

# Ideal Cardiovascular Health Behaviours in Nationally Representative School-Based Samples of Adolescents in the Caribbean

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**Background:** Ideal cardiovascular health behaviour (CVHB) measures four ideal health behaviours (non-smoking, body mass index <85th Percentile, healthy diet, and physical activity). This study aimed to determine the prevalence, distribution, and correlates of ideal CVHB among adolescents in the Caribbean.

**Methods:** Nationally representative cross-sectional data of 2016 or 2017 with complete CVHB measurements were analysed from 7556 school adolescents from four Caribbean countries.

**Results:** The prevalence of 0–1 ideal metrics CVHB was 20.4%, 2 ideal metrics 48.7%, and 3–4 ideal metrics 30.8%. Only 5.0% had all 4 ideal CVHB metrics, 41.0% intermediate CVH ( $\geq 1$  metric in the intermediate category and none in the poor category), and 54.0% had poor CVH ( $\geq 1$  metric in poor category). In adjusted logistic regression analysis, compared to students from Dominican Republic, students from Jamaica (Adjusted Odds Ratio-AOR: 1.36, 95% confidence interval-CI: 1.01–1.85), students from Trinidad and Tobago (AOR: 1.46, 95% CI: 1.17–1.82) and male sex (AOR: 1.35, 95% CI: 1.11–1.64) were positively associated with meeting 3–4 ideal CVHB metrics. In addition, in unadjusted analysis, rarely or sometimes experiencing hunger was negatively and high peer and parent support were positively associated with meeting 3–4 ideal CVHB metrics.

**Conclusion:** The proportion of meeting 3–4 ideal CVHB metrics was low among adolescents in four Caribbean countries. Both high-risk and school-wide intervention programmes should be implemented in aiding to improve CVHB in Caribbean countries. Several factors associated with ideal CVHB were identified, which can be targeted in school health interventions.

**Keywords:** cardiovascular health behaviour, adolescents, Caribbean

## Background

Globally, 31% of all global death were attributed to cardiovascular diseases (CVDs) in 2016.<sup>1</sup> Stroke and ischaemic heart disease were the top-ranked causes of disability-adjusted life years (DALYs) in older adults in 2019.<sup>2</sup> More than three-quarters of deaths from CVDs occur in low- and middle-income countries.<sup>1</sup> To reduce CVDs, the American Heart Association (AHA) developed the concept of ideal cardiovascular health (CVH) for adolescents and adults, including four ideal health behaviours and three health factors.<sup>3,4</sup> An increasing number of ideal CVH metrics have been found protective against morbidity and mortality.<sup>5,6</sup> Recently, more evidence has shown that ideal CVH behaviours (CVHB) in adolescents are

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associated with better cardiovascular outcomes in adulthood.<sup>7–9</sup> Caribbean countries lack national data on CVHB in the young population. A large proportion of mortality in the Caribbean countries can be attributed to heart disease (13–25%) and cerebrovascular disease (1–13%).<sup>10</sup>

In low- and middle-income countries, few studies reported on CVHB among adolescents, eg, in adolescents (12–18 years) in Beijing in 2014, China, 34.7% had CVHB (3–4 ideal metrics),<sup>11</sup> and among urban Chinese children and adolescents (6–18 years), 0.9% had all four ideal CVHB, and 3–4 ideal CVHB 16.4% and 23.1% (0–1) ideal CVHB.<sup>12</sup> Studies in high-income countries found among Canadian adolescents (12–19 years) in 2009/10 a mean of 2.49 CVHB, 49.7% poor CVHB (0–2 ideal metrics), 33.7% intermediate CVHB (3 ideal metrics) and 16.6% ideal CVHB (4 ideal metrics),<sup>13</sup> and in urban adolescents (12–19 years) in Philadelphia, USA, 0.6% had ideal CVHB, 49.2% intermediate CVHB (at least one intermediate and none in poor category) and 50.2% poor CVHB (at least one poor category) the mean CVHB score was 2.50.<sup>14</sup> In a review of six studies (in the USA and Europe) among young people, Pacor et al<sup>15</sup> found that the prevalence of ideal diet was 0–10%, ideal physical activity (PA) ranged from 66.2% to 85.4% ideal body mass index (BMI) ranged from 66.3% to 85.4%. In a study among adolescents (14–19 years) in Austria, ideal BMI 78.3%, ideal PA 42.55, non-smoking 70.4%, and ideal diet 8.1%,<sup>16</sup> and the prevalence of ideal CVH in European adolescents in 10 larger European cities (12.5–17.5 years) were ideal BMI 67.8%, non-smoking 60.9%, ideal PA 62.1%, ideal diet 1.7%.<sup>17</sup>

