Health Promotion Interventions for Tackling Type 2 Diabetes in Surabaya: A Multi-Perspective Root Cause Analysis

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ABSTRACT

***Background**: Type 2 Diabetes Mellitus (T2DM) is a metabolic disorder. In Surabaya, it has been a growing public health challenge, with rising prevalence and increasing strain on people and healthcare. **Objective**: The purpose was to identify a root cause of T2DM, and to provide possible solutions to tackle the problem. **Methods**: A mixed-method design was used. Qualitative data were obtained from three structured interviews capturing the perspectives of a patient, a physician, and a community health center worker. Problems contributing to DMT2 were brainstormed and then prioritized using the USG method. A "web of causation" approach was applied to identify the root cause of the problem. **Results**: Unhealthy lifestyle behaviors were prioritized based on the USG analysis. Knowledge insufficiency was identified as the root cause. Two evidence-based solutions are proposed: (1) mobile messaging and (2) "point-of-decision" education in workplaces, canteens, and other public spaces. **Conclusion**: WhatsApp/SMS education through Puskesmas registries and "point-of-decision" education in public spaces are feasible interventions to enhance diabetes knowledge, promote healthier eating, and reduce sugary product consumption.*

***Keywords**: Diabetes Education, Diabetes Mellitus Type 2, Healthy Intervention, Health Promotion*

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a metabolic disorder due to high blood sugar levels arising from insulin resistance. It is among the leading non-communicable diseases worldwide and poses major public health issue, especially in rapidly urbanizing and densely populated areas (IDF, 2025; (Solis-Herrera *et al.*, 2018). The condition is strongly influenced by lifestyle factors such as unhealthy diet, physical inactivity, and obesity, along with genetic predispositions, and it poses serious risks for complications including cardiovascular disease, kidney issues, and neuropathy (Manihar *et al.*, 2024).

Worldwide prevalence of diabetes data is worrisome. Specifically, people aged 65-99 years-old with both types of diabetes accounted for 158.3 million sufferers in 2024. Moreover, if the trend remains same, then the number of diabetes patients aged between 65-99 is expected to be as high as 278 million by 2050 (IDF, 2025). In Surabaya, T2DM is a significant and growing health problem as well. Incidence of T2DM has doubled from the year of 2023 to 2024, in absolute numbers: 32,228 people in 2023 to 58,806 people in 2024. Prevalence also has risen in absolute numbers from 106,351 in 2023 to 149,055 in 2024 (DINKES,2025). Prevalence is particularly drawing attention, considering that Surabaya's population is expected to rise (Worldpopulationreview, 2024).

Numerous individuals with diabetes mellitus in Surabaya fail to meet treatment targets for blood glucose levels (FPG and HbA1c), which results in complications such as microvascular issues, increased serum creatinine, and metabolic syndrome. These issues lower the quality of life and heighten psychological distress

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and difficulties in understanding illness among patients (Soewondo *et al.*, 2010).

Patients incur expenses related to direct treatment, such as medications and hospital visits, as well as indirect costs stemming from decreased productivity and the requirement for family caregiving assistance (Dewanti *et al.*, 2025).

Financial burden is increasing due to rising medication treatment, complication management, and need for continual monitoring. Significant portion of hospital visits is due to T2DM with the need for long-term care and treatment (Patty, Mufarrihah and Nita, 2021).

T2DM is not merely a clinical condition but also a behavioural and social issue which demands health promotion approaches. This becomes particularly clear, when we consider that major determinants of T2DM are modifiable, such as unhealthy diet, physical inactivity and limited health literacy. In addition, gaps in community awareness and undeveloped environment support for healthy choices, undoubtedly, contributing to high prevalence of T2DM. Health promotion strategies that possess behavioural, social and environmental aspects along with consideration on the community level is needed.

