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A FRAMEWORK FOR MANAGING MODIFIABLE RISK FACTORS FOR CARDIOVASCULAR DISEASES IN FIJI

RUNNING TITLE: MODIFYING CARDIOVASCULAR DISEASES IN FIJI

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ABSTRACT

Fiji is progressing through demographic and epidemiological transitions, including a decline in infectious diseases and improved life expectancy. However, in concert with other developing nations, “modernization” is accompanied by increased mortality from non-communicable diseases, with cardiovascular diseases (CVD) leading the way. This transition has been associated with changes to socio-cultural aspects of Fiji, including poor lifestyle choices that may contribute to a cluster of cardio-metabolic conditions which precede CVD. The current review will look at modifiable *lifestyle* (physical inactivity, poor nutrition, risky alcohol behaviour, and cigarette smoking) and *cardio-metabolic* (obesity, diabetes mellitus, high cholesterol, and high blood pressure) risk factors among indigenous-Fijian and Indo-Fijian sub-groups. A conceptual framework and guidelines will be presented for monitoring and tracking these modifiable risk factors.

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INTRODUCTION

Fiji, in concert with other *developing* Pacific Island nations, have seen decreases in infectious diseases and significant rises in the prevalence of non-communicable diseases (NCD), most notably cardiovascular disease (CVD) [1]. CVD has become the leading cause of death [1], with proportional mortality increasing from around 20% in the 1960s to over 45% today [2]. Limited data is available comparing Fiji's two main ethnic groups (indigenous-Fijian & Indo-Fijian), though at least one study has found higher CVD mortality rates among Indigenous-Fijian men compared to Indo-Fijian men; after accounting for all other measured risk factors, the relative risk for CVD mortality was lower among Indo-Fijian men (RR = 0.49, 95% CI : 0.30-0.82) but not women (RR = 0.58, 95% CI : 0.32-1.05) [3]. The same study also found deaths due to coronary heart disease to be higher in urban than rural areas.

A cluster of *modifiable* cardio-metabolic risk factors precede CVD, including obesity, diabetes, high cholesterol, and high blood pressure (see Table 1 for guidelines). In turn, modifiable lifestyle risk factors contribute to the development of this cluster of cardio-metabolic conditions (conceptualized in Figure 1). Modifiable lifestyle risk factors include, but are not limited to, physical inactivity, poor dietary choices, cigarette smoking, and risky alcohol behavior. Multiple studies have revealed that modifiable risk factors are responsible for a large number of premature deaths due to CVD [4,5]. A study by Danaei et al [4] reported that the single largest risk factor for cardiovascular mortality in the US was high blood pressure, responsible for 45% of all cardiovascular deaths, followed by obesity, physical inactivity, high cholesterol and

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smoking. Notably, many of these metabolic and lifestyle risk factors are relatively simple to monitor and track (Table 1).

The current review will look at *cardio-metabolic* (overweight-obesity, diabetes, high cholesterol, and high blood pressure) and *modifiable lifestyle* (physical inactivity, poor nutrition, risky alcohol behavior, and cigarette smoking) risk factors among indigenous-Fijian and Indo-Fijian adults. The discussion will focus on the causal relationship between modifiable lifestyle risk factors and cardio-metabolic conditions. The review will finish with recommendations for future direction.

MODIFIABLE CARDIO-METABOLIC METABOLIC RISK FACTORS

The following section will highlight the prevalence of *modifiable* cardio-metabolic risk factors in Fiji for CVD: obesity, diabetes, high cholesterol, and high blood pressure (see Table 1). Each of these risk factors is relatively simple to measure and monitor.

