

## **Title: A preliminary impact study to assess the effectiveness of Intelligent Health Risk Assessment (IHRA) software to improve risk behaviours of metabolic comorbidities**

### **Introduction**

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Type II Diabetes (T2DM), Hypertension (HTN), and Dyslipidemia are the leading causes of mortality and morbidity worldwide. Diabetes is estimated to affect 387 million globally, with disease prevalence expected to increase to 592 million by the year 2035. Approximately 80% of people with diabetes live in developing and income countries creating a pressing need for prevention and treatment efforts focused on these regions. It is predicted that by 2030 diabetes mellitus may afflict up to 79.4 million individuals in India, while China (42.3 million) and the United States (30.3 million) would also see a significant increase in those affected by the disease. Currently, an estimated 1.13 billion people worldwide have Hypertension. WHO has set a global target to reduce the prevalence of the non-communicable diseases Type II Diabetes and Hypertension by 25% by 2025 (baseline 2010). The presence of Type II Diabetes, Hypertension and/or Dyslipidemia leads to other complications such as cardiovascular diseases, diabetic kidney disease and diabetic neuropathy.

Although biomarkers such as blood pressure, fasting blood sugar levels, HbA1C, serum adiponectin and inflammatory cytokines are being used by doctors for diagnosis and prevention of metabolic comorbidities, there is a need for the development of a procedure that is non-invasive, faster and makes it easy for periodic screening of individuals to identify those at an early stage before the disorder reaches clinically significant levels. Metabolic comorbidities such as Type 2 diabetes, Hypertension and Dyslipidemia take a long time to manifest – estimated to be 4 to 7 years before these comorbidities can be detected by blood tests. After any of these comorbidities afflict a person, the health and economic situation of a person is affected tremendously.

In majority of the cases, these chronic illnesses are asymptomatic in nature or the symptoms are very generic, leading to a delayed diagnosis. At present, there are no easy-to-use, accurate, non-contact and painless methods for early detection of these comorbidities. However, it's important to note that these conditions are preventable if they are detected at an early stage.

To date, few chronic disease prevention technologies have been tested in the Indian population. Earlier, three studies using in-person or telephone counselling showed feasibility, acceptability, and preliminary evidence of efficacious screening and treatment for prediabetic and diabetic patients in rural India. However, these interventions require extensive personnel and equipment use that preclude

scalability. To slow the epidemic of diabetes in India, scalable prevention interventions are needed.

Aarca Research, a health-tech company whose product IHRA (Intelligent Health Risk Assessment) is a first-of-its-kind, pre-diagnostic method for the early detection or risk evaluation of Type 2 diabetes, Hypertension and Dyslipidemia. IHRA is an independent test that can be utilized in very early subclinical stages and long before the intended medical conditions can be clinically diagnosed using current methods like a blood test, or a blood pressure cuff. IHRA helps individuals of 21 years of age and older to learn about their health risks in relation to metabolic comorbidities. IHRA is a cloud-based software that uses computer vision, signal processing and machine learning models. IHRA takes non-contact infrared thermography video of the user's face as input, analyses and processes the said video and generates a report that provides risk scores for Type 2 Diabetes, Hypertension and Dyslipidemia. The risk is indicated on a scale of 0-10, with severity bands as Normal, very low, Low, Medium, High for each condition. The IHRA algorithm's primary principle is based on the analysis of the pulsatile nature of the blood flow through emitted infrared radiation and modelling its variability under the influence of Type 2 Diabetes, Hypertension and/or Dyslipidemia. When used as a screening tool for the early detection of the onset of these conditions, this will engage the healthcare personnel for further investigations and prevention strategies. IHRA has the potential for widespread improvement in clinical outcomes and for deployment in large public health programs across communities.

A preliminary survey was designed to understand the post evaluation effectiveness of IHRA and the impact of IHRA results on individuals who have completed screening with this technology to make better lifestyle and dietary choices. Furthermore, the analysis also tried to evaluate the level of risk score to the level of impact on the individuals in taking these prevention steps.

## Methods

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### Survey Design, Participants

Survey questions for the post-evolution program were developed by the Aarca Research team. The survey contains 10 questions and were kept brief intentionally, to assess initial feasibility and potential for public health benefit. The questions were designed to understand the individual's understanding of the metabolic comorbidity risk screening report, whether it motivated them to make changes to diabetes risk behaviours and increase awareness about the causes and complications of diabetes. A randomised sample (n=120) was selected from the customer base of Aarca Research. The sole eligibility criteria was that participants were needed to complete their screening in the year 2021.

