Accuracy of Self-Perception of Cardiovascular Risk in the Community

Abstract

Background: Assessment of individual risk is an important part of the primary prevention of coronary disease and stroke. The accuracy by which individuals perceive their risk is unclear. We aimed to explore the accuracy of self-perceived cardiovascular risk in the community, and the value of one-to-one interview, using a risk assessment tool, in increasing the accuracy.

Methods: Participants in 2 community health fair events in 2006 were asked to assign their 5-year cardiovascular risk to one of 3 categories (high, moderate and low), before and after being counseled about their risk using a Framingham-based risk calculator. Agreement between perceived risk and calculated risk was studied using kappa analysis. Change in perception was the indicator of response to the study intervention. Predictors of accuracy, underestimation, and responsiveness to the study intervention were identified using logistic regression.

Results: There were 146 participants that were included in the analysis (mean age±SD, 47±15; 64% women). Rate of inaccuracy was 66% (mainly due to underestimation of risk n=86 participants). Agreement between perceived and objective risk was poor (kappa±standard error [SE] 09.0±4.3%). After the study intervention, the rate of accuracy significantly increased to 74% (n=108, p<0.0001). Post intervention kappa±SE 60.9±5.7%. Age >45 years predicted inaccuracy. Age > 45 years, non-African-American race, and alcohol use predicted underestimation. Family history of cardiovascular diseases or risk factors predicted responsiveness.

Conclusion: Self perception of the 5-year risk of cardiovascular events is inaccurate, mainly due to underestimation. A targeted educational session using a risk assessment tool improved the accuracy.

Keywords: stroke prevention, risk factors, coronary artery disease, community survey

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Despite recent advances in the treatment of acute stroke and myocardial infarction (MI), prevention remains the best means of reducing the increasing burden of cardiovascular diseases.[1, 2] Patient and healthcare provider awareness of individual risk of cardiovascular diseases is essential for accurate planning and successful implementation of prevention strategies[3]. The American Heart Association and the American Stroke Association recommend that assessment of individual risk be part of the primary prevention of coronary heart disease and stroke (both recommendations are Class I with Level of Evidence A).[3, 4] Previous studies have shown that persons who accurately perceive their risk of cardiovascular diseases may be more likely to engage in practices to reduce their risk compared to those who do not perceive themselves to be at risk[5]. But the accuracy with which individuals assess their risk of cardiovascular diseases is a more controversial issue. Many studies showed inaccurate perception, mainly due to underestimation, and less frequently due to overestimation of risk[5-7]. Other studies showed fairly accurate perception[8]. Previous investigators have tried to correct this inaccuracy using public campaigns[9], mailing feedback material[5], and one-to-one interviews[10]. Most of these methods were successful, but still the need exists for a simple, time-saving method that is specifically devised for risk of cardiovascular diseases awareness and can be incorporated into daily practice.

In this study, we aim to: (a) explore the accuracy of individuals' perceived cardiovascular risk, by comparing it to an objective risk, calculated using a Framingham-based risk assessment tool, and, (b) assess the value of using this tool, in the context of one-to-one interview, in increasing the subjects' awareness of their risk of cardiovascular diseases.

Methods

Study participants were recruited in the summer of 2006, in Newark, New Jersey, during 2 events of free stroke screening as part of a community health fair. Attendance was encouraged by distribution of fliers handed out at local churches and through press releases, weeks before the events. All adults were welcome to participate. The screening team was composed of two neurologists, several nurse

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practitioners, a biostatistician and a Spanish interpreter for non-English speaking Hispanic participants.

Screening was performed in 5 steps:

1) Registration and first interview: Every participant was given a code (to avoid using personal identifiers) and asked to assign his/ her risk of having a stroke or a heart attack in the next 5 years to one of three categories: high, moderate, or low.

2) Medical history reporting: using the Stroke Risk Assessment Form (American Stroke Association), participants were asked to report their personal and family history of cardiovascular risk factors including, previous myocardial infraction, stroke, transient ischemic attack, hypertension, dyslipidemia, diabetes mellitus atrial fibrillation, and smoking.

3) Measurement of physiologic parameters: random blood glucose and total cholesterol levels were measured using a fingerstick machine. Blood pressure was measured once in either arm using an automated device.

4) The second interview: Each participant was personally interviewed again immediately after measurement of his/her physiologic parameters by one of the study personnel. Five-year cardiovascular risk was calculated, using the Framingham calculator, the numeric value was presented, and interpreted for the participant. The participant's risk factors and their impact on calculated risk were discussed, along with different aspects of primary prevention. Participants' questions were answered. The second interview was 5 minutes long on average.