OBESITY

Excess body fat increases the risk of developing a range of health problems, including high blood pressure, diabetes mellitus, and CVD [6-8]. Population studies typically estimate the prevalence of overweight/obesity by calculating an individual's Body Mass Index (BMI) score [9]. Despite widespread use, BMI has been heavily criticized[10-15]. BMI is calculated by dividing weight by height, and it assumed that body weight equates to body fat. Romero-Corral et al [10] undertook a meta-analysis to determine the nature of the relationship between obesity and cardiovascular mortality in patients with CHD. Patients with severe obesity (BMI $\geq$35) had the greatest relative risk

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(RR) for cardiovascular mortality (RR=1.88) compared to people with a normal BMI (BMI 20-24.9). However, overweight patients (BMI 25-29.9) had the lowest risk (RR=0.88), and obese patients (BMI >30) had no increased risk (R = 0.97). The authors suggested that these findings could be explained by the lack of discriminatory power of BMI to differentiate between body fat and lean mass. Alternatively, waist-to-hip ratio (WHR) takes into consideration body-fat distribution, especially abdominal obesity [16], and a number of studies, investigating a range of ethnic groups, have found WHR to better predict cardio-metabolic and cardiovascular risk factors than BMI [11-14]. However, studies over the past two decades indicate that cutoffs for WHR differ by ethnic groups, therefore the reference values provided in Table 1 should be used to provide a guidelines [17], not to ascertain absolute risk.

The Pacific region is ranked among the highest prevalence of obesity in the world [18] and Fiji is no exception with a doubling in obesity over the past decade [19]. The 2002 Fiji Non-Communicable Disease (NCD) STEPS survey reported that 29% of the adult (15-64 years) population were overweight, with an additional 18% obese [20]. Generally the females had a higher BMI than males (mean BMI 26.7 vs 24.2), and the burden of overweight/obesity was greater among indigenous-Fijians (50%) than Indo-Fijians (35%). These findings have been corroborated by other studies, estimating that more than one-third of the population is overweight or obese [19,21,22] with higher rates among indigenous-Fijians [19,21], although both groups have increased over recent years [21].

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DIABETES

Diabetes mellitus is a metabolic disease in which high blood glucose levels result from defective insulin secretion, insulin action or both [23]. There are several types of diabetes mellitus, each with a different cause and clinical history. The two most prominent however are Type 1 and Type 2 diabetes, which differ according to their underlying pathophysiology, with Type 1 often attributed to an autoimmune response and Type 2 often related to several lifestyle factors. Type 2 (T2DM) diabetes accounts for 90-95% of diabetes cases and is a major risk factor for CVD [27, 30-35]. Several modifiable risk factors play a role in the onset of T2DM, including obesity, physical inactivity and poor nutrition, as does genetic predisposition and ageing [30-34]. T2DM risk can be monitored by measuring glucose tolerance or fasting blood glucose. A fasting blood glucose of <100 mg/dl is considered optimal [35].

The 2002 NCD STEPS survey registered 16% of the adult population (25-64 years) as diabetic, with a further 11% having impaired fasting glucose (>217 mg/dL and <235 mg/dL) [20]. Among those with T2DM, 53% were previously un-diagnosed. The prevalence of T2DM was shown to increase with ageing, with 5% of 25-34 year olds registering as diabetic versus 33% of 55-64 year olds. The T2DM burden is particularly pronounced among the Indo-Fijian, with a prevalence of 21% versus 12% of indigenous-Fijians. Locality was also shown to be important, with a prevalence of 25% among urban dwellers versus 13% among rural dwellers. More recently, the Fijian Ministry of Health estimated the total prevalence of T2DM at 18% [36].

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CHOLESTEROL

The two most common blood lipids are cholesterol and triglycerides. These two blood fats are carried on particles called lipoproteins, the most important of which are low density lipoprotein (LDL) and high density lipoprotein (HDL). Both carry cholesterol, but it is high LDL-cholesterol levels that have been shown to be pro-atherogenic [37-41], whereas low levels of HDL-cholesterol are associated with increased CVD morbidity and mortality [42-45]. Conversely, high HDL-cholesterol levels convey reduced risk [42-45]. In population studies, serum total cholesterol is often used as a surrogate for LDL-cholesterol levels, however, measurement of LDL-cholesterol concentrations confers greater predictive value for cardiovascular events [37-41]. High cholesterol usually has no symptoms, and people may not be aware they have the condition unless they have had a blood test. Therefore, the best way to determine the true prevalence of high cholesterol in the community is through fasting blood samples [46]. An LDL-cholesterol level <100 mg/dl is considered optimal [47].

A recent survey conducted by the World Health Organization (WHO) [48] reported a greater prevalence of high total cholesterol levels (≥213 mg/dL) among Indo-Fijian men (46%) than indigenous-Fijian men (36%), but not for women (32% vs. 31%, respectively). The same report also found greater higher total cholesterol levels in urban (38%) than rural (35%), and an increased prevalence with age (30% among 18-35 year olds vs. 44% for 50-65 year olds).

