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The Effectiveness of Community-based Cardiovascular Risk Factors Screening Program in Rural Community Shopping Mall: Health Takes Heart Study

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Abstract Cardiovascular disease (CVD) significantly impacts rural communities due to the high CVD prevalence rates compared with urban communities. This study aimed to assess the effectiveness of a community-based screening program for CVD risk factors by employing established risk factor scoring in a rural community. In this descriptive cross-sectional study, 1582 participants aged 20 and above participated in the screening program. Data was collected using a self-report questionnaire and measuring other CVD risk factors directly. The metabolic syndrome score and Framingham risk score (FRS) for 10-years of risk of developing heart attack and death were calculated for all participants. Then the level of follow-up with family physicians (FPs) following a screening program for CVD risk factors and a brief one-on-one educational intervention from a Registered Nurse to modify their risk factors was evaluated. The result revealed that 77% of the participants had 1 to 3 risk factors, and 52.7% followed up with FPs. Hypertension and abdominal obesity were the most common risk factors, with 51.1% and 55%, respectively. This study showed that 36.2% of the population had moderate to high FRS (death/MI>20%), and 30% had a high metabolic syndrome score. Community-based CVD risk factor screening successfully identified a high ratio of participants with high CVD risk factors and FRS. The screening program and educational interventions were beneficial in increasing public awareness of CVD risk factors, and a high percentage of participants with high FRS followed up with their FPs.

Keywords Cardiovascular Disease, Risk Factors, Community-based Screening, Follow-up, Rural Community

1. Introduction

Cardiovascular disease (CVD) is the second highest cause of death; it is responsible for 20% of all deaths in Canada and is considered the leading cause of hospitalization [1]. 90% of Canadians have at least one CVD risk factor, and 40% have three risk factors or more [2]. The economic burden of CVD is significant in Canada

because CVD costs the health sector over $22.2 billion, including $7.6 billion for direct health care costs and $14.6 billion for indirect costs resulting from lost economic productivity due to disability or death [3]. CVD creates an extra burden in rural communities due to the high prevalence rates of CVD, high rates of CVD risk factors, and the systematic barriers to accessing health services [4-5]. Additionally, the older population living in rural areas with low socioeconomic and education levels are at higher risk of developing CVD than those in urban communities [6-7].

Initiatives that address social determinants of health through preventive interventions and health promotion policies will reduce the risk factors for CVD. Risk factors include hypertension, diabetes, overweight, high cholesterol, smoking, excessive alcohol consumption, physical inactivity, and an unhealthy diet, all of which are modified risk factors [8-10]. Unmodified risk factors include age, gender, and ethnicity [8-9]. In many cases, CVD risk factors are uncontrolled because of a lack of access to adequate primary care. It has been found that 90% of myocardial infarcts could be prevented or delayed by monitoring and managing the controllable risk factors. The evidence clearly shows that people with lower risk factors have a lifelong lower risk of heart disease and stroke [9].

Screening can identify people with unrecognized risk factors or diseases to allow individuals to seek timely care [11]. Screening for CVD risk factors has been done in the context of a primary care setting, outpatient clinic, or community setting [12-14]. Community-based screening is a common intervention in detecting CVD risk factors in rural and urban communities [14-15]. Community-based screening for CVD and diabetes effectively identified risk factors in high-risk populations such as ethnic and immigrant populations and rural communities [9,14,16]. It has been suggested that interventions such as counselling or education after risk identification reduce the risk factors at the community level [17-18]. Furthermore, when individuals are made aware of their CVD risk factors early on, they may take action to achieve effective prevention, thus reducing the burdens of CVD. Therefore, community-based screening programs may attract people more likely to be motivated to modify their risk factors.

Since there are disparities in CVD prevalence in rural communities, there is a dearth of knowledge about the prevalence of CVD risk factors in rural communities such as Cape Breton (CB). Therefore, this study aims to (1) find the level of CVD risk factors in the CB community, the knowledge of CVD risk factors of individuals living in this community (2) the impact of community-based CVD screening and educational intervention in enhancing public awareness of CVD risk factors, (3) and find the up-take of this community upon follow up with FPs as an early prevention measure to modify their CVD risk factors. This research will contribute to the body of knowledge about the impact of community-based screening on the prevalence of controlled, uncontrolled, and undiagnosed risk factors for CVD in rural communities in Canada, such as CB. The results of this study will also be beneficial to give insight to health policymakers and health interventionists to plan and design strategies and interventions to control CVD risk factors in rural communities.