5) Finally, the participant was asked to re-estimate his/her risk in the light of the new information.

The calculator used in this study is an online calculator, developed using the Framingham study data, based on the equation from the article by Anderson et al[11] with the HTML design by Christopher & Martin Dawes and modified by Neville. The input data consist of age, gender, systolic blood pressure, total cholesterol, high density lipoprotein cholesterol, being diabetic or not and being a smoker or not. The output of the calculator is an estimated 5-year and 10-year cardiovascular risk.

"Low" risk was defined as < 1%, "moderate" risk was defined as 1-5%, and "high" risk was defined as > 5%. Accuracy was defined as the ability of the participant to assign his/her risk of cardiovascular diseases to the same category as his calculated risk. Responsiveness to the study intervention was defined as the ability of the participant to modify an initially inaccurate assessment in the right direction.

<u>Statistical Analysis</u>

The analysis was performed in subjects with complete data (able to calculate the risk score according to the Framingham scheme), who had no past history of cardiovascular events. Kappa analysis was done to study the agreement between perceived and objective risk, before and after the study intervention, using the weighted Kappa. McNemar's test was used to detect the difference in response before and after the study intervention. A univariate analysis was done comparing participants with an accurate perception in their initial assessment with those who had an inaccurate perception in their initial assessment using a chi-squared analysis for categorical variables, and a t-test for interval variables. The same analysis was done comparing participants with an accurate perception in their initial assessment with those who underestimated their risk. The third univariate analysis was done to compare participants who were responsive to the study intervention versus those who were not. Logistic regression analysis was used to study the predictors of accuracy, underestimation, and responsiveness.

Results

There were 183 participants. Thirty seven participants were excluded (incomplete data, n=28; previous stroke or MI, n=9). Excluded participants (mean age ± standard deviation [SD] of 45±19 years; 21 women) were not significantly different from the included group in their demographic profile (data not shown). Table 1 summarizes the demographic and the risk factor profile of the included participants (n=146).

The majority of participants perceived their risk as low (n=95, 65%), while 43 (30%) perceived it as moderate and 8 (6%) perceived it as high. Ninety six participants (66%) were inaccurate in their perception, while 50 (34%) were accurate. Underestimation was observed in 86 participants (60% of the total sample; 90% of inaccurate participants), while overestimation was observed in only 10 participants (6% of the total sample; 10% of inaccurate participants). Kappa analysis showed low agreement between perceived and objective risk before the in-

Table 1. Demographics and risk factors of the sample included in the analysis (n=146).

Characteristics	Value
Age*	47±15
Sex	
Female	93 (64%)
Male	53 (36%)
Race/Ethnicity	
African American	82 (56%)
White	11 (8%)
Hispanic	29 (20%)
Other	13 (9%)
Not reported	11 (7%)
Risk Factors	
Hypertension	35 (24%)
Hypercholesterolemia	27 (19%)
Current Smoking	25 (17%)
Diabetes	14 (10%)
Two or more risk factors	22 (15%)
One risk factor	53 (36%)
No risk factors	71 (49%)
Family History	
Hypertension	97 (53%)
Diabetes	77 (42%)
Hyperlipidemia	59 (32%)
Stroke and/or TIA	43 (24%)
Coronary Artery Disease	40 (22%)
Measurement/Calculation	
Systolic Blood Pressure *	129±19
Diastolic Blood Pressure *	78±10
Random Total CE *	189±44
Random Blood Sugar *	116±41

Abbreviations used: SD, standard deviation; TIA, transient ischemic attack

Table 2. Agreement between perceived and objective cardiovascular risk before and after the study intervention.

Perceived risk		Objective risk		
		Low	Moderate	High
Before	Low	25 (80.7%)	54 (67.5%)	16 (45.7%)
	Moderate	5 (16.1%)	22 (27.5%)	16 (45.7%)
	High	1 (3.2%)	4 (5.0%)	3 (8.6%)
	Kappa±standard error	9.0±4.3%		
	Accuracy rate	50 (34.2%)		
After	Low	29 (93.6%)	15 (18.8%)	6 (17.1%)
	Moderate	2 (6.5%)	55 (68.8%)	5 (14.3%)
	High	0 (0%)	10 (12.5%)	24 (68.6%)
	Kappa±standard error	60.9±5.7%		
	Accuracy rate	108 (74.0%)		

Table 3. Self-assessment of cardiovascular risk before and after the study intervention.