## Procedures

The survey was shared using Google forms with the randomly selected participants in the month of January, 2022. One month duration was given for participants to respond. A reminder email was sent. In one month (n=95) people responded. The Aarca Research team then compiled the results along with their risk scores and demographic information, including, age, and health behaviours which were collected during the initial screening.

## Statistical Analysis

Data checking, cleaning, and analyses were conducted in February 2022. The random sample characteristics are as follows. Sample size included 65 male and 30 female participants. The sample size was distributed by age group as, 21-35 age group containing 30 people, 36-50 age group containing 56 people and 51-65 age group containing 9 people. The survey participants' risk distribution by the condition is as displayed in Table 1. The sample size risk distribution is following a general risk distribution when segmented by the age groups, i.e Individuals risk is increasing with age across the three conditions.

IHRA Risk score	Diabetes Risk Distribution	Hypertension Risk Distribution	Dyslipidemia Risk Distribution
High	14%	16%	7%
Medium	44%	28%	32%
Low	28%	34%	28%
Very Low	6%	17%	13%
Normal	7%	5%	20%

Table 1: Sample size risk distribution by the condition.

## Results

### Principal Findings

#### *Feedback for IHRA screening*

The responses from all the participants (N=95) for each survey question were analyzed and were evaluated based on the age group and the IHRA risk determined for the Type 2 Diabetes, Hypertension and Dyslipidemia conditions. The majority of the participants responded that the IHRA screening report was very helpful (Yes = 77%, Maybe = 13%, No = 11%) in understanding their health better related to metabolic comorbidities. The participants were also willing (Yes = 81%, Maybe = 13%, No = 6%) to take another IHRA screening for knowing the risk status in the future after making dietary or lifestyle changes. Figure 1. shows the distribution of responses to the survey questions regarding usefulness of IHRA screening. Figure 1 also shows the distribution

of feedback responses based on age group. The feedback to retake the screening has been overwhelmingly positive and remained consistent across the age groups.