2. Materials and Methods

2.1. Design and Setting

This descriptive, cross-sectional study was designed to collect data on CVD risk factors levels in a community-based setting. This community-based screening program was conducted at a public shopping mall (Mayflower mall) in the context of "Health Takes Heart" to encourage the public in the CB community to participate in the study. This study was initiated by cardiologists and nurses who worked at the Cape Breton Regional Hospital and Cape Breton University. Briefly, CB county, where the study was conducted, is located on the Atlantic coast of North America and is part of the province of Nova Scotia, Canada. The population of CB county is above 93,000 based on 2021 statistics, which is 12% lower than that reported in 2007 [19]. It is important to note that CB county is considered a rural community with a high percentage of aged population (36% of the population) and a first nation (Mi'kmaq) where the average population age is 47 with a high percentage of low-income status [19-20].

2.2. Recruitment

The recruitment process was done through a media campaign launched four weeks before the study started, inviting the public to attend the "Health Takes Heart" screening clinic in the public mall using radio and newspaper ads. The screening booth was established at a local commercial shopping mall close to the accessible population. People visiting the clinic booth were invited to take an interactive quiz about CVD risk factors to generate interest in the study. The screening booth was open every Saturday between 10:00 am and 4:00 pm from January to June 2007 to recruit and screen participants and provide the educational interventional session after screening.

2.3. Sample

The CVD screening program was open to all public aged 20 years and older who presented in person at the screening station and could consent to participate. The sample of this study was a convenient sample in which 1582 participants volunteered to participate. The participants were all from CB, where over 49% of the participants were from Sydney, and the rest of the participants were from North Sydney (9.4%), Glace Bay (19.4%), New Waterford (9.0%),

Louisburg/Mira (6.8%), and other (6.1).

2.4. Data Collection and Screening Program

The CVD risk screening was completed, and data were collected by a research team of 7 to 8 health professionals, including registered nurses and student nurses. The research team was trained to administer the screening program, which included:

1. Self-reported risk factors include age, smoking status, physical activity, and a known history of diabetes, hypertension, CVD, or peripheral vascular disease (PVD).
2. Measuring the participant's weight and height using a hydro scale and Heart and Stroke measuring tape to calculate the body mass index (BMI).
3. Measuring the abdominal waist using established criteria, where risky abdominal waist parameters were >40" (102 cm) for men and >35" (88 cm) for women.
4. Measuring blood pressure using a Bp TRU machine with 2 to 4 readings to report the average blood pressure. Research participants were seated 30-60 minutes before the blood pressure reading was taken.
5. Measuring non-fasting glucose and cholesterol levels using Cholestech LDX Machine on-site analysis.
6. A computer-calculated FRS was generated to estimate the 10-year risk of experiencing a CVD event or dying from CVD. FRS was calculated based on age, sex, body mass index, smoking status, hypertension, high-density lipoprotein cholesterol (HDL), triglycerides, and non-fasting glucose. The FRSs are classified into low, moderate, and high, with values < 10%, 10-20%, and >20%, respectively [21].
7. Metabolic syndrome score was determined based on the presence of at least three risk factors: abdominal obesity, high blood pressure (systolic > 130 mmHg), low HDL Cholesterol, high blood glucose, and high triglyceride [22]. High blood glucose was eliminated because non-fasting blood sugar was measured for the research participants.
8. The results were provided to the participants with an explanation from a Registered Nurse to review their 10-year FRS for heart attack and death in a unique visual representation of happy vs sad faces demonstrated individual risk score /100 faces (**Appendix 1**). The participant received information regarding the recommended action(s) they should follow to modify the CVD risk factor(s).
9. Participants with one to three CVD risk factors received a phone call after 3 to 6 months of the screening to report if they had followed up with a FP to modify their CVD risk factors.