Novelty of current paper lies on studying behavioral and environmental determinants by multiperspective interview approach in order to link with practical health promotion interventions. Unlike other studies that focus on risk factor analyses, current study attempts to comprehensively assess behavioural aspect diabetes from views-points of stateholders, such as a patient, endocrinologist, and public health worker.

Importance of the current study is reflected in explanation of how different health theories influence and sustain T2DM. Therefore, aim of current article is to propose possible health promotion intervention program through root cause analyses of T2DM aided by multiperspective interview approach.

METHODS

Data collection was conducted in Surabaya City Health Center. First, possible problems that maintain T2DM as a health issue were brainstormed by the local staff and based on published data several problems were suggested. Then problem prioritization was performed by 7 public healthcare workers (PHW) using USG method (Ariyanti *et al.*, 2020), where brainstormed problems were scored from 1 to 5 in relation to *Urgency, Seriousness, Growth*. Before scoring each of the problem, USG method was explained and was conducted by gathering these 7 PHW. USG method is used because it is simple, rapid and structured way to prioritize a health problem.

Primary data was obtained through three structured interviews from a patient, an endocrinologist, and a public health center worker perspective. Three interviewees were recruited through *snowball sampling*. Ethical clearance was certified with the number: 1088/HRECC.FODM/X/2025. Interview questions were designed by the first author and then were revised after discussion with the other authors.Latter was done to ensure content validity, improve clarity and cultural fit and to reduce possible bias that might arise if only one person has developed interview questions.A fundamental principle for questions design is based on multi-perspective interview approach which has been widely used by other investigators (Grant *et al.*, 2020); (Peleg *et al.*, 2009); (Cheng *et al.*, 2023). This design enables to comprehensively approach a given problem.

Since sampling of interviewees is n*on-probabilistic*, current paper does not aim to synthesize representative views of all patients, endocrinologists and public health care workers of Surabaya, but rather aims to *explore* views assessed by multi-perspective approach, thus sample size is not expected to be large.

After prioritized problem was identified by USG method, based on literature review, six areas are chosen as core reference domains for interview questions development. They are: 1) Diet and nutrition; 2) Physical activity; 3) Healthcare access; 4) Behavioral factors; 5) Culture; 6) Socioeconomic and environmental factors (Colillas-Malet *et al.*, 2023); (Lisetyaningrum, Pujasari and Kuntarti, 2021); (Martinez-Lacoba *et al.*, 2018). Examples of how questions differ depending on the perspective can be found in Table 1. Through multiperspective approach different insights can be obtained. For example, from patient's side personal barriers, habits, daily struggles are revealed. An endocrinologist can share

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valuable information regarding risk factors, treatment challenges, complications can be gained. Puskesmas worker's side can shed some light on the community level issues, such as access, health policy, screening barriers. Therefore, by differentiating these viewpoints can provide more holistic understanding of complex diabetes behaviour and its care, which is poorly comprehensible from single viewpoint. Based on interview results and published secondary data regarding unhealthy lifestyle, a root cause was analyzed. Specifically, it was performed using "Web of causation" method, first proposed by Susser and further developed by MacMahon and Pugh (Susser, 1973). This method acknowledges that health problems originate from multiple, interacting social, behavioral and biological factors rather than from isolated causes.

RESULTS AND DISCUSSION

Health problem prioritization

After brainstorming with non-communicable disease team, six problems were identified (see Table 2). 7 experts were asked to score from 1 to 5 each problem in relation to Urgency, Seriousness, Growth as described in methods. The results of scoring by using method USG are provided in Table 2. According to 7 respondents the first priority problem is "Unhealthy lifestyle of people".