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HYPERTENSION

Hypertension is a major risk factor for CVD. For every 20 mmHg systolic or 10 mmHg diastolic increase in resting blood pressure, there is a two-fold increase in mortality from both coronary heart disease (CHD) and stroke [49]. Hypertension is associated with shorter overall life expectancy, shorter life expectancy free of CVD, and more years lived with CVD [50]. A systolic blood pressure <120 mmHg and a diastolic blood pressure <80 mmHG is considered optimal [35]. Blood pressure should be monitored using the ausculatory method, with a properly calibrated devise following 5 minutes quiet rest in a chair [35].

In 2002, the prevalence of hypertension in Fiji among 15-64 year olds was 19%, 63% of which were new cases [20]. The prevalence of hypertension was greater among indigenous-Fijians (21%) than Indo-Fijians (16%), as was the proportion of uncontrolled previously diagnosed cases (81% vs. 58%, respectively) suggesting that hypertension is not being well recognized among indigenous-Fijians. For both groups, the prevalence of hypertension increased with age, from 9% among 15-24 year olds to 51% among 55-64 year olds. Prevalence is slightly greater among rural dwellers (20%) than urban dwellers (17%). The 2002 STEPS survey [20] reported similar rates of hypertension between genders, but more recently the 2004 National Nutrition Survey reported a higher prevalence among females (19%) than males (14%) [19]. This high prevalence of hypertension is explained by poor management, with a high proportion of cases being uncontrolled, particularly among the indigenous-Fijians [19,20].

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MODIFIABLE LIFESTYLE RISK FACTORS

The following section will discuss the prevalence of physical inactivity, poor nutrition, risky alcohol behavior, and cigarette smoking risk. While not exhaustive, these variables represent *modifiable* lifestyle risk factors which have been proven to modulate the cardio-metabolic factors discussed above.

PHYSICAL ACTIVITY

Regular physical activity reduces CVD risk in its own right and also improves CVD risk factors such as obesity, diabetes, high cholesterol, and hypertension[51-56]. It has been estimated that physical inactivity is responsible for 12% of the global burden of myocardial infarction[57]. The American College of Sports Medicine (ACSM) recommends at least 30 minutes of moderate-intensity physical activity (e.g., walking briskly, mowing the lawn, dancing, swimming, bicycling) on most days of the week [58] . A number of tools have been developed to measure physical activity, ranging from objective measures such as accelerometry, to subjective questionnaires [59]. Physical activity questionnaires are prone to technical error, but are inexpensive, practical for use in large population studies, and can provide information about physical activity type and context [59]. The International Physical Activity Questionnaire (IPAQ) (http://www.ipaq.ki.se/ipaq.htm) is a freely available, cross-national monitoring tool which has been validated for use in adults [60-64] and children [65-68].

The 2002 NCD Steps Survey found relatively low rates of sedentary activity behaviour for both indigenous (12%) and Indo-Fijians (11%). However, rates of prescribed physical activity (≥30 mins/day on most days) were low for both indigenous

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(25%) and Indo-Fijians (21%). For both ethnic groups, sedentary behaviour was greater among males (16%) than females (8%) and more prevalent in urban (14%) than rural (11%) areas. A recent study confirmed that urban-dwelling Fijian men engaged in less frequent and less strenuous activities than did rural dwellers, though no such divide was observed for women [19].

NUTRITION

A diet high in fruits and vegetables can reduce the risk for many leading causes of death [29,69-72]. In meta-analyses of prospective cohort studies, each daily serving of fruits or vegetables was associated with a 4% lower risk of CHD (RR: 0.96, 95% CI: 0.93 to 0.99) and a 5% lower risk of stroke (RR: 0.95, 95% CI 0.92 to 0.97) [71,72]. Five or more daily servings of fruit and vegetable is considered optimal[29,70]. Food Frequency Questionnaires (FFQs), including the freely available National Cancer Institute Diet History Questionnaire (http://riskfactor.cancer.gov/dhq2/) [73,74], allow for assessment of the usual patterns of food intake over an extended period of time [75,76]. Food frequency surveys are inexpensive in both time and cost in comparison to other measurement tools, which is an important consideration in studies involving large cohorts [77].

