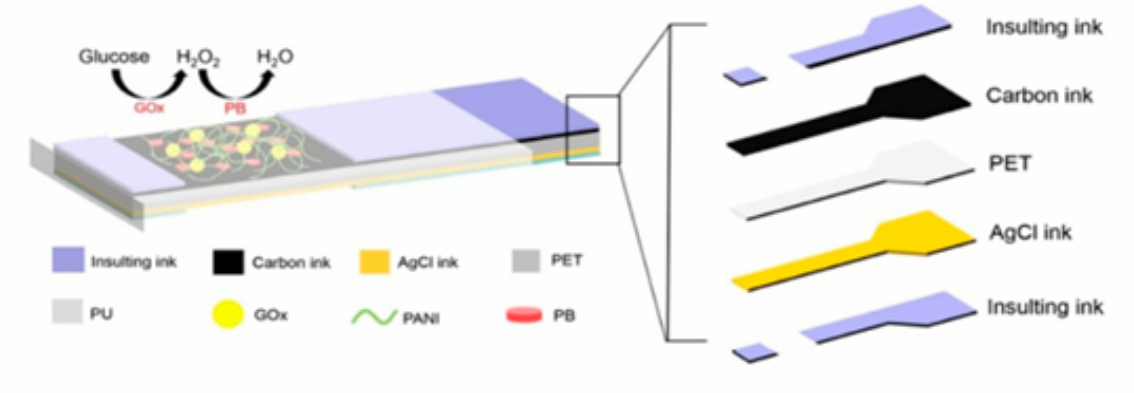
Implant: Utilizing functionalized reduced graphene oxide (rGO), this device employs a phosphate buffer solution and assesses human blood serum samples to gauge the impact of interfering molecules on the readings. The implant is constructed based on a thin layer of mesoporous metal-organic frameworks covering carbon nanotube (CNT) surfaces, serving as a platform for supporting electron mediators and the recognition molecule of glucose dehydrogenase. The implantation procedure involves a small incision of 3–5 mm in the skin to place the device beneath the skin. This method relies on a straightforward single-step modification of nano-polyaniline (PANI) and glucose oxidase (GOD), ensuring simplicity,

cost-effectiveness, and suitability for large-scale production.



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5

Which one of these are you most likely to use?

Wristband

Mouthguard

Glasses

Skin Patch

Implant

Biosensors Advances and Challenges

Biosensors are costly, not user friendly, and ineffective.

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

Biosensors CANNOT monitor or is not accurate in reporting glucose levels due to sensor calibration, lifetime, or bio fueling.

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

Biosensors would cause discomfort physically and would be physically seen by others, causing social discomfort.

Strongly disagree

Disagree

Neutral

Agree

Strongly agree