Root cause analysis and other involved factors

Based on the interview results, several contributing factors emerged that align with established health behavior models. The availability and marketing of processed, high-calorie, nutrient-poor foods act as cues to action according to the Health Belief Model (HBM) (Alyafei and Easton-Carr, 2024). In Surabaya, fast-food outlets, convenience stores, and sugary beverage promotions dominate the food environment, making unhealthy choices more accessible (and often cheaper) than fresh, nutrient-rich options. This abundance of marketing serves as a constant "visual cue," encouraging the consumption of refined carbohydrates and unhealthy fats, which can contribute to insulin resistance over time. As one respondent noted, "the culture of eating vegetables and fruits is still very low…," a behavior that is well explained by the subjective norms component of the Theory of Planned Behaviour (TPB) (Chen and Yang, 2019).

Long working hours and having multiple jobs are *perceived barriers* of HBM, which can further limit the ability to prepare healthy meals, pushing people toward quick, ready-to-eat, but often unhealthy options. Another factor which has been revealed by interview is deficiency of knowledge of how unhealthy nutrition can lead to increased diabetes susceptibility. This means that *perceived susceptibility*, as conceptualized in HBM, is still low. Moreover, another component of TPB, *perceived behavioral contro*l, due to financial limitations is low. This is revealed by a respondent who pointed out that *"…low education has direct impact on type of job he/she will get which directly affects income…."*.

On *individual level* in line with Ecological Model (EM), it is observed that stress, depression, and emotional eating can promote consumption of energy-dense foods, which can temporarily improve mood but contribute to long-term metabolic harm (Schiavo *et al.*, 2025).

Ecological model explains that health behaviour is affected on many levels (Schiavo *et al.*, 2025). On level of policy and environment, there is still lack of supportive policy and infrastructure. Without governmental action to regulate unhealthy food marketing, subsidize healthy foods, or improve access to affordable fresh produce, individual efforts to maintain a healthy diet are often challenging. This web of factors, lying on many levels, creates the root causes of poor dietary habits that significantly elevate the risk of T2DM.

Figure 1 below demonstrates web of causation for unhealthy lifestyle. The factor that has the highest number of arrows is considered as "an important influencer" and root cause of a problem. In this case "*knowledge insufficiency*" has the highest number of arrows, thus should be tackled first.

Table 1. Six domains explored from different perspectives, can provide more comprehensive understanding of problems/challenges hidden in each domain

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Domain	Perspective		
	A patient	An Endocrinologist	Puskesmas worker
Diet and nutrition	Were there any challenges (cost, time, surrounding environment) in accessing or choosing healthy food?	What common dietary habits do you observe in patients with T2DM?	What barriers do people in your community face in accessing healthy foods?
Health care access	Before your diagnosis, did you ever undergo regular screenings for diabetes? If not, what were the main reasons? Any difficulties related to going for screenings?	What limitations in healthcare delivery hinder prevention of Diabetes type 2? What could be improved, changed, or added?	How accessible are preventive health services in your community? Are there any services? If not or not many, what are the main reasons for that?
Behaviour	What motivates and discourages you from sticking to healthy routines? Please discuss both that motivates and discourages.	Do you think advertisement of sugar containing products have a real impact on increase of diabetes cases? Why or why not?	Are food traditions contributing to higher diabetes risk in terms of behaviour?
Culture	How do your family, friends, or cultural traditions influence your eating and activity habits? Please discuss separately form each family, friends and cultural traditions perspectives.	Do cultural beliefs or traditions affect how patients view diet and exercise? Please provide your opinion in this regard.	What role do cultural norms play in shaping lifestyle choices linked to diabetes?
Environmental and socioeconomic	How does your work schedule or living environment affect your lifestyle?	Do you notice income or education levels influencing diabetes risk in your patients? Why or why not?	Are there social stigmas or beliefs that make it difficult for people to change unhealthy habits?
Physical activity	Have you ever tried exercise programs? If yes, what challenges did you face?	How does sedentary lifestyle contribute to diabetes among your patients?	Are there safe and accessible spaces for exercise in your community? If not, what are the main reasons?