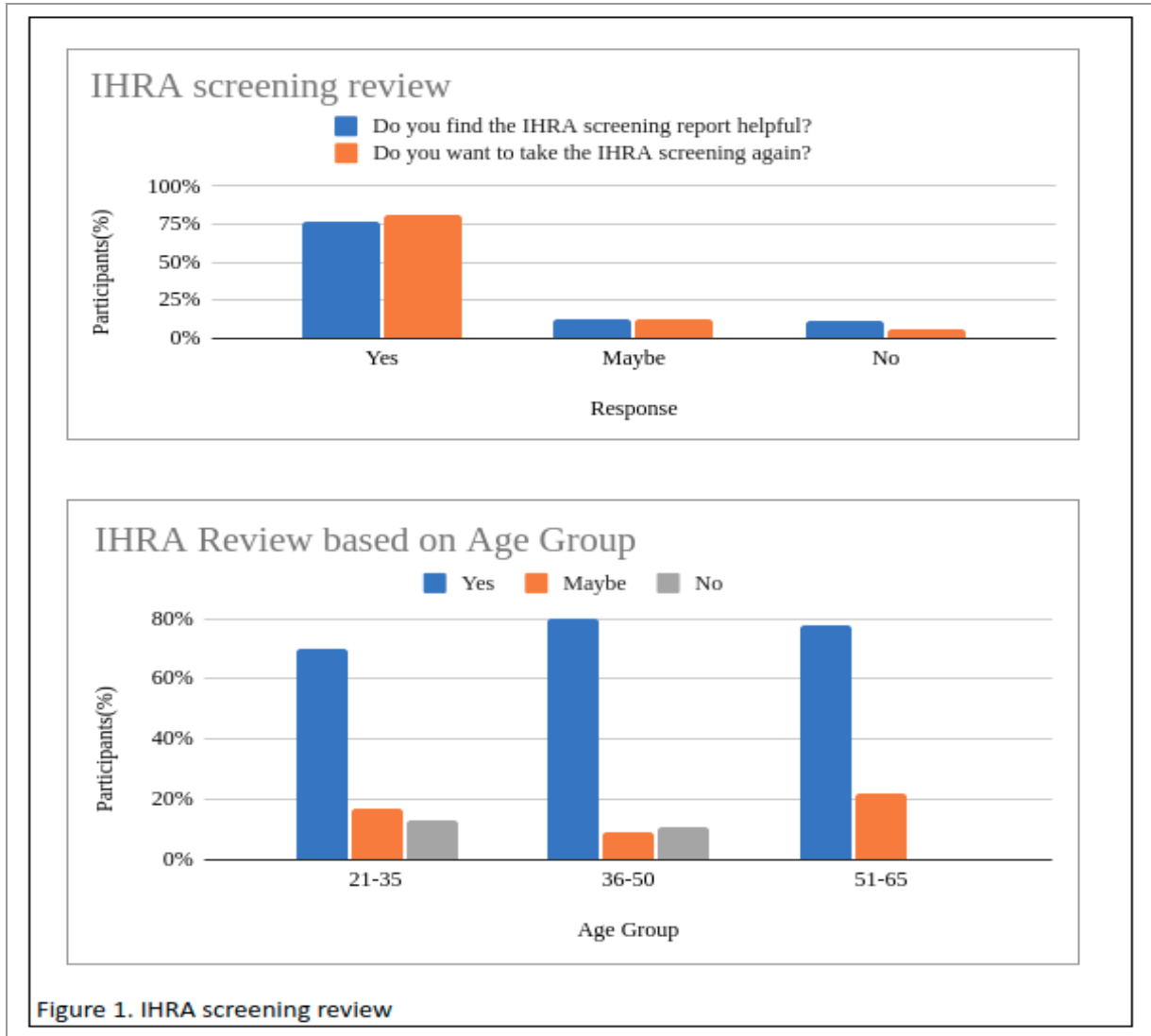


Figure 1: Feedback of IHRA across age groups

Figure 2. demonstrates the responses of participants for recommending the IHRA screening to others, where most of the participants responded to highly recommend (Score  $\geq 8$ ) the IHRA screening while all the participants presented a score of at least 6 on the recommendation scale (0 - 10; 10 being highly likely).