2.5. Data Analysis

Descriptive and inferential statistics were used to analyze the data. Percentages were used to describe CVD risk factors, and a one-way ANOVA test was used to investigate possible associations between variables based on gender differences and differences based on an age cut-off of > 60 or < 60 years. SPSS 16 was used to analyze data, and a p-value lower than 0.05 was considered statistically significant.

2.6. Ethical Considerations

This project was approved by the Cape Breton University Research Ethics Board Committee and the Cape Breton Regional Hospital Research Ethics Board. Informed consent for the participant's involvement was obtained from each participant who attended the "***Health Takes Heart***" public clinic and met the inclusion criteria.

3. Results

In this study, 1,582 subjects participated in the community screening program, where most of the participants were women, with 63% (n=997) and 37% (n=585) being men (Table 1). The mean age was 57, and ages ranged from 20 to 95, with 53.4% (n=844) of the participants aged less than 60 and 46.6% (n=737) of the participants older than 60 (Table 2). The CVD risk factor screening results (percentage and number of participants) based on gender and age are summarized in Tables 1 and 2, respectively.

Table 1. The percentage and number (%, n) of participants with CVD risk factors in the studied population based on gender differences.

Risk Factor	Total % (n)	Men % (n)	Women % (n)	P-value
Total	(n=1582)	37% (585)	63% (997)	
Smoking	6.9 (109)	8.2 (48)	6.1 (61)	<0.001
Physical Activity[a]	52.7 (833)	49.2 (288)	54.7 (545)	<0.04
Overweight[b]	46.4 (734)	52.5 (307)	42.8 (427)	<0.001
Obese	28.5 (221)	32.0 (98)	26.4 (113)	<0.001
Abdominal Obesity[c]	55.6 (880)	43.5 (254)	62.8 (626)	<0.001
Diabetes	8.4 (133)	11.6 (68)	6.5 (65)	<0.001
Heart Disease	7.8 (123)	13.0 (76)	4.7 (47)	<0.001
Stroke	2.1 (33)	2.2 (13)	2.0 (20)	<0.001
CVA	3 (47)	2.9 (17)	3.0 (30)	<0.001
Hypertension (≥130 mm Hg)	51.1 (808)	51.2 (299)	51.1 (509)	<0.001
Triglycerides (≥1.7 mmol/l)	55.3 (875)	61.8 (362)	51.5 (513)	<0.001
HDL Cholesterol[d]	42.7 (675)	45.7 (267)	40.9 (408)	<0.001

[a]Percentage of participants met CACR's Physical Activity Recommendation. (30 – 60 min x 5/week).

[b]Normal weights (BMI <25), (overweight BMI 25-30), obese (BMI >30).

[c]Percentage of participants with abdominal obesity for Men >40" (102 cm), Women >35" (88 cm).

[d]Percentage of participants with HDL cholesterol 1.0 mmol/L (men) or < 1.3 mmol/L (women)

Table 2. The percent of the presence of CVD risk factors in the study population based on an age cut-off of < 60 and > 60.

Risk Factor	Age<60	Age>60	P-Value
Total	53.4 (844)	46.6 (737)	
Smoking	9.6 (81)	3.8 (28)	<0.001
Physical Activity	54.0 (455)	51.2 (378)	NS
Overweight	74.0 (616)	75.7 (553)	NS
Abdominal Obesity	52.3 (441)	59.4 (439)	NS
Heart Disease	2.5 (21)	13.8 (102)	<0.001
Stroke	0.7 (6)	3.8 (28)	<0.001
CVA	0.6 (5)	3.8 (28)	<0.001
Hypertension	23.5 (198)	43.6 (322)	<0.001

Tables 1 and 2 indicate that men and younger populations had higher smoking rates than women and people older than 60. Table 1 shows that the average smoking rate of the study population was 6.9% (n=109), notably lower than the average national and provincial smoking rate from 2007 to 2020 [23]. The smoking rate for men was 8.2% (n=48) which was higher than that in women, 6.1% (n=61). The smoking rate among participants younger than 60 is 9.6% (n=81) which was almost two times greater than that for participants with an age greater than 60 years old (Table 2).