Factors associated with CVHB among adolescents include younger adolescents,<sup>16</sup> female sex,<sup>11,18</sup> higher socioeconomic status,<sup>11</sup> urban residence,<sup>18</sup> parental ideal health behaviours,<sup>19</sup> and better health-related quality of life.<sup>20</sup> This study aimed to determine the prevalence, distribution, and correlates of ideal CVHB among school-going adolescents in four Caribbean countries in 2016/2017.

## Method

### Participants and Procedures

Data from four cross-sectional, nationally representative school-based student health surveys in four Caribbean countries in 2016–2017 were analyzed.<sup>21</sup> These four countries were selected based on the latest available Global

School-based Student Health Surveys (GSHS) conducted in the Caribbean. More detailed information on the sampling and the data can be publicly accessed.<sup>21</sup> The inclusion criteria for the present study were individuals from Trinidad and Tobago, Jamaica, Suriname, and Dominican Republic, with no data missing for smoking status, body mass index (BMI), physical activity (PA), and diet. From 9143 participants, a total of 7756 participants with full required information were included. National ethics committees approved the study and “written informed consent was obtained from the participating schools, parents, and students.”<sup>21</sup>

## Measures

### Cardiovascular Health Behaviour

Poor, intermediate, and ideal CVHB levels for smoking, BMI, PA, and diet were determined based on the AHA definitions.<sup>3,4,22</sup>

#### Smoking Status

Poor smoking: Smoked in the past 30 days and ideal smoking: never tried.

#### Body Mass Index (BMI)

Poor BMI: >95th Percentile, Intermediate: 85th–95th Percentile, and ideal: <85th Percentile. BMI was assessed by self-reported body weight and height.

#### Healthy Diet

Three indicators of healthy diet were assessed: 1) ideal fruit and vegetable intake:  $\geq 5$  servings/day; 2) ideal soft drink intake: less than daily soft drink intake; and 3) ideal fast-food intake per week:  $\leq 1$  day per week. Students who scored 2 or 3 healthy diet components: ideal, students with one component as intermediate and students with 0 components as having a poor healthy diet metric.<sup>4,22</sup>

#### Physical Activity (PA)

“Poor: None, Intermediate:  $>0$  and  $<60$  min of moderate or vigorous PA every day, and Ideal:  $\geq 60$  min of moderate or vigorous PA every day.”

The four CVHB items were dichotomised (1: ideal, 0: not ideal), and grouped into 0–1, 2, and 3–4 ideal CVHB metrics.<sup>11</sup> In addition, three CVHB groups were created as follows:

ideal CVHB is all four metrics at ideal level, intermediate CVHB is at least one health metric at the intermediate level, but no poor CVHB metrics, and poor CVHB is at least one of the four CVHB metrics at poor level.<sup>3,4,14</sup>

Sociodemographic covariates included age, sex, proxy of economic status (experience of hunger), peer support, school attendance, parental support, and psychological distress.<sup>21</sup> Peer support was sourced from the question “During the past 30 days, how often were most of the students in your school kind and helpful?” Responses were trichotomized into 1: Never or Rarely, 2: Sometimes and 3: Most of the time or Always.<sup>21</sup> The psychological distress items (no close friends, loneliness, anxiety, suicidal ideation, and suicide attempt) were summed and grouped into 0=0, 1=1 single, and 2–5=2 multiple.<sup>23</sup> “The four items on parental or guardian support were summed and classified into three groups, 0–1 low, 2 medium, and 3–4 high support”.<sup>23</sup>