The 2002 NCD Steps Survey found generally low consumption of fruits and vegetables in Fiji, with 66% of survey participants eating less than one serving of fruits per day and 26% eating less than one serving of vegetables per day [20]. No differences were reported by gender, age or locality, though Indo-Fijians were found to eat larger amounts of vegetables each day. A more recent survey confirmed these findings, reporting that only 20% of the population consume five servings of fruits and vegetables

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per day [48]. Furthermore, the 2004 National Nutrition Survey [19] reported a decline in traditional foods between 1980 – 1993, e.g., green leafy vegetables decreased from 50% to 30% whereas, consumption of rice (25% to 55%) and bread (19% to 30%) increased over the same period. In 2004, the major source of energy was cereal (bread, flour products, rice and roti) at 34%, followed by root crops at 24% [19].

SMOKING

Cigarette smoking increases the incidence of CVD in a dose-dependent manner [78-84], with even occasional smoking increasing the risk of CVD [85]. The relationship between smoking and CVD results from multiple mechanisms that interact to contribute to atherosclerosis, vascular injury, vascular dysfunction and thrombosis, although the precise mechanisms are largely unknown [85-87]. Long-term prospective studies have clearly demonstrated the considerable mortality risk reduction associated with smoking cessation [88-90].

The 2002 NCD Steps Survey reported higher rates of cigarette smoking among indigenous (45%) than Indo-Fijians (24%), a higher proportion of males (53%) than females (18%) smoking, and smoking was found to be more prevalent in rural (41%) than urban (26%) areas. These findings are corroborated by the earlier National Fijian Adult Substance Use Survey [91] which reported a total prevalence of 38%. The overall prevalence of smoking increased 1.4% between 1993 and 2004, with a 4.8% increase in males who smoked up to four cigarettes daily [19].

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ALCOHOL

Accumulating scientific evidence indicates that light to moderate alcohol consumption may significantly reduce the risk of CVD and all-cause mortality [92-94]. In contrast, excessive alcohol intake is toxic to both the heart and overall health [92-94]. In particular, binge drinking, even among otherwise light drinkers, increases cardiovascular events and mortality [92-94]. The American Heart Association guidelines caution people not to start drinking if they do not already drink alcohol because it is not possible to predict in which people alcohol abuse will become a problem [95]. Alcohol intake can be monitored using a food frequency survey (see Nutrition section above).

The 2002 NCD Steps Survey estimated the prevalence of current alcohol consumption (consumed alcohol in the last 12 months) among 15-64 year olds at 24% [20]. However, rates of risky alcohol consumption were high at 17% for indigenous-Fijian versus 15% for Indo-Fijians. The same survey reported that males (40%) were more likely than females (6%) to consume any alcohol, and were also more likely to exhibit risky alcohol consumption behavior (80% vs. 59% among males and females that currently consume alcohol, respectively). These findings have been corroborated by the national Nutrition Survey [19] which also reported a higher prevalence of alcohol consumption in urban (35%) that rural (20%) areas.

MONITORING CARDIOVASCULAR DISEASE: ENDOTHELIAL FUNCTION

Upsetting the delicate balance of functions performed by the endothelium initiates a number of events that promote atherosclerosis, the precursor to CVD [96-98]. Although atherosclerosis is commonly described as the presence of plaques that obstruct the

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lumen of the conduit arteries, endothelial dysfunction precedes plaque formation [99-101]. Reduced endothelial responses can be observed early in the course of atherogenesis, preceding angiographic or ultrasonic evidence of atherosclerotic plaque [102]. There is therefore widespread interest in the application of clinical tools to assess the function and health of this essential monolayer.

The flow-mediated dilation (FMD) test is the standard tool used to assess endothelial function [103,104]. Reduced FMD, an early marker of atherosclerosis [103], has been noted for its capacity to predict future CVD events [105-108] and has been used to demonstrate an impaired vascular response in children as young as 7 years old with familial hypercholesterolemia [109]. A recent meta-analysis by Inaba et al. [108] reported that the relative risk of cardiovascular events for a 1% absolute change in FMD is 0.87. This suggests that a 1% decrease in FMD is associated with 13% (95% CI: 9% to 17%) increase in risk of future cardiovascular events. Standardised guidelines have recently been developed for conducting this non-invasive test [103,110,111] .