Tables 1 and 2 show that women and participants younger than 60 were more physically active than men and the older population. 52.7% (n=883) of participants self-reported doing physical activities 30 – 60 minutes 5 times a week, keeping with the Canadian Association of Cardiac Rehab guidelines [24]. Although the participants reported high rates of physical activity (52%), over 46% (n=734) of the study population were overweight (BMI >25), and 28.5% (n=221) were obese (BMI >30). These percentages were significantly higher than the national obesity (17%) and overweight rates in 2007 [25]. It is essential to point out that rates of overweight and obesity were higher in men (52.5% and 32%, respectively) than in women (42.8% and 26.8%, respectively). Table 1 also shows that 55% of the study population had abdominal obesity risk factors, which was very common in women, with 62.8% (n=626). However, there was no significant

difference in the abdominal obesity risk factor based on the age differences.

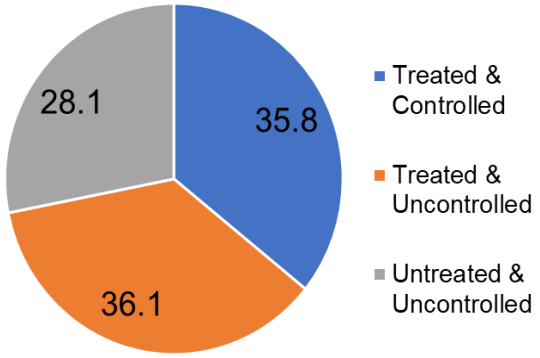

Figure 1. Percent of hypertensive patients treated to target, treated but not controlled to target, and untreated and not controlled to target

This study shows that 8.4% (n=133) of the study population reported having diabetes, which was higher in men (11.6%) than in women (6.5%). Diabetes prevalence rates in the study population were higher than the national (7.6%) and provincial (6.1%) average [26]. 7.8% (n=123) of participants reported having heart disease, which was higher than the national average (4.8% in 2007) [27]. It is also important to note that the heart disease rates among men were almost three times greater (13%) than women's (4.7%). It was also five times higher (13.8%) in the older population than in the people of the age younger than 60 (2.8%) (Table 2). Rates of stroke at 2.1% (n=33) and peripheral vascular disease at 3% (n=47) were at comparable levels for both genders. However, the stroke rate was five times higher in the older population age >60 (3.8%, n=28) than in a population younger than 60 (0.7%, n=6).

Hypertension (>140/90, diabetic>130/80 systolic) was measured in 51.1% (n=808) of the population, where comparable percentages of hypertension in men (51.2%, n=299) and women (51.1, n=509). Hypertension in the study population was 30% more than the national average (22%) [27]. Hypertension significantly increased with age (Table 2), as expected, and 43.2% (n=322) of participants over 60 had high measured hypertension. This study shows that 35.8% of the study population with hypertension were treated and controlled, 36.1% were treated but uncontrolled, and 28.1% were untreated and uncontrolled, as shown in Figure 1. The last group in this population needed urgent medical attention to control their hypertension risk factor. High cholesterol levels were noticed in 42.7% (n=675) of the study population, with comparable levels for both genders. Triglyceride levels ≥1.7 mmol/l were found in 55.3% (n=875) of the study population, slightly higher in men (61.8%, n=362) than women (51.5%, n=513).

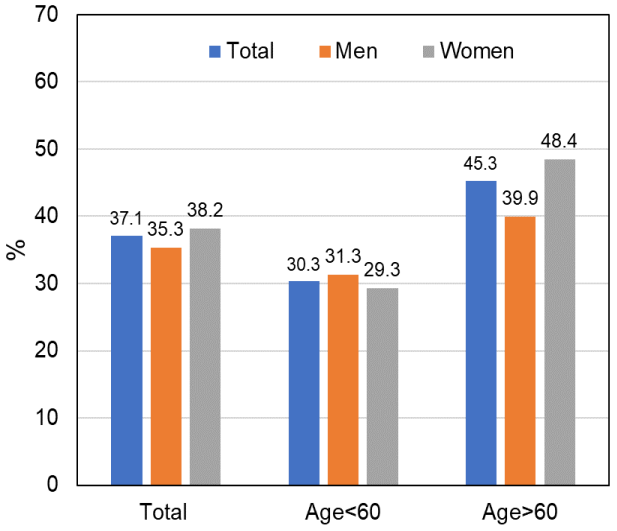

Figure 2. The metabolic syndrome risk score is based on at least three risk factors. Non-fasting blood glucose was eliminated. (P-value <0.001)