## Data Analysis

Considering the clustered study design, all statistical analyses were conducted with STATA software version 14.0 (Stata Corporation, College Station, TX, USA). Only participants with complete CVHB assessments were included in the analysis. Chi-square tests were used for estimating differences in proportions and Student’s *t*-test for differences in means. CVHB metrics are described across ideal, intermediate, and poor CVH. Unadjusted and adjusted logistic regressions were used to calculate sociodemographic predictors of meeting 3–4 CVHB metrics. Variables adjusted for included study country, sex, age group, experience of hunger (proxy for socioeconomic status), psychological distress, school attendance, parental, and peer support. P-values below 0.05 were accepted as significant and missing values were excluded from the analysis.

## Results

### Sample Characteristics

The sample included 7756 school adolescents (15 years: median age, IQR: 13–16), 54.2% were female, and 58.3% had high socioeconomic status (never experienced hunger). The prevalence of 0–1 ideal CVHB metrics was 20.4%, 2 ideal metrics 48.7%, and 3–4 ideal CVHB 30.8% (see Table 1).

### Distribution of CVHB Metrics

The distribution of the three levels of all four CVHB metrics in the overall adolescent population and by country and sex is shown in Table 2. A significant higher proportion of girls had ideal smoking than boys, while

boys had significantly higher ideal BMI, PA, and ideal diet.

In all, 1.5% had zero, 19.0% one, 48.7% two, 25.9% three, and 5.0% all four ideal CVHB metrics. In addition, 41.0% had intermediate CVH ( $\geq 1$  metric in the intermediate category and none in the poor category), and 54.0% had poor CVH ( $\geq 1$  metric in poor category). The total mean number of ideal CVHB metrics was 2.14 (SD=0.8). Boys had higher ideal CVHB metrics in the different measures than girls (see Table 2).

## Associations with Meeting 3–4 Ideal CVHB Metrics

In adjusted logistic regression analysis, compared to students from Dominican Republic, students from Jamaica (adjusted odds ratio – AOR: 1.36, 95% confidence interval – CI: 1.01–1.85), students from Trinidad and Tobago (AOR: 1.46, 95% CI: 1.17–1.82) and male sex (AOR: 1.35, 95% CI: 1.11–1.64) were positively associated with meeting 3–4 ideal CVHB metrics. In addition, in the unadjusted analysis, rarely or sometime experiencing hunger was negatively and high peer and parent support were positively associated with meeting 3–4 ideal CVHB metrics (see Table 3).

## Discussion

To our knowledge, this is the first national study among adolescents on the prevalence and distribution of CVHB metrics in the Caribbean. In this nationally representative sample of adolescents in four Caribbean countries, the prevalence of poor CVHB (0–1 ideal metrics) (20.4%), and ideal CVHB (3–4 ideal metrics) (30.8%), was similar to a study among adolescents (12–18 years) in Beijing (34.7% 3–4 ideal CVHB metrics),<sup>11</sup> but higher than in urban Chinese children and adolescents (6–18 years) (23.1% 0–1 ideal CVHB and 16.4% 3–4 ideal CVHB).<sup>12</sup> The prevalence of having all four ideal CVHBs in this study (5.0%) was higher than in urban Chinese children and adolescents (6–18 years) (0.9%),<sup>12</sup> and in urban adolescents (12–19 years) in Philadelphia, USA (0.6%),<sup>14</sup> but lower than among Canadian adolescents (12–19 years) (16.6%).<sup>13</sup> The prevalence of intermediate CVH ( $\geq 1$  metric in the intermediate category and none in the poor category) (41.0%), and poor CVH ( $\geq 1$  metric in poor category) (54.0%) was similar to adolescents in Philadelphia (49.2% intermediate CVHB and 50.2% poor CVHB).<sup>14</sup> The total mean CVHB (2.14) in this study was

**Table 1** Sample and Cardiovascular Health Behaviour (CVHB) Among School Adolescents in Four Caribbean Countries, 2016–2017