Table 2. Health problem Prioritization by USG method

No.	Type of problem	Total Score			Total (U+S+G)	Prioritization
		U	S	G		
1	Early detection of Type 2 Diabetes Mellitus through HbA1c measurement is still not widely available.	16	17	14	47	VI
2	There are broken / inaccurate lipid profile testing devices in several community health centers.	19	22	19	60	V
3	The limited number of glucose sticks means not all groups can be screened for diabetes mellitus using glucose sticks	25	25	25	75	III

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4	Monitoring and evaluation of patients are not conducted routinely and in a structured manner.	23	23	18	64	IV
5	Lack or deficiency of patient knowledge about the severity and consequences of type 2 diabetes mellitus.	25	26	28	79	II
6	**The unhealthy lifestyle of people**	**25**	**30**	**28**	**83**	**I**

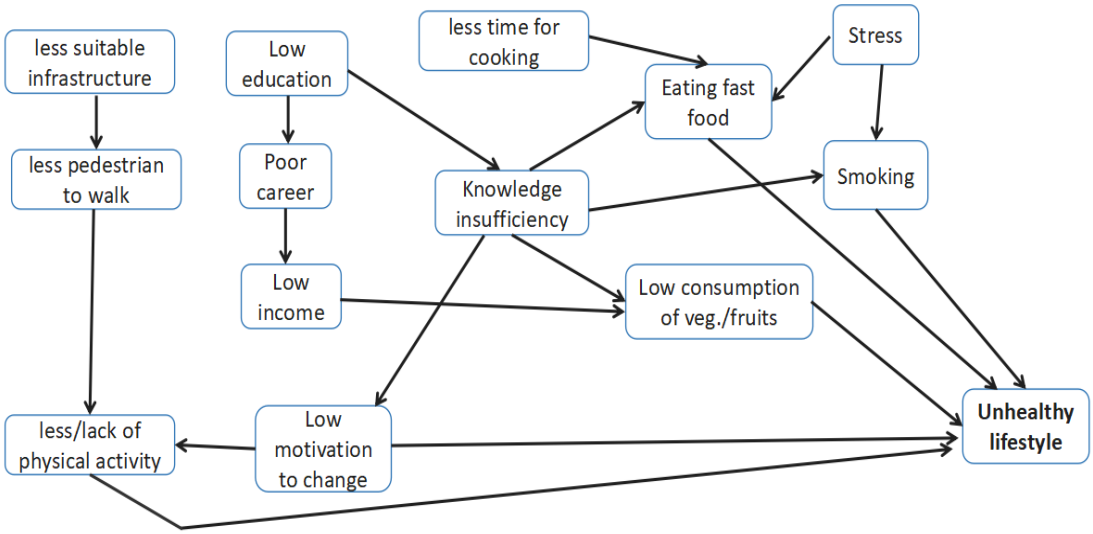

Figure 1. Web of causation method revealing "knowledge insufficiency" as a root cause

Health promotion solutions to tackle T2DM related problems

After extensive literature, two health promotion solutions are being proposed, both justified by conclusions of meta-analysis articles. One way to decrease the frequency of diabetic complication rates and mortality rates is achieved by proper control of HbA1c levels (Boye *et al.*, 2022); (ten Brinke *et al.*, 2008). This HbA1c levels were shown to be effectively controlled in a meta-analysis by (Haider *et al.*, 2019). Essentially, they analyzed 11 RCTs, where text messaging related to healthy lifestyle used to motivate and aided T2DM patients. In the current paper, a pilot study in Surabaya is being proposed, which includes sending short, actionable messages 2-3 times per week, texts with quick tips, myth-busting facts, and prompts for small behavior changes (for example, "Swap sweet tea for water three times this week"). They are cost-effective, scalable, and designed to be short enough to read quickly, specific so they can be implemented, and measurable so participants can track their progress. Some possible examples of these prompts are provided in Supplementary material table 3. Potentially, these text messaging can be implemented by first building an opt-in list using patient records from public health centers (Puskesmas) and visitors to Posbindu, with the option of segmenting participants based on risk factors such as overweight, genetic predisposition to diabetes, or showing signs of elevated fasting glucose. For fast implementation, this idea can be incorporated to already existing programs such as Puskesmas digital outreach or any other program that uses WhatsApp to reach local community. A structured 12-week curriculum can then be introduced, with each week focusing on a specific theme. For example, Week 1 on healthy beverages, Week 2 on vegetables, and Week 3 on light physical activity. To sustain engagement, automated reminders can be sent for Posbindu screening days along with follow-up messages asking whether participants tried the suggested practices. Through this approach, the program is expected to improve dietary literacy, encourage healthier choices such