A modified metabolic syndrome score was used without glucose, as non-fasting glucose was measured for the participants. Figure 2 shows that 37.1% (n=587) of participants had evidence of metabolic syndrome, whereas both genders had comparable levels of metabolic syndrome. However, metabolic syndromes were significantly higher among the older women population (> 60), with 48%. The 10-year FRS estimates everyone's risk for heart attack or death from CVD, summarized in Figure 3a. FRS analysis reveals that 63.8% of the study population had a low-risk score of having CVD in the next ten years, while 36.2% (22% high risk + 14% moderate risk) of the population were moderate to high risk. It can also be noted that moderate to high FRS were three times higher amongst men than in women. Figure 3b also reveals that both genders of the older population (Age > 60) had a 3.7 times higher percentage of high FRSs than the younger population (Age<60). It can also be seen that older men had the highest percent of high FRS levels, with a high-risk score of 61.6%. Furthermore, the FRS was detailed for patients with hypertension and Chol/HDL risk factors. Table 3 summarizes the comparison between patients who were on target and those who were not in controlling their risk factors in relation to their FRS. The results reveal that the highest rates of successful controlling their total cholesterol/HDL ratio and hypertension (On target) were seen in the lowest-risk population (90.1% and 75%, respectively), while the worst at controlling them (Not on target) was seen in the highest risk population.

Table 3. The FRS for who are at high risk of blood pressure (hypertension) and cholesterol/HDL levels. On target means the participant controlled their risk factor, and not on target means the participants did not control their risk factor

Characteristic	Low Risk	Moderate Risk	High Risk	P-Value
Cholesterol\HDL				
On Target	90.5	62.6	36.8	<0.001
Not on Target	9.5	37.4	63.2	<0.001
Blood Pressure				
On Target	75.1	56.0	51.7	<0.001
Not on Target	24.9	44.0	48.3	<0.001

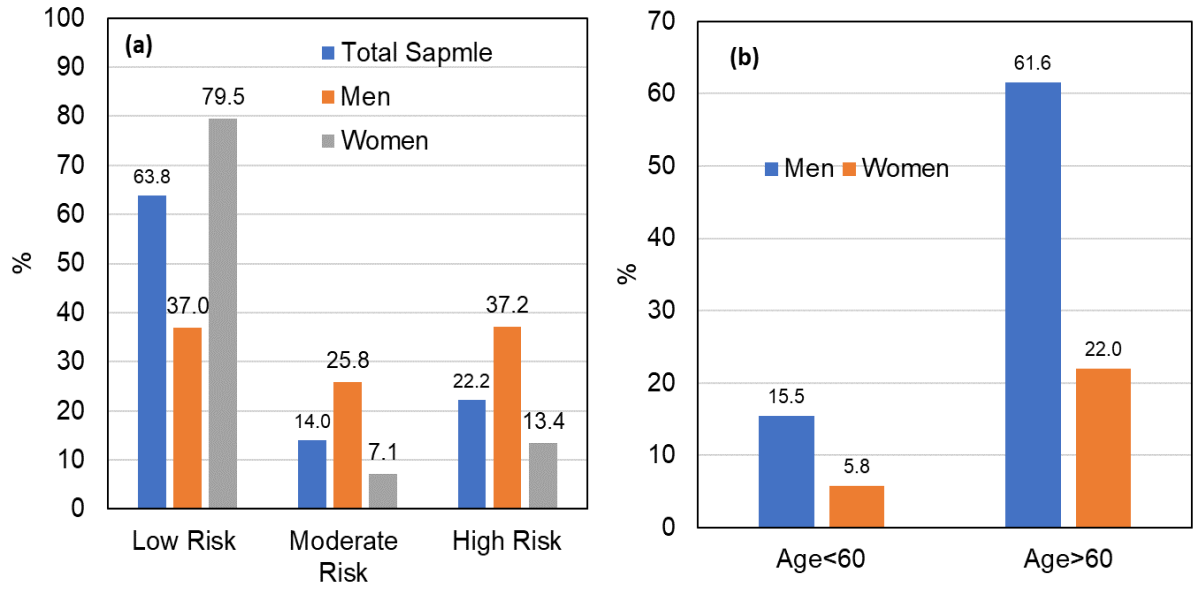

Figure 3. (a) The measured FRS represents the 10-year CVD risk based on gender and is ranked as low risk (<10%), moderate risk (10-20%), and high risk (>20%). (p-value < 0.001). (b) The percent of participants with high FRS (>20%) based on gender and age at an age cut-off of < 60 and >60. (p-value < 0.001)