Variables	Sample	0–1 Ideal CVHB	2 CVHB	3–4 Ideal CVHB
	N (%)	%	%	%
All	7756	20.4	48.7	30.8
Country				
Dominican Republic	1123 (14.5)	20.5	51.1	28.4
Jamaica	1460 (18.8)	20.4	45.6	34.0
Suriname	1979 (25.5)	21.9	47.5	30.6
Trinidad and Tobago	3194 (41.2)	19.7	44.1	36.2
Sex				
Female	4207 (54.2)	22.3	49.6	28.1
Male	3549 (45.8)	18.5	47.8	33.8
Age in years				
13 or less	2020 (12.9)	20.4	47.5	32.0
14–15	3452 (42.5)	20.4	49.6	30.0
16 or more	2284 (44.7)	20.5	48.2	31.4
Hungry				
Never	4146 (58.3)	19.4	49.1	31.5
Rarely/sometimes	2982 (37.2)	22.1	48.5	29.5
Mostly/always	587 (4.5)	18.7	45.8	35.5
Psychological distress				
0	4377 (61.8)	18.3	50.0	31.7
1	1530 (19.3)	18.8	46.3	34.9
2–5	1408 (18.9)	26.1	46.8	27.1
School attendance past 30 days				
Not all days	1686 (25.5)	25.5	45.8	28.7
All days	5956 (74.5)	18.5	49.9	31.6
Peer support				
Never/rarely	2534 (30.2)	24.8	44.1	31.2
Sometimes	2341 (29.3)	19.6	50.8	29.6
Mostly/always	2691 (40.5)	17.8	50.4	31.8
Parental support				
Low (0–1)	3047 (37.8)	22.5	46.6	31.1
Medium (2)	1966 (28.0)	19.3	48.6	32.1
High (3–4)	2219 (34.1)	17.7	52.2	30.1

**Abbreviation:** CVHB, cardiovascular health behaviour.

lower than among Canadian adolescents (2.49)<sup>13</sup> and adolescents in Philadelphia (2.50).<sup>14</sup>

Similar to a review of six studies (in the USA and Europe),<sup>15</sup> this study found that a healthy diet had a low prevalence among ideal CVHB metrics (32.4%), which is, however, higher than in a review of six studies (in the USA and Europe) (0–10%).<sup>15</sup> Some of these differences may be explained by the stricter AHA definitions, eg, on diet (scoring 4 or 5 healthy diet components, compared to 2 or 3 healthy diet components in this study), in the six

studies compared to this study.<sup>22</sup> The highest ideal CVHB metric was found for non-smoking (89.7%), which is higher than in European adolescents in 10 larger European cities (12.5–17.5 years) (60.9%)<sup>17</sup> and among adolescents in Austria (70.4%).<sup>16</sup> Ideal BMI (66.6%) in this study was similar to the 10 larger European cities study (67.8%)<sup>17</sup> and lower than among adolescents in Austria (78.3%)<sup>16</sup> and ideal PA (15.8%) was much lower than in the 10 European cities study (62.1%)<sup>17</sup> and among Austrian adolescents (42.6%).<sup>16</sup> The low prevalence of