The FMD test is a non-invasive, valid [105-108] and reliable [112,113] technique, but is highly technical. Alternatively, cardiovascular health can be assessed using pulse wave analysis (PWA). The FMD test indicates the functional health of the vascular system, whereas PWA is used to assess the composite of functional structural characteristics [114]. PWA is a simple [114], non-invasive, valid [115-117] and reliable [118-120] technique that has been widely used in epidemiological [121] and interventional studies [122].

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DISCUSSION

Fiji can be considered a *developing* nation. As countries move through the demographic and epidemiological transitions, declines in under-nutrition and infectious diseases are reflected in improvements in in life expectancy. However, the rise in modernization is accompanied by increased mortality from NCDs, most notably CVD. A recent report indicates that 82% deaths in Fiji are attributed to NCDs [20] with CVD leading the way [123]. Four modifiable cardio-metabolic diseases were identified as obesity, diabetes, high cholesterol, and hypertension. These diseases can be tackled together since they have common causes known as the four lifestyle risk factors (physical inactivity, poor diet, tobacco use, and harmful use of alcohol). However, as will be discussed, the government must play a key role in setting priorities for interventions to fight these diseases.

Socio-cultural aspects play an important role in the prevalence of obesity in Fiji. As with many Pacific Island nations, there is no vernacular term for obesity in the Fijian language [124], and Fijians perceive being larger as indicative of good health and good relationships [125]. For example, Fijian males found thicker female physique more attractive than comparable Australian male subjects did [125]. However, these perceptions are deeply rooted in traditional Fijian society [126] and cannot entirely explain the doubling in obesity over the past decade [19]. The prevalence of obesity has been exacerbated by the “westernization” of Fiji, in particular the resultant increase in physical inactivity that arises from urbanization, along with poor dietary choices that result from exposure to westernized culture [125,127,128]. Prior to colonization by the British, food consumption patterns included root crops, tropical fruits and vegetables, fish, and game, all foods rich

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in nutrients and low in processed sugars and fat [128,129]. Today, the main drivers of food choices appear to be cost and convenience. Overall, the food environment is unsupportive of healthy eating for many, particular urban dwellers, where prices for local foods such as fish and root crops are high relative to the average wage [130]. There is limited access to healthier options in settings such as restaurants and schools, and marketing is heavily skewed towards the promotion of less healthy foods. Effective action on obesity involves addressing the right to information to make informed choices about activity and diet (e.g., food labels that people can understand), as well as the right to healthcare for medical access.

The rate of diabetes levels in Fiji having also been attributed to physical inactivity and poor food choices [128]. Decreased consumption of traditional root crops in Fiji has been attributed to urbanization, the abolition of a regulation requiring Fijian males to produce sufficient crops for their families and the substitution of root crops with cereals [128]. The decreased consumption of fruit and green vegetables in Fiji is due in part to the rural-urban shift, especially in the case of Fijians moving to minimal space for gardening. The recent importation of processed white flour, white rice and added sugars has contributed to the increasing rates of diabetes and obesity as well as of hypertension and high cholesterol [128].

Increasing physical inactivity, along with the type and frequency of physical activities, has been attributed to the rise in urbanization [20,131]. For example, urban-dwelling Fijian adults engaged in less frequent and less strenuous activities than did rural dwellers [131]. The gender differences in obesity appear to reflect the relative status of males and females in Fiji, with an energy imbalance being created by differential

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patterns of eating and household and recreational activities [126]. The impact of hierarchical structures and status variables on patterns of eating, physical activity and body size for Fijians remains an important consideration for future studies.

With regard to the modifiable risk factors, there is a need to increase awareness among health care providers serving Fijian peoples. Healthcare providers and systems should provide accurate information, early screening and treatment, and recommend appropriate behavioral modifications for Fijians. For example, a comprehensive communitarian education campaign could be effective in breaking myths associated with culturally-specific tobacco use and in providing alternates to facilitate the preservation of traditional and celebratory practices [132]. Culturally-specific tobacco products should be included in regulations governing the import and sale of tobacco, ensuring taxation statues and warning label guidelines. Enforcement of tobacco licensing regulations on retailers selling culturally-specific products may also curtail access and availability to youth, which is currently both common and socially acceptable in Fiji [133].