The research team contacted 77% (n=1218) of the study population who had at least 1 to 3 CVD risk factors to find out if they followed up with primary care providers after 3 to 6 months of the screening to mentor their risk factors. It was found that 52.7% (n=642) of the targeted patients have followed up with their FP because of screening (Table 4). There were no significant differences based on gender or the presence of prior stroke or PVD risk factors in following up with a FP. However, there were significant differences (P<0.001) for a follow-up with a FP based on age where the older participant (age > 60 years) with diabetes, hypertension, elevated triglycerides, low HDL, higher abdominal waist, and metabolic syndrome risk factors had higher follow up rates (Table 4). A significant percentage (over 50%) among participants with overweight risk factors followed-up with a FP. This study also revealed that over 62% and 59% of participants with high and moderate FRSs, respectively, had followed up with a FP to modify their CVD risk factors (Figure 4).

4. Discussion

To our knowledge, the "*Health Takes Heart*" study was, to date, the first and largest community-based CVD risk factor screening program conducted in the Cape Breton area. This descriptive cross-sectional study examined the efficiency of community-based CVD risk screening programs in rural communities in identifying populations with high CVD risk factors. The promising effectiveness of advice as a means of modifying some risk factors, combined with the opportunity for continuity of care that allowed reinforcement of prevention messages, supported this study's approach of motivating people with risk factors to visit their FP.

Table 4. The percent of participants who followed up with a FP within 3 to 6 months of screening based on the presence or absence of their risk factor

Risk Factor	Percent (%) Followed up with a FP		P-value
Age			
<60	45.4		<0.001
>60	59.9		
Gender			
Men	52.5		NS
Women	51.7		
Risk factor	presence	Absence	
Diabetes	64.1	51.7	<0.001
Heart Disease	61.3	51.9	NS
CVA	58.3	52.6	NS
PVD	61.5	52.4	NS
Hypertension (BP>140/130)	60.0	44.7	<0.001
Triglyceride (>1.7Mmol/L)	57.9	45.9	<0.001
HDL (<1.0/1.3)	56.2	50.1	<0.001
Abdominal Waist (> 102/88 Cm)	57.6	46.4	<0.001
Metabolic Syndrome	60.0	46.1	<0.001
Overweight	53.6	47.4	<0.001
Obese	56.3		<0.001
Total	52.7%		

The community-based screening program engaged many people in the Cape Breton area to learn about their CVD risk factors. Very high rates of risk factors were observed in the community, where 77% of participants with at least 1 to 3 CVD risk factors were referred to follow-up with their FPs. This is consistent with the Canadian Heart and Stroke Foundation report, which indicates that 90% of Canadian have at least one heart/stroke risk factor, and 40% have at least three risk factors [2-3]. This study also identified that the study population had many CVD risk factors, with prevalence rates higher than the national and provincial average. These high rates of CVD risk factors were likely related to the high percentage of the aged population in the CB community, with 46% of the study population older than 60 years. A Swedish study has indicated that rural communities have higher CVD risk factors because they have an older population with lower education levels and a high sedentary lifestyle [6].

This study found that abdominal obesity, high BMI, hypertension, high triglycerides, and increased HDL cholesterol levels were prevalent risk factors in the studied population leading to high metabolic syndromes risk scores. Important to note that the traditional risk factors such as age, sex, and hypertension were the primary factors in increasing the FRS, which are considered primary CVD predictors [28]. These findings are consistent with previous studies comparing rural and urban communities, which indicated that rural communities have a higher prevalence of smoking, obesity, and hypertension, in addition to a lack of access to primary health care providers leading to higher heart and stroke disease prevalence rates [6,7, 29].