**Table 2** Ideal Cardiovascular Health Behaviour (CVHB) Metrics Distribution

Health Metrics		Total Sample	Dominican Republic	Jamaica	Suriname	Trinidad and Tobago	Boys	Girls	Chi-Square p-value
		%	%	%	%	%	%	%	
Smoking	Poor	10.3	8.3	14.7	13.7	10.4	12.5	7.9	<0.001
	Intermediate	—	—	—	—	—	—	—	
	Ideal	89.7	91.7	85.3	86.3	89.6	87.5	92.1	
Body mass index	Poor	10.8	10.3	9.3	11.2	16.7	9.0	12.5	<0.001
	Intermediate	16.6	17.7	14.3	16.8	16.6	15.2	18.0	
	Ideal	66.6	72.0	76.4	72.0	66.6	75.7	69.5	
Diet	Poor	15.3	12.3	20.0	20.3	20.8	14.6	15.9	0.007
	Intermediate	52.3	57.1	47.6	46.3	35.8	51.6	52.7	
	Ideal	32.4	30.6	32.4	33.3	43.5	33.8	31.4	
Ideal fruit and vegetable		17.9	17.4	17.3	29.7	16.9	17.7	18.1	0.952
Ideal soft drinks		29.4	25.4	32.2	20.6	47.9	31.0	27.8	0.890
Ideal fast food		73.8	79.5	66.5	66.6	64.2	75.3	72.3	0.002
Physical activity	Poor	32.0	33.7	29.1	34.5	27.2	28.3	34.5	<0.001
	Intermediate	52.2	54.3	47.3	46.6	52.6	53.5	51.3	
	Ideal	15.8	12.0	23.6	18.8	20.2	18.1	14.3	
Total number of CVHB	0	1.5	1.3	1.5	3.1	1.8	1.2	1.7	<0.001
	1	19.0	19.2	18.9	18.8	18.0	17.3	20.6	
	2	48.7	51.1	45.6	47.5	44.1	47.8	49.6	
	3	25.9	24.8	26.2	25.7	30.6	27.9	23.9	
	4	5.0	3.6	7.7	4.9	5.5	5.9	4.1	
CVHB metrics	Poor <sup>a</sup>	54.0	52.3	44.1	59.7	56.1	51.2	56.7	<0.001
	Intermediate <sup>b</sup>	41.0	44.1	36.2	35.4	38.3	42.9	39.1	
	Ideal <sup>c</sup>	5.0	3.6	7.7	4.9	5.5	5.9	4.1	
Mean number of CVHB		<b>M (SD)</b>	<b>M (SD)</b>	<b>M (SD)</b>	<b>M (SD)</b>	<b>M (SD)</b>	<b>M (SD)</b>	<b>M (SD)</b>	<b>t-test</b>
									<b>p-value</b>
		2.14 (0.8)	2.10 (0.8)	2.20 (0.9)	2.11 (0.9)	2.20 (0.9)	2.20 (0.8)	2.08 (0.8)	<0.001

**Notes:** <sup>a</sup>Poor CVHB (at least one poor category), <sup>b</sup>Intermediate CVHB (at least one intermediate and none in poor category) and <sup>c</sup>Ideal CVHB (all 4 ideal metrics).<sup>3,4,14</sup>  
**Abbreviations:** CVHB, cardiovascular health behaviour; M, mean; SD, standard deviation.

ideal PA (15.8%) in this study compares with the weighted average among adolescents in 26 Latin American and Caribbean countries (15.5% ideal PA),<sup>24</sup> and the prevalence of ideal BMI (66.6%) is lower weighted average among adolescents in 15 Latin American and Caribbean countries (73.6% ideal BMI).<sup>25</sup>

Consistent with previous research,<sup>15</sup> ideal CVHB differed by country, with Dominican Republic having the lowest ideal CVHB. Unlike some studies in China,<sup>11,18</sup> this study showed an association between male sex and ideal CVHB. The male sex preponderance of ideal CVHB may be particularly explained by their high proportion of

ideal BMI, ideal PA and ideal diet compared to girls. Interventions targeting girls may be needed given lower CVHB shown, in particular in Trinidad and Tobago.

In unadjusted analysis, compared to never experiencing hunger, rarely or sometimes experiencing hunger was inversely associated with ideal CVHB. This finding is consistent with a study showing that higher socioeconomic status was associated with ideal CVHB.<sup>11</sup> The study found in unadjusted analysis that high peer and parental support are positively associated with ideal CVHB, which seems to confirm results from some previous studies.<sup>19,26,27</sup> Unlike some previous research,<sup>20</sup> this