		Before	After	McNemar's p-value
Self assessment	Low risk	95 (65%)	50 (34%)	<0.0001*
	Average risk	43 (30%)	62 (43%)	
	High risk	8 (6%)	34 (23%)	
Accuracy	Accurate	50 (34%)	108 (74%)	<0.0001
	Inaccurate	96 (66%)	38 (26%)	
	Underestimation	86 (60%)	26 (18%)	<0.0001
	Overestimation	10 (7%)	12 (8%)	0.823

* Simple kappa p-value

Table 4. Univariate analysis comparing the demographics and risk factor profiles of the study participants based on the accuracy of their perception

Variables	Responsive (n=71)	Non-responsive (n=25)	*P value
Age	52±12	51±14	0.73
Male	26 (37%)	13 (52%)	0.17
Race/Ethnicity			**0.74**
White	7 (70%)	3 (12%)	
African American	35 (49%)	15 (60%)	
Hispanic	15 (21%)	4 (16%)	
Other	9 (13%)	1 (4%)	
Risk Factors			
Hypertension	18 (25%)	7 (28%)	0.80
Diabetes Mellitus	9 (13%)	2 (8%)	0.53
Hyperlipidemia	12 (17%)	8 (32%)	0.11
Current smoker	11 (16%)	7 (28%)	0.17
Alcohol use	8 (11%)	7 (28%)	0.06
≥ 2 risk factors	11 (16%)	8 (32%)	0.09
Family History			
Stroke	14 (20%)	6 (24%)	0.65
Hypertension	40 (56%)	8 (32%)	0.04
Coronary artery disease	16 (23%)	3 (12%)	0.26
Diabetes mellitus	32 (45%)	6 (24%)	0.06
Hyperlipidemia	28 (39%)	4 (16%)	0.03
>2 risk factors	39 (55%)	7 (28%)	0.02
Physiological parameters (mean± SD)			
Systolic blood pressure*	129±17	136±23	0.16
Diastolic blood pressure*	78±11	81±11	0.21
Random blood sugar*	117±32	104±17	0.05
Random total cholesterol*	191±41	202±44	0.23

*P value = 0.05

tervention (kappa± SE 09.0±4.3%; Table 2).

After the study intervention, the rate of accuracy significantly increased to 74% (n=108, p<0.0001), which was reflected on increased agreement between perceived and objective risk (kappa±SE 60.9±5.7%). The rate of underestimation significantly decreased (n=26, 18%, p<0.0001) while the rate of overestimation did not change (n=12, 8%, p=0.82; see Figure 1 and Tables 2 and 3).

Seventy one participants (74% of the inaccurate participants) were responsive to the study intervention. In univariate analysis, there were no significant differences between responsive and non-responsive groups in demographic characteristics or risk factors. Responsive group had non-significant lower rate of participants reporting multiple risk factors, i.e. 2 or more risk factors (16% vs. 32%; p=0.085), and participants reporting alcohol use (11% vs. 28%; p=0.058) compared with the non-responsive group. Responsive participants reported higher rates of family history of hypertension (56% vs. 32%; p=0.034) and hyperlipidemia (39% vs. 16%; p=0.047). The median calculated risk was not significantly lower in the responsive group (median 3.2 vs. 4.5, p=0.27; see Table 4). In multivariate analysis; family history of cardiovascular disease (OR 4.02, 95% CI 1.36-13.64, p<0.017) and absence of hyperlipidemia (OR 6.25, 95% CI 1.41-20, p=0.016) predicted responsiveness, after adjusting for age, gender, race/ethnicity, and clinical risk factors. Other variables that predicted responsiveness but did not reach statistical significance were: age of 45 years or older, non smoking and diabetes mellitus.

In univariate analysis, participants who perceived

Table 5. Univariate analysis comparing the baseline demographic and risk factor profile of participants who estimated their risk correctly with those who did not and those who specifically underestimated their risk.