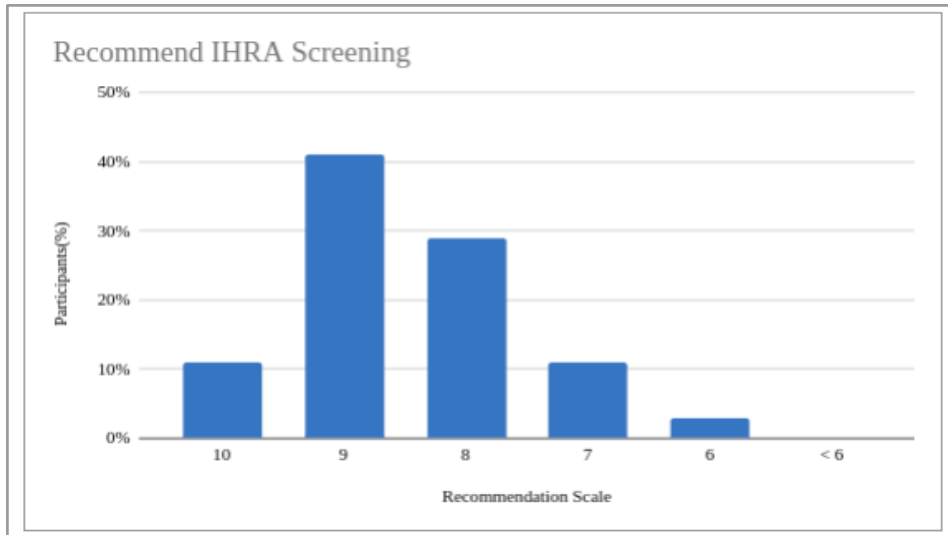


Figure 2: Participants interest to recommend IHRA to their friends and family

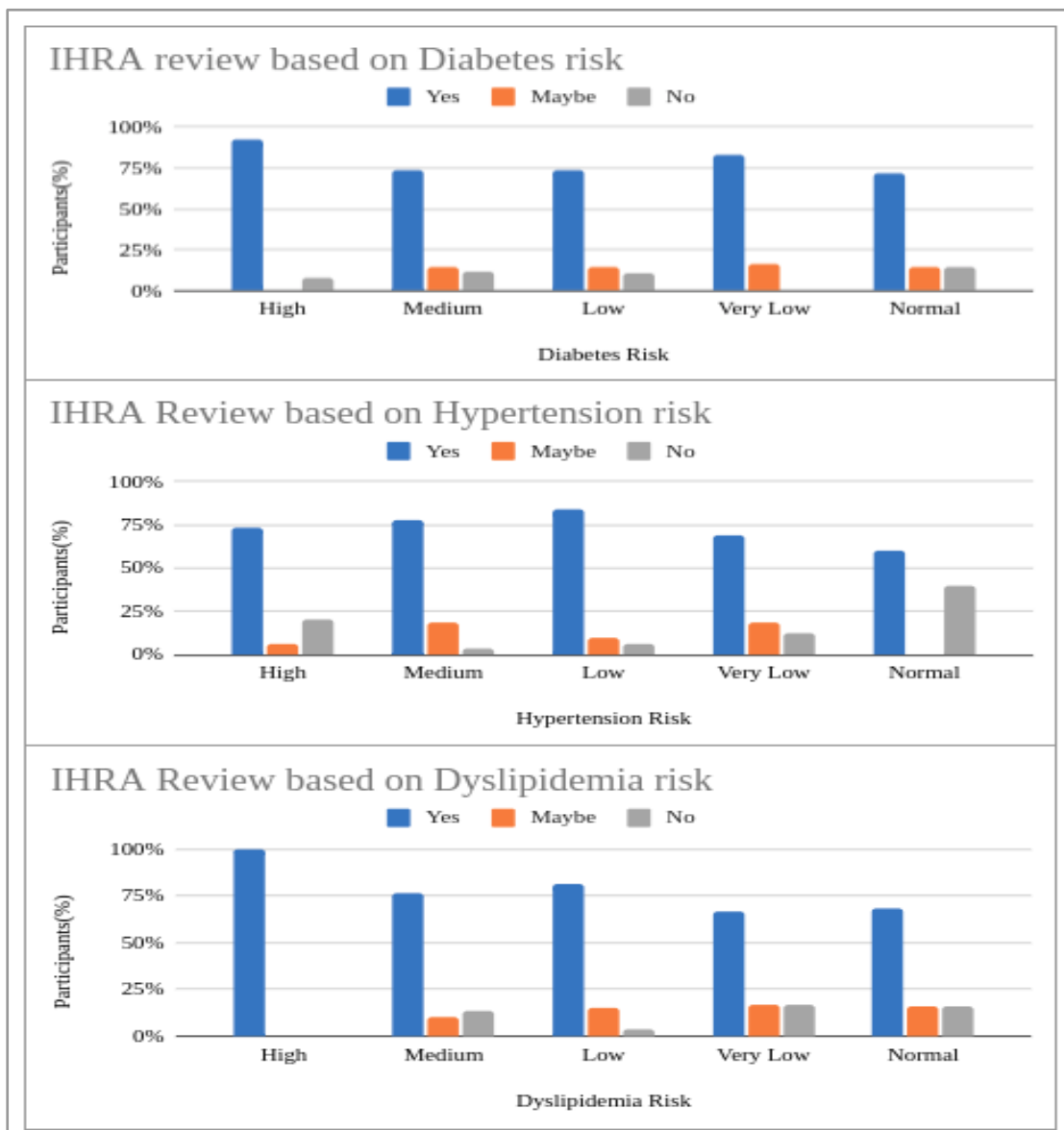


Figure 3: Impact of IHRA in understanding health conditions related to metabolic comorbidities

### Impact of IHRA screening in understanding Metabolic Health

Figure 3. demonstrates the responses towards the impact of the IHRA screening in understanding health conditions based on the risk of the participants for Type 2 Diabetes, Hypertension and Dyslipidemia conditions. The results demonstrated that across all the comorbidities the survey participants whose risk was high or medium, found that the IHRA screening was helpful in understanding their metabolic health.

### Impact of IHRA screening in making dietary and lifestyle change

The responses of the participants reveal that the majority of the participants were motivated to make dietary changes (Yes = 72%, Maybe = 6%, No = 22%) and lifestyle changes (Yes = 79%, Maybe = 7%, No = 14%) based on the IHRA screening report. Figure 4. depicts the distribution of responses for the motivation of IHRA screening report on making dietary and lifestyle changes in comparison to the risk distribution of the participants, where more participants with high and medium risk across all comorbidities were motivated to make dietary changes than the participants with low risk or in normal condition. While for the lifestyle changes, the motivation of the participants was consistent across all the risk categories.