**Table 3** Associations with Meeting 3–4 Cardiovascular Health Behaviour (CVHB)

Variables	COR (95% CI)	p-value	AOR (95% CI) <sup>a</sup>	p-value
Country				
Dominican Republic	1 (Reference)		1 (Reference)	
Jamaica	2.30 (1.70, 3.10)	<0.001	1.36 (1.01, 1.85)	0.046
Suriname	1.63 (1.20, 2.23)	0.002	1.06 (0.88, 1.28)	0.520
Trinidad and Tobago	1.81 (1.41, 2.32)	<0.001	1.46 (1.17, 1.82)	<0.001
Sex				
Female	1 (Reference)		1 (Reference)	
Male	1.33 (1.09, 1.59)	0.005	1.35 (1.11, 1.64)	0.004
Age in years				
13 or less	1 (Reference)		1 (Reference)	
14–15	0.85 (0.66, 1.09)	0.203	1.15 (0.87, 1.52)	0.932
16 or more	0.89 (0.37, 2.11)	0.783	1.06 (0.84, 1.34)	0.613
Hungry				
Never	1 (Reference)		1 (Reference)	
Rarely/sometimes	0.71 (0.53, 0.95)	0.020	0.88 (0.63, 1.23)	0.449
Mostly/always	0.74 (0.50, 1.10)	0.137	1.02 (0.64, 1.63)	0.918
Psychological distress				
0	1 (Reference)		1 (Reference)	
1	1.12 (0.87, 1.43)	0.371	1.08 (0.80, 1.48)	0.601
2–5	0.80 (0.61, 1.05)	0.103	0.97 (0.70, 1.34)	0.865
School attendance past 30 days				
Not all days	1 (Reference)		1 (Reference)	
All days	1.28 (0.95, 1.72)	0.107	1.12 (0.82, 1.54)	0.469
Peer support				
Never/rarely	1 (Reference)		1 (Reference)	
Sometimes	0.97 (0.74, 1.26)	0.801	0.94 (0.72, 1.22)	0.633
Mostly/always	1.38 (1.03, 1.83)	0.029	1.20 (0.88, 1.65)	0.249
Parental support				
Low (0–1)	1 (Reference)		1 (Reference)	
Medium (2)	1.02 (0.72, 1.46)	0.907	0.98 (0.68, 1.41)	0.896
High (3–4)	1.38 (1.03, 1.85)	0.032	1.17 (0.85, 1.61)	0.345

**Notes:** <sup>a</sup>Adjusted for study country, sex, age group, experience of hunger (proxy for socioeconomic status), psychological distress, school attendance, parental and peer support.

**Abbreviations:** COR, crude odds ratio; AOR, adjusted odds ratio; CI, confidence interval.

study did not show any association between psychological well-being and ideal CVHB. To improve CVH among adolescents in the Caribbean, CVH behaviours should be improved through comprehensive interventions targeting the promotion of healthy diets, body weight control, smoking cessation, and PA. Findings of the study may help in the NCD policy and plan of action in the Caribbean. The Health and Family Life Education (HFLE) school health programme has been adapted by the educational ministers of Caribbean Community (CARICOM) states to be implemented through a school

life skills approach, including content areas related to eating and fitness, self- and interpersonal relationships, sexuality and sexual health, and managing the environment.<sup>28</sup> However, in an evaluation of HFLE implementation in Trinidad and Tobago found that in some cases only partial implementation and non-implementation.<sup>29</sup>

The study strength is the large nationally representative sample and using standardized World Health Organization GSHS methodology and measures. Study limitations include the cross-sectional design, the

assessment of some variables were assessed by self-report. Furthermore, we included only three healthy diet components and not all five components of AHA healthy diet, and BMI was only assessed by self-reported body weight and height. Studies among adolescents comparing self-reported and measured body weight show that differences are relatively small, with estimates likely to be lower in self-report than measured body weight.<sup>30,31</sup> Furthermore, other behaviours such as sleep, its duration and quality, health care access, and neighborhood environmental factors that could impact cardiovascular health were not assessed and should be included in future studies.

## Conclusion

The proportion of 3–4 ideal CVHB metrics was low among school going adolescents in four Caribbean countries. Both high-risk and school-wide intervention programmes should be implemented in aiding to improve CVH in the Caribbean. Several factors associated with ideal CVHB were identified, which can be targeted in school health interventions.

## Abbreviations

AHA, American Heart Association; BP, blood pressure; BMI, body mass index; CVD, cardiovascular disease; CVH, cardiovascular health; DALYs, disability adjusted life years; FV, fruit and vegetables; GSHS, Global School-based Student Health Survey; HFLE, Health and Family Life Education (HFLE); NCD, non-communicable disease; PA, physical activity.

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## Disclosure

The authors report no conflicts of interest in this work.

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