Variable	*P value	Inaccurate (n=96)	Accurate (n=50)	Underestimation (n=86)	µP value
Age	0.0001	52±12	40±14	53±12	<0.0001
Male	0.08	39 (41%)	13 (26%)	36 (42%)	0.06
Race/Ethnicity	0.30				0.26
White		10 (10%)	1 (2%)	10 (12%)	
African American		50 (52%)	32 (64%)	42 (49%)	
Hispanic		19 (20%)	10 (20%)	19 (22%)	
Other		10 (10%)	3 (6%)	9 (11%)	
Missing		5 (5%)	4 (8%)	5 (6%)	
Risk Factors					
Hypertension	0.41	25 (26%)	10 (20%)	24 (28%)	0.30
Diabetes mellitus	0.29	11 (12%)	1 (2%)	0	0.28
Hyperlipidemia	0.31	20 (21%)	3 (6%)	10 (12%)	0.25
Current smoker	0.47	18 (19%)	7 (14%)	19 (22%)	0.39
Former smoker	0.56	8 (8%)	4 (8%)	7 (8%)	1
Alcohol use	0.12	15 (16%)	3 (6%)	15 (17%)	0.07
≥ 2 risk factors	0.79	15 (16%)	7 (14%)	15 (17%)	0.34
Family History					
Stroke	0.22	20 (21%)	15 (30%)	20 (23%)	0.39
Hypertension	0.25	48 (50%)	30 (60%)	42 (49%)	0.21
Coronary artery disease	0.17	19 (20%)	15 (30%)	16 (19%)	0.13
Diabetes mellitus	0.61	38 (40%)	22 (44%)	36 (42%)	0.81
Hyperlipidemia	0.93	32 (33%)	17 (34%)	29 (34%)	0.97
>2 risk factors	0.25	45 (47%)	7 (14%)	15 (17%)	0.15
Physiological parameters (mean ± SD)					
Systolic blood pressure	0.19	131±19	127±20	132±20	0.12
Diastolic blood pressure	0.10	79±11	76±9	79±11	0.09
Random blood sugar	0.89	114±30	113±29	114±30	0.94
Random total cholesterol	0.05	194±42	179±42	196±41	0.02

*P value (0.05) for test comparing inaccurate versus accurate estimation
µP value (0.05) for test comparing inaccutrate versus underestimation

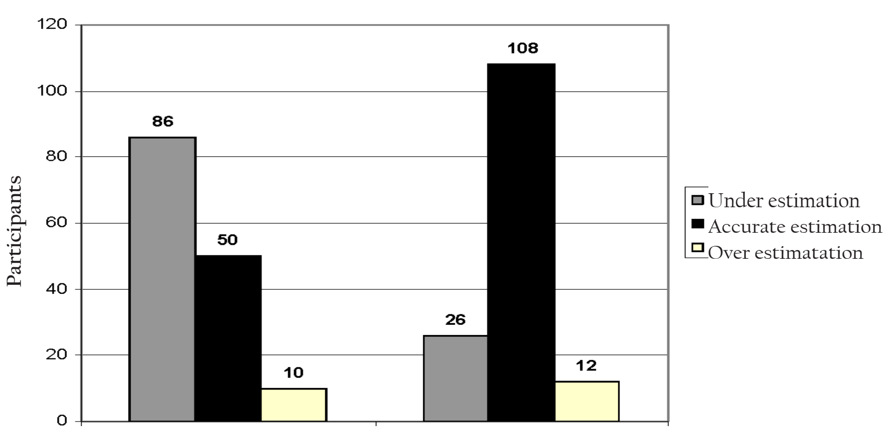

Figure 1. Accuracy of self-assessment of cardiovascular risk before and after the study intervention.

their risk accurately were younger than inaccurate participants (mean age±SD 40±14 vs. 52±12 years; p=0.0001) and had significantly lower median calculated risk (0.95 vs. 3.30; p=0.0001). In multivariate analysis, age of 45 or older predicted inaccuracy (odds ratio [OR] 6.67, 95% confidence interval [CI] 2.86-16.67, p<0.0001), after adjusting for sex, race/ethnicity, hypertension, diabetes, hyperlipidemia, current smoking, alcohol use, and family history of 2 or more cardiovascular risk factors or disease. There was also an association between inaccuracy and history of alcohol use (OR 3.85, 95% CI 0.99-20, p=0.07) although this did not reach statistical significance.

Underestimation was studied by comparing participants who initially underestimated their risk to those who were accurate. Underestimators were older (mean age±SD 53±12 vs. 40±14 years; p=0.0001), had higher serum cholesterol (196±41 vs. 179±42 mg/dL; p=0.02) and higher median calculated risk (3.9 vs. 0.95; p<0.0001). There was also a non-significant trend towards higher prevalence of alcohol use (17% vs. 6%; p=0.07; see Table 5). In multivariate analysis, age of 45 years or older (OR 12.44, 95% CI 4.80-36.96, p<0.0001), non-African American race (OR 3.45, 95% CI 1.32-10, p=0.015), and alcohol use (OR 7.47, 95% CI 1.67-44.75, p=0.015) were associated with underestimation of cardiovascular risk, after correcting for sex, diabetes, hypertension, hyperlipidemia, and family history of or more cardiovascular risk factors or disease.

