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THE IMPLEMENTATION OF A NATIONAL PHYSICAL ACTIVITY INTERVENTION IN COLOMBIA

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ABSTRACT

Background: In 2011, the Colombian government started a nationwide program, Hábitos y Estilos de Vida Saludable (HEVS; Healthy Life Habits), to provide free, community-based physical activity classes for individuals across Colombia. This study describes the HEVS program, participant baseline characteristics, and changes in their anthropomorphic and health measures following participation.

Methods: Demographic information, current health status, lifestyle habits, and anthropomorphic measures were collected from HEVS participants during 2016. Data were aggregated and analyzed using R software. Changes in anthropomorphic and health measurements before and after HEVS program participation were compared using a paired t-test and McNemar's Test, respectively.

Results: A total of 56,472 adult participants (86.5% female) enrolled in the HEVS program. The greatest proportion of participants were between the ages of 18-34. Prior to participating in HEVS, mean body mass index (BMI) and waist circumference (WC) were 26.3 kg/m^2 and 85.7 cm, respectively. Post-program data from 17,145 individuals showed statistically significant decreases in BMI, WC, and the proportion of patients with self-reported hypertension and diabetes.

Conclusions: The HEVS program successfully engaged a large number of Colombians in physical activity programming and resulted in significant improvements in their health, demonstrating the effectiveness of a government-supported, community-based physical activity program.

Introduction

Physical inactivity is gaining increasing recognition as an international public health dilemma. According to the most recent estimates from the World Health Organization (WHO), 31% of the world's population is not meeting the minimum recommendations for physical activity.[1] Physical inactivity is a major risk factor for many non-communicable diseases including coronary heart disease, type 2 diabetes, and various types of cancer.[2] Further, physical inactivity has been estimated to account for at least 3 million preventable deaths a year and is responsible for 9% of worldwide premature mortality.[2] Due to this myriad of negative health consequences, physical inactivity exacts a large economic toll, accounting for 13.4 million disability-adjusted life-years worldwide, as well as an estimated global cost of $53.8 billion due to a combination of direct health care costs and indirect productivity losses.[3]

A lack of global physical activity programs and policies has contributed to this epidemic. While 80% of countries worldwide have established national physical activity policies or plans, only 56% are operational.[4] This gap between policies and their tangible implementation is particularly marked in low- and middle-income countries.[4] In many of these countries, a lack of physical activity programming is compounded by inadequate program evaluation and scientific inquiry. The majority of research on physical activity interventions has been carried out in high-income countries. While physical activity programs have been initiated in low- and middle-income countries, relatively few have been evaluated and reported on.[5] This has led to a gap in the current body of literature on successful international physical activity programs and how best to scale them up at a population level.

Globally, the Americas have the highest prevalence of physical inactivity of all WHO regions with approximately 40% of all individuals falling short of physical activity goals.[1] In

Colombia, only 53.5% of adults achieve recommended physical activity levels.[6] To address the growing levels of physical inactivity, the Colombian government created a series of physical activity programs organized by Coldeportes - the National Department of Sport, Recreation, and the Use of Free Time.[7] These programs include "Vías Activas y Saludables"[8] (commonly called "Ciclovías," temporary road closings in cities across Colombia for citizens to provide a safe and free space for physical activity and recreation) and the National Program of Healthy Life Habits that includes free physical activity classes in public spaces,[9] access to local events and advising sessions, and a national educational training system on physical activity and health living.[10] These initiatives have been widely praised as models of effective intervention.[11]

Since 2004, Coldeportes has developed and disseminated a community-based physical activity program to all departments (or states) of the country.[12] First known as the Healthy and Active Colombia program, the Habitos y Estilos de Vidas Saludables (HEVS; Healthy Life Habits) program employed a team of 266 monitors (exercise professionals) in 2016 who organize, promote, and lead free community-level physical activity classes for thousands of Colombians.[13,14] The HEVS program has a community focus that incorporates health education and utilizes established criteria in current literature for evidence-based approaches to scale-up physical activity interventions.[5,11] With three hour-long classes each week, the HEVS program offers program participants the opportunity of completing at least 180 minutes of moderate-to vigorous intensity aerobic activity, easily exceeding WHO weekly physical activity guidelines.[1] In addition to these regular physical activity groups, HEVS also includes large health events, access to local organizations, ciclovía promotion, and events to promote healthy lifestyle habits.[15] Comparable programs have had promising results, most notably the Academia das Cidades program in Brazil.[16,17] Participants in Academia das Cidades significantly increased

their physical activity levels, especially the female participants who were 46% more likely to reach WHO-recommended activity levels than females that did not participate in the program.