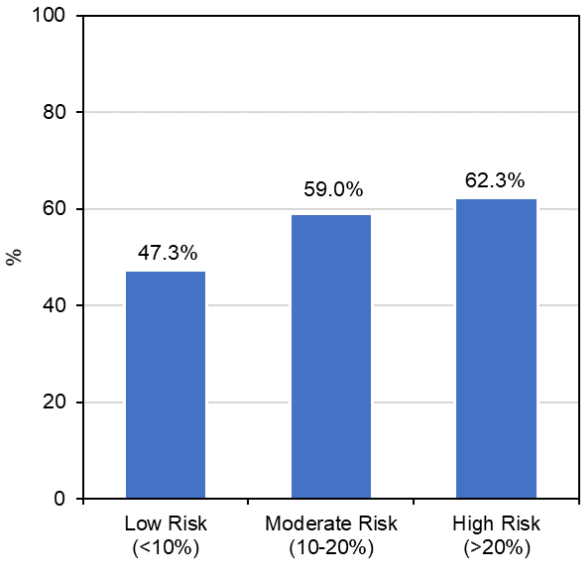

Figure 4. Percent of participants who followed up with a family physician after 3-6 months of screening based on their FRS. (P-Value <0.001).

The finding of this study showed that over one-third of

the CB community have moderate to high FRSs. If the metabolic syndrome was combined with moderate and high-risk FRSs, 55.2% of the participants would demonstrate increased risk. These findings support that community-based screening programs can effectively identify risk factors in high-risk populations [15, 30]. This study also identified that almost half of the studied population had hypertension which was 30% higher than the national average [27]. This screening program successfully identified that about one-third of the population had untreated and uncontrolled hypertension that requires immediate medical attention. This is consistent with previous community-based studies, which identified untreated and uncontrolled hypertension populations in urban communities [15].

Previous studies have found that in community-based screening efforts that participants often do not follow up with their physicians or primary health care providers [31-32]. However, this study showed that over half of the targeted participants followed up with FPs. This indicates that over half of the participants adhered to the research team recommendations, and CVD risk factor educational interventions effectively increased public awareness of CVD risk factors. High-risk populations such as older populations with significant hypertension and metabolic syndrome risk factors had very high follow-up rates with their FPs. This supports the idea that brief educational intervention after community-based screening can enhance individual knowledge of CVD risk factors and empower them to seek medical assistance from a primary health care provider. This finding supports the communication approaches "from education to motivation" and personalized communication' to enhance patient motivation and adherence to CVD prevention [33].

Furthermore, our study is the first to report this paradox of controlling the risk factor based on the calculated FRS in a community screening project. An Italian study showed a similar paradox of low and medium-risk patients having better blood pressure control than higher-risk patients using European Society of Cardiology/(ESH/ECH) guidelines [34]. The underutilization of established therapies to reach targets and those at highest risk were the least likely to be at recommended cholesterol and blood pressure targets, indicating an increased need for alternative screening programs and consideration of other treatment models.

This study has some limitations. The prevalence of the CVD risk factors may not reflect the actual prevalence in the CB area because the sample included participants based on a voluntary screening program rather than a population-based cohort study. It is also possible that high-risk rates reflect a volunteer bias, with participants suspecting a higher risk of heart disease being screened. There could also be a social response bias, such as over-reporting their physical activity levels and under-reporting their smoking status. A shopping mall setting as a place to do a screening program might not be quiet and private and may hinder some participants with a high risk of volunteering in the screening program. Hypertension diagnosis requires validation with repeated measurements. In this study, a minimum of 2 to 4 readings were done at one-minute intervals. Non-fasting blood sugar was measured, which might not reflect the accurate value.

5. Conclusions

The "*Health Takes Heart*" community screening program in the rural CB community identified high CVD risk factors prevalence rates, with high metabolic syndrome and FRSs. Furthermore, post-screening educational interventions were very effective in enhancing public awareness of their CVD risk factors and the importance of following up with a primary health care provider to modify their CVD risk factors. Future efforts and research should focus on determining compliance factors and how to get patients at the highest risk to receive more appropriate levels of treatment. Chronic disease management strategies will be essential with an aging population, demand for health human resources, a lack of access to primary care and an ever-increasing burden of CVD.

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Conflict of Interest

Non to Declare

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