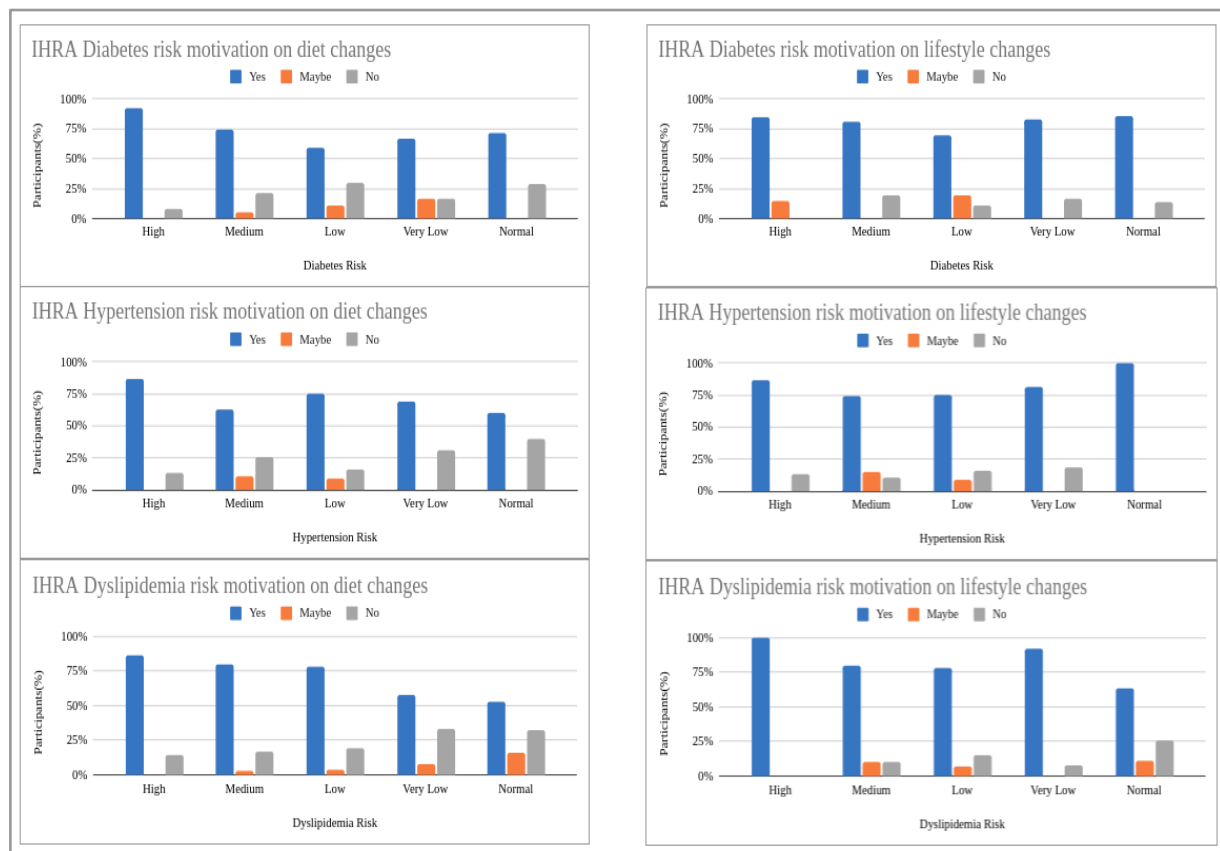


Figure 4: Impact of IHRA screening in motivating participants to take dietary and lifestyle changes

*Impact of IHRA screening for taking blood tests and doctor consultation*

The survey participants have shown an overall positive attitude (Yes = 65%, Maybe = 4%, No = 31%) towards going for a blood test or doctor consultation based on the IHRA screening. Figure 5. compares the responses of participants to their motivation for taking blood test/doctor consultation with the risk of the participants across all the comorbidities. This reveals that the positive attitude towards taking clinical measurements has remained across all risk categories.