Discussion

In this community based study, two thirds of the study participants, who were mainly African American women, were inaccurate in assessing their own risk of cardiovascular event in the next 5 years, mainly due to underestimation of their risk. About three quarters of the initially inaccurate participants responded to the study intervention. The rate of accuracy significantly increased, while the rate of underestimation decreased, after the study intervention. Accuracy was predicted by age younger than 45, while underestimation was predicted by age older than 45. Responsiveness to the study intervention was predicted by family history of cardiovascular disease and absence of hyperlipidemia.

Inaccuracy and underestimation

The term "optimistic bias" was first used by Weinstein to describe the phenomenon of illogical underestimation of risk.[12] In our study, the vast majority (90%) of inaccurate participants underestimated their cardiovascular risk, while only (10%) overestimated their risk. Underestimation has been reported in previous studies. In a sample of 1,317, Kreuter et al. compared perceived risk with objective risk, and optimistic biases were found for perceived heart attack andstroke risks. In that study, 46% of participants had optimistic bias, 19% had pessimistic bias and 35% had accurate perception of their risk.[5] In another study, Harwell et al[13] conducted a random telephone survey of adults aged 45 years and older (n = 800) and found that 51% of respondents with two or more risk factors did not consider themselves to be at risk for developing a stroke. In a third study, Niknian et al[14] collected data from two community health surveys (n = 4,171). Perceived cardiovascular risk was compared with total RISKO score (from the American Heart Association's cardiovascular risk assessment instrument). The overall kappa was 0.078; indicating poor agreement between perceived and objective cardiovascular risk, with twice as many people underestimated their risk, compared to those who overestimated their risk. In a fourth study, Frijling el al[6] compared perceived to calculated cardiovascular risk in 1194 patients with diabetes mellitus and hypertension. The rate of inaccuracy was 42% and 47% for the 10-year risk for Myocardial Infarction and stroke, respectively. However, this study reported overestimation as the underlying cause for inaccuracy.

Age was the most important independent predictor of inaccuracy and underestimation. The mean age difference between accurate and inaccurate participants and between accurate and underestimators was 12 and 13 years, respectively. Age older than 45 years predicted inaccuracy and underestimation. The important question is whether the participants, who accurately perceived their risk, were accurate because of their insight or because they were young, and that they will shift to the underestimators' group as they grow older. Our observation agrees with the study by Harwell et al[13], in which logistic regression demonstrated that, younger age, not older age, was independently associated with inaccurate perception of the risk for stroke. Other studies report to the contrary, that younger participants were more likely to have optimistic bias to both stroke and heart attack.[5, 14]

Interestingly, participants in our study were unable to recognize their cardiovascular risk, despite being able to report their cardiovascular risk factors. Moreover, participants with two or more risk factors were not more accurate in estimating their risk, than those with less than 2 risk factors, an observation also reported by Harwell et al.[13] This implies lack of ability to connect between having the risk factors for cardiovascular disease, and actually having a cardiovascular event; a simple cause-effect relation, taken for granted by some healthcare professionals. Samsa et al[7] reported the observation that only 27% of the study participants who were known to be at high risk of stroke reported being told by a physician that they were at high risk. They also found a strong correlation between stroke risk being told by physicians (and patients recalling being told) and patient's awareness. However, 26% of patients who were informed of their increased stroke risk by a physician felt themselves not to be at increased risk.