Alcohol consumption is additional modifiable lifestyle risk factor that should be tackled by the Fijian government. Development and commercialization is leading the Fijian government to become more dependent upon taxes, tariffs, licensing fees and profits generated from sales of alcohol [131]. Where governments become dependent on these revenue streams, they commonly face the challenge of negotiating two competing interests. For revenue purposes, government officials develop an interest in maintaining high levels of alcohol consumption. Yet, these same officials would like to reduce consumption to control alcohol-related harm [127]. A leadership decision should promote

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public health promotion over revenues to protect the community: development and commercialization is leaving local men strained from their political and economic statuses. Increased drinking and alcohol-related violence among them seems associated with a growing sense of demoralization and loss of control [131].

Finally, the environmental change depicted with climate change can contribute to cardio-metabolic diseases. In general, climate changes can lead to reduction in health because of extreme weather conditions, environmental changes and ecological disruptions, as well as population displacements [134]. In Fiji, those at higher risk of extreme weather tend to be poor, Indo-Fijian farmers (living predominantly on floodplains and in grass huts) and children [135]. Following extreme weather conditions, population displacement decreases the use of crops, increases the destruction of local economies and increases resource scarcity and violence. Environmental changes should also be addressed by the government to minimize malnutrition or the use of outside resources that can lead to NCDs.

CONCLUSIONS

The current review provides a simple working model, along with guidelines, for managing and monitoring CVD in Fiji. Arguably, at the heart of poor lifestyle choices is the interaction between Westernization and socio-cultural aspects of Fiji. Given that Fiji has a strongly embedded hierarchical social structure, the Fijian government, in concert with NGOs, must play a key role in setting priorities for interventions to fight these lifestyle choices and related diseases. The government should provide leadership to set the agenda and show the way, develop and implement policies (including laws and

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regulations) to create healthier food and activity environments, secure increased and continued funding to reduce obesogenic environments and promote healthy eating and physical activity.

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FIGURE LEGENDS

Figure 1. Causation pathway for cardiovascular disease (CVD). Adapted from [136].

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Table 1. Lifestyle and Metabolic Risk Factor Analysis

Risk Factor	Metric	Optimal	Low Risk	High Risk	Disease Outcomes	Ref.
Endothelial dysfunction	Flow-mediated dilation (%)	≥10	≤7	≤4.5	Atherosclerosis	108,137
High blood Pressure	Systolic blood pressure (mmHg)	<120	130-139	≥140	CVD; hypertension; renal failure	35
	Diastolic blood pressure (mmHg)	<80	80-89	≥90		
High blood glucose	Fasting plasma glucose (mg/dl)	<100	100-125	≥126	CVD; diabetes; cancers	138
High cholesterol	LDL-cholesterol (mg/dl)	<100	100-129	≥190	CVD	139
Obesity	Waist:hip ratio[1]	M: ≤0.90 F: ≤0.80	M:≥0.91 F: ≥0.81	M: ≥0.95 F: ≥0.86	CVD; hypertension; diabetes; cancers	17,140,141
Alcohol use	Standard drinks/day	M: ≤1 F: ≤1	M: ≥3 F: ≥2	M: ≥5 F: ≥4	CVD; respiratory disease; cancers; diabetes; digestive disorders	94
Poor nutrition	Fruit and vegetable (servings/day)	≥5	<5	<1	CVD; cancers	29,70
Physical inactivity	Moderate physical activity (mins/day)	≥30 min (5 days/wk)	<30 min day	Sedentary	CVD; cancers; diabetes; hypertension	58
Tobacco smoking	Cigarettes/day	0	≥1	≥1	CVD; respiratory disease; cancers; diabetes; hypertension	142,143

M = males; F = females; CVD = cardiovascular disease; HT = hypertension; LDL = low-density lipoproteins. Reprinted from [136].