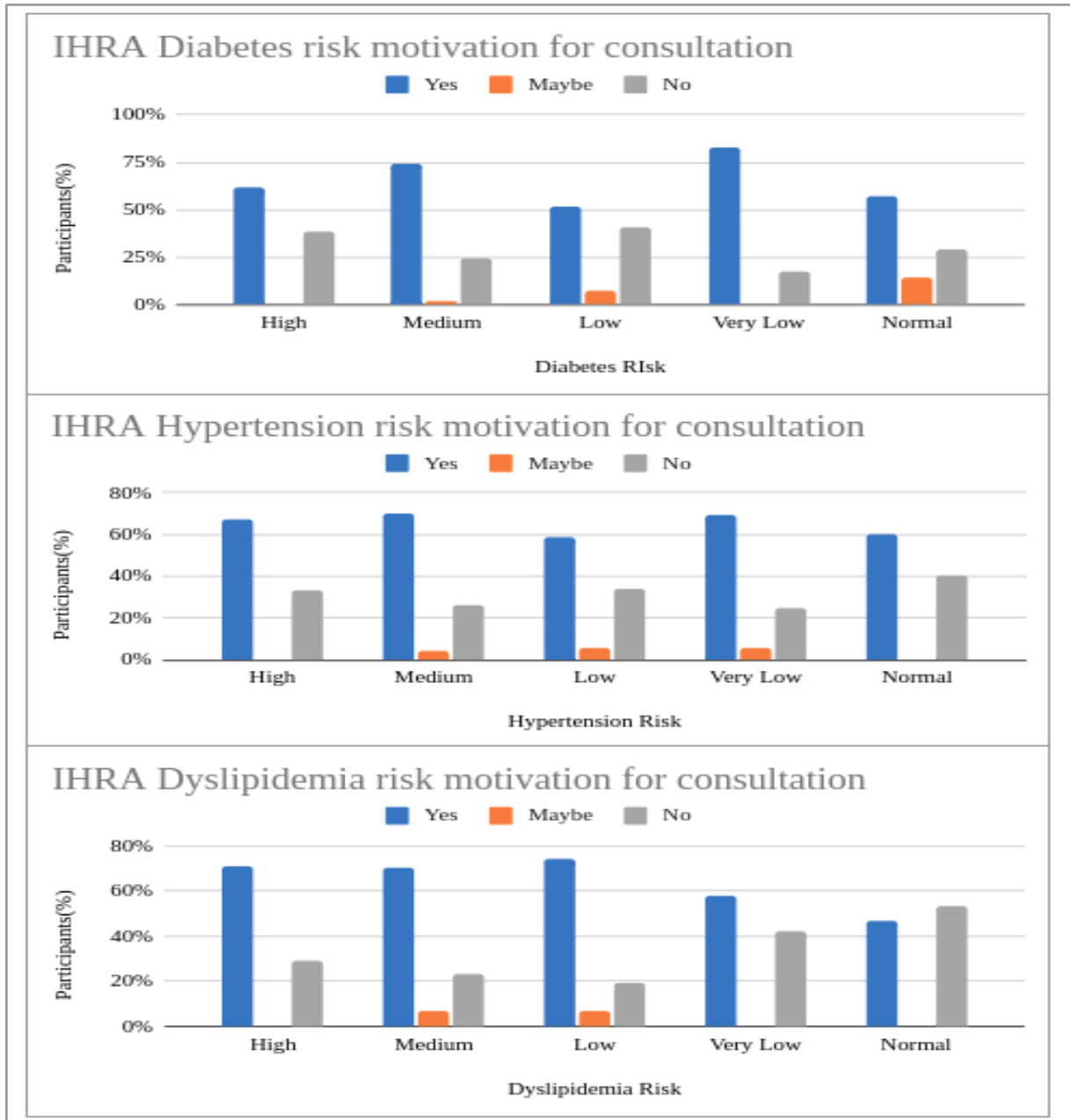


Figure 5: Impact of IHRA screening in motivating participants to take blood tests and/or doctor consultation

Overall, results support the feasibility, acceptability, and preliminary effectiveness of IHRA as an intervention to prevent degradation of health behaviours over time and to promote the acquisition of metabolic comorbidities preventive behaviours.

## Conclusion

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This survey demonstrated the feasibility and initial evidence of effectiveness of IHRA as Type 2 diabetes, Hypertension and Dyslipidemia prevention intervention. Participants demonstrated increased awareness of metabolic comorbidities' risk factors and displayed greater willingness in making diabetes preventive behaviours changes. Importantly, this non-invasive screening improved general understanding of metabolic health overall, an important learning since multiple co-occurring risk behaviours are implicated in the development of diabetes and other comorbidities. The results from this survey demonstrate that IHRA can create required awareness in improving behaviours that reduce the risk of diabetes and other chronic diseases, thus making this non-invasive screening intervention an effective public health investment. IHRA is an attractive solution for screening purposes in situations where it may not be feasible to collect blood samples or where the activity is constrained by low resources. Hence, further evaluation of IHRA in a larger population would go a long way in strengthening the case to utilize it as a routine technique for the early detection of Type II Diabetes, Hypertension and Dyslipidemia, and as a Point of Care (POC) screening tool.