In our study, underestimation was higher among non-African American participants. This contradicts Kreuter et al[5], probably because in that study, 86% of the sample were caucasian, as opposed to 7% in ours. Therefore, African American race in our study is being compared with Hispanics and other races/ethnicities. Alcohol use was another predictor of underestimation, unlike a previous study which associated alcohol use with better ability to estimate risk of cardiovascular diseases.[6]

Responsiveness

Participants responded favorably to the study intervention with significant reduction in the rate of underestimation. Despite the lack of significant differences between the responsive and non-responsive groups in demographic and risk factor profile, we observed a trend towards lower rates of high risk behavior such as cigarette smoking (16% vs. 28%; p=0.17) and alcohol use (11% vs. 28%; p=0.06) in responsive participants. More importantly was the significant difference between responsive and non-responsive participants in the reported family history. The responsive group had higher rates of hypertension (56% vs. 32%; p=0.03), and hyperlipidemia (39% vs. 16%; p=0.04). The median number of cardiovascular diseases risk factors or diseases reported by per participant was also higher in the responsive group (2 vs. 1; p=0.02). The logistic regression analysis confirmed the effect of family history in predicting responsiveness, which implies a strong learning effect. Participants with previous experience with cardiovascular diseases or the related risk factors in their family are already primed for accepting the facts and more flexible in correcting their faulty perception based on these facts. Frich et al[13] reported that patients with familial hypercholesterolemia tend to compare themselves to other family members when assessing their own cardiovascular risk.[15]

Implications

This study shows that health care professionals need to educate the public more about cardiovascular diseases, with special emphasis on the relation between having the risk factors and having the actual cardiovascular event. Health care professionals should not assume that subjects would be able to deduce the relation between risk factors and risk of cardiovascular diseases. Counseling should take one more step forward in orienting subjects to their own risk. The study intervention is simple, practical, and effective. It can be implemented in outpatient clinics and community based surveys. Previous studies have shown that physicians also tend to be inaccurate in assessing their patients' risk of cardiovascular diseases, mainly due to overestimation.[16-20] We chose 5-year risk, rather than 10-year risk, in assessing perceived risk because it was thought to reflect more realistic expectations about near future events, based on current state of health.

Some studies reported better patient communication with visual aids and scale[6], with other studies showing patient difficulty in interpretation of numerical information.[21] Other studies have shown that individuals have different quantitative meanings for qualitative descriptions of risk.[22, 23] We attempted to overcome this difficulty through our one-to-one interview, where numerical values were presented and interpreted. We were also able to reinforce this information by providing explanation as to what risk factors contributed to the calculated risk. The interactive nature of our methods, where participants are allowed to guess first, and then learn whether they were right or wrong, and why, also reinforced the information. This patient-tailored counseling can only be facilitated through one-to-one interview process.

In a systematic review of 96 published articles, Edwards et al observed that risk-communication interventions generally had positive beneficial effects, and were most productive when they included individual risk estimates in the discussion between professional and patient.[10]

Therefore, based on the results, our recommendation would be directed mainly to the primary care providers to counsel their patients about their cardiovascular risk in an individualized one-to-one interview using a risk assessment tool.

Limitations

Our study was conducted in Newark, New Jersey. Based on the U.S Census data from 2006,26 53.9% of Newark population are African Americans, 31.47% are Hispanics, and 22.1% are White. Twenty four percent of individuals are below poverty level (13% national average. Only 11.9% have bachelor degree or higher (27% national average). According to the most recent Heart Disease and Stroke statistics published by the American Heart Association[27], African Americans have higher rates of cardiovascular disease, hypertension, diabetes mellitus, and heart failure than non-Hispanic Whites. Smoking rate was equal in both races. Hispanics came third in all above disorders except diabetes mellitus, where they came second. Using the Framingham data, the cutoff point for high risk is ≥ 15%, for moderate risk is 14-10% and for low risk is < 10%. The cutoff points used in our study are lower (high risk >5%, moderate 1-5% and low< 1%). We chose these arbitrary cutoff points based on the assumption that the Framingham equation will probably underestimate the cardiovascular risk in our study population. Several studies have shown that Framingham overestimates risk in low risk populations, such as some European countries .[24, 25]

Other limitations of the study include (a) risk factors were self-reported; (b) blood pressure was measured once during the screening process may not be representative of the participant's baseline blood pressure; (c) cholesterol was measured in the non-fasting state, which might have resulted in a non representative values; (d) the calculator used, although the most practical one we found on the web (other risk tools required data that was unlikely to be available, e.g. left ventricular hypertrophy), does not account for important known risk factors such as left ventricular hypertrophy, significant family history, and being on preventive medication such as antihypertensive or antiplatelet agents; (e) other potential predictors of interest such as numeracy and literacy, or their proxy, education, are not evaluated; and (f) responsiveness to the study intervention may be a temporary phenomenon, and does not reflect a change in behavioral patterns.

Conclusions

Self perception of the 5-year risk of cardiovascular events is inaccurate, mainly due to underestimation. A targeted educational session using risk assessment tool, improved the accuracy of this community based study sample.

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