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Table 2. *Prevalence of cardio-metabolic risk factors among adults.*

Group	Population		Life Expect.	CVD		Body Weight		Diabetes	High Cholest.	HT	Ref.
				Prev.	Mortality	Over	Obese				
	million	*%*	*yrs*	*%*	*%*	*%*	*%*	*%*	*%*	*%*	
Fiji	0.84	100	70	5	41	29	18	16	37	19	
Indigenous Fijian	0.48	57	N/A	N/A	N/A	33	17	12	33	21	[20,36,144,145]
Indo-Fijian	0.31	37	N/A	N/A	N/A	24	11	21	39	16	

CVD = cardiovascular disease; HT = Hypertension; *Overweight* = a body mass index ≥25.0 kg/m^2; *Obese* = a body mass index = ≥30.0 kg/m^2 is considered obese; *Diabetes* = blood glucose ≥6.1 mmol/L (235 mg/dL) or <6.1 mmol/L and currently receiving anti-diabetic medication or controlled diet prescribe by a health worker [20]; *high cholesterol* = total cholesterol ≥5.5 mmol/L (≥213 mg/dL) for adults aged 18-64 [48]; *HT* = defined as SBP ≥140 mmHg and/or DBP ≥90 mmHg, or use of antihypertensive medication [20]; CVD, HT, diabetes and body weight data are for adults aged 15-64 [20].

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Table 3. *Prevalence of modifiable lifestyle risk factors.*

Group	Activity Behavior		Nutrition		Alcohol Behavior		Smokers	Ref.
	Sedentary	Prescribed	Veg.	Fruit	Any	Risky		
	%	*%*	*% ≥2 day*	*% ≥2 day*	*%*	*%*	*%*	
Fiji	12	24	52	14	24	19	37	[20]
Indigenous Fijian	12	25	48	15	24	17	45	
Indo-Fijian	11	21	56	13	24	15	24	

Prescribed *activity behavior* = ≥30 mins/day most days, or at least 150 mins/week [20]; *smokers* = any type of tobacco consumption [20]; risky *alcohol behavior* = ≥5 standard drinks/day males and ≥4 females [20]

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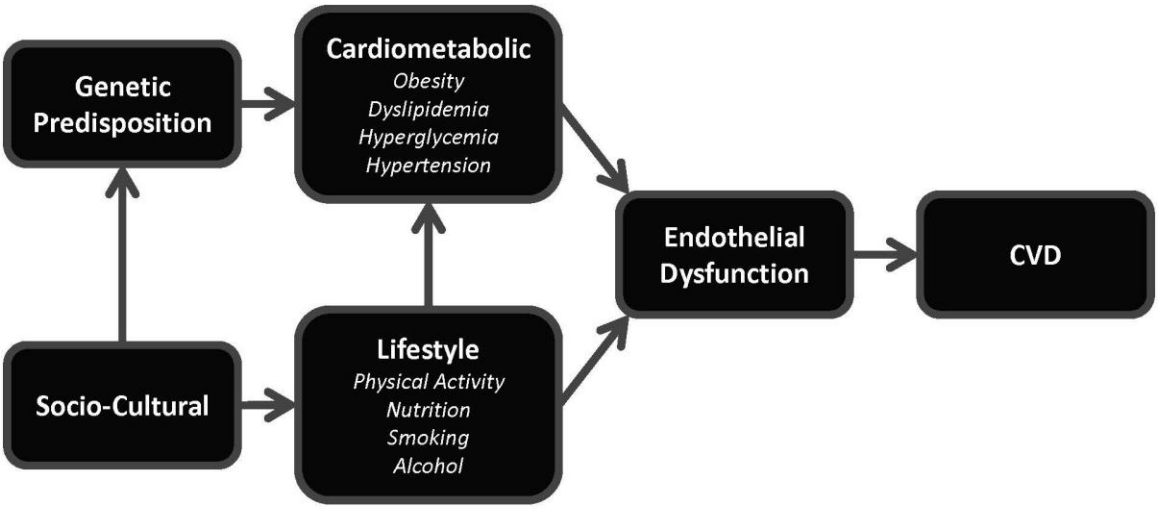
Genetic Predisposition
Cardiometabolic
Obesity
Dyslipidemia
Hyperglycemia
Hypertension
Endothelial Dysfunction
CVD
Socio-Cultural
Lifestyle
Physical Activity
Nutrition
Smoking
Alcohol

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