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as increased water, vegetable, and whole-grain consumption, and boost participation in health screenings.

Another possible health promotion program is *"Point-of-Decision"* education. According to this program simple labeling, such as icons indicating "high sugar" or "better choice," along with visual displays of sugar content in drinks using teaspoon equivalents can be introduced in canteens, schools, and large workplaces. The program should be integrated with GERMAS and local "Kantin Sehat" campaigns, if possible. Over time, such measures are expected to encourage gradual shifts away from sugary beverages and calorie-dense foods, while also improving public understanding of food labels and portion sizes. Meta-analytical evidence shows that clear labeling can lead to modest but meaningful reductions in calories selected and consumed (Shangguan *et al.*, 2019). Possible menu design with on site education is provided in Figure 2 of the supplementary material.

These two interventions will facilitate more healthy behaviour by acting on several levels of Ecological Model of health behaviour. Particularly, individual, policy and organizational and environmental levels will be involved. According to Ecological Model it is believed that in order to promote healthy behaviour as many as possible levels should be targeted (Schiavo *et al.*, 2025).

Antonovsky's Sence of Coherance

This study emphasizes the importance of health promotion by highlighting how knowledge insufficiency and environmental cues shape diabetes-related behavior. In addition, the proposed health programs align with salutogenic principles, particularly Antonovsky's concept of Sense of Coherence (Antonovsky, 1996). By enhancing individuals' understanding of health risks (comprehension), providing actionable steps (manageability), and linking daily choices to long-term well-being (meaningfulness), these two intervention programs can help redirect individuals toward healthier behaviors. More importantly, these interventions can strengthen individuals' capacity to adhere to healthier decisions and develop lasting habits, which is an essential aim of health promotion.

This study has several limitations. First, the USG method has inherent drawbacks, including scoring subjectivity, a limited scope (focusing only on Urgency, Seriousness, and Growth while excluding factors such as financial feasibility), and the oversimplification of complex problems into three dimensions. Second, the structured interviews could have included additional perspectives, such as family members, friends, or primary care physicians to provide a more comprehensive understanding of the issue. Despite these limitations, this study proposes two programmatic solutions supported by relevant meta-analyses, which can be directly adopted to improve the situation of type 2 diabetes in Surabaya. Furthermore, this paper not only identifies root causes but also offers multilevel interventions that enhance human resources and capacity to maintain health in daily life.

CONCLUSION

In conclusion, two health promotion interventions are proposed to improve knowledge about diabetes, promote healthy eating, and reduce high-sugar product consumption. The first is Mobile phone education and pushes via Puskesmas registries, and the second is "Point-of-decision" education in workplaces and canteens. Although these interventions are not novel, the authors truly believe that their implementation in long term will improve situation related to Type 2 Diabetes Mellitus. For mobile messaging intervention, a pilot study can be launched in Surabaya with integration to the existing programs such as Puskesmas digital outreach, "Kantin Sehat" or Germas in order of rapid and efficient implementation.

Further research is neccessary to gain more insightful knowledge with involvement of other significant perspectives and studies with a larger sample size. Current exploratory study involves views from a patient, an endocrinologist, and a Puskesmas worker.

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