Though the HEVS program has existed since 2011, data collected on program participants and changes in their health outcomes have not been fully analyzed. Using data collected in 2016, this study aims to describe the participants, as well as their health outcomes and anthropomorphic measurements before and after participation in the HEVS program. This work seeks to add to current literature and provide information on developing a large scale, community-based physical activity program.

Methods

Data Collection and Entry

Data were obtained through the efforts of the 266 monitors employed by the HEVS program in 2016. In addition to recruiting participants and conducting weekly exercise sessions, each monitor was responsible for administering program surveys to collect participant data. The HEVS program survey included four separate sections: personal information, current health status, lifestyle habits, and anthropomorphic measurements. The personal information included age, sex, and occupation status. The current health status section included questions on self-rated health status, self-reported hypertension and diabetes diagnosis, and other diagnoses. Lifestyle habits included fruit, vegetable, and alcohol consumption, as well as smoking history. Anthropomorphic measurements included the assessment of participant height, weight, and waist circumference (WC), as measured by the monitors on the first day that participants attended the HEVS program. The survey was completed before and after the HEVS program. After collecting completed surveys, monitors sent the results to the Coldeportes main office in Bogotá by mail where staff collated and entered the data into their computer system.

Data Analysis

Information on HEVS program participants was collected and stored under their government-issued identification number. Participant data from the 2016 HEVS program was aggregated using this identification number. Duplicate and incorrect entries (i.e., entries with the age listed as the ID number) were removed from the final data set (n=634). Analysis was limited to participants 18 years of age or older (defined as individuals born December 31st, 1998 or earlier), as only basic personal information was collected on younger participants (n=8651).

Using the final participant dataset (n=56,472), a descriptive analysis of the baseline sample was conducted for the entire sample and by gender. Participant responses were tabulated for each question from the personal information, current health status, and lifestyle habits sections.

Our analysis of the anthropomorphic measurements primarily focused on baseline levels and changes in the body mass index (BMI) and WC. BMI was calculated using the measured heights and weights and participants were categorized based on established BMI and WC criteria.[18,19] For participants who completed the post-intervention survey (n=17,145), baseline levels were compared to the final values using a paired t-test. Similarly, changes in rates of self-reported hypertension and diabetes were compared using a McNemar's Test for Symmetry. Using a Bonferroni correction, significance was set at $p < 0.0125$. All data analyses were completed using R Statistical Software (R Foundation for Statistical Computing, Vienna, Austria).

Results

Baseline Data

A total of 56,472 adults were included in the analysis from the 2016 HEVS program (Figure 1). Table 1 shows the demographic characteristics of these participants at baseline. A large majority (n=48,821; 86.5%) were female. The 18-34 age group had the largest number of participants (35.5%), with a gradual decrease in the number of participants with increasing age. While this pattern was similar for the female participants, there was a relatively equal number of male participants aged 35-49 (21.5%) as there were 65 and older (21.5%), compared to men aged 50-64 (18.1%). At the start of the HEVS program, 80.1% of participants were either working (34.4%) or stay-at-home parents (45.7%). Among females, 51.9% were stay-at-home parents, 32.2% were employed at least part-time, and 6.6% were attending school. Among the male participants, 48.3% were employed at least part-time, 24.8% reported being unemployed, and 10% were attending school.

A majority of participants (80.3%) self-identified as having a health status of "good," "very good," or "excellent," with 13.2% and 9.2% of men and women, respectively, reporting being in "excellent" health (Table 2). Overall, 16.8% of participants stated that they had been diagnosed with hypertension (men: 18.5%; women: 16.5%) and 6.7% reported being diagnosed with diabetes (men: 6.6%, women: 6.8%) at the start of the HEVS program. Only 3.6% of the participants (men: 11.6%; women: 2.4%) reported smoking in the 30 days prior to starting the HEVS program. When asked about their diet, 61.7% and 66.5% of participants reported eating 1-2 servings of fruits and vegetables per day, respectively. Only 5.5% and 4.4% of participants stated that they consumed no servings of fruits or vegetables per day, respectively. Men and women reported similar rates of fruit and vegetable consumption.

The mean BMI at baseline was 26.3 kg/m^2 (median: 25.8 kg/m^2). For women, the mean and median BMI were 26.5 and 26.0 kg/m^2, respectively, and for men the mean and median BMI

were 25.4 and 25.0 kg/m^2, respectively. Overall, 39.8% of the participants (men: 46.8%; women: 38.7%) were considered as being at a healthy weight based on their BMI; 40.7% (men: 39.7%; women: 40.9%) were considered overweight and 18.0% (men: 11.4%; women: 19.0%) were classified as being obese. The mean and median WC was 85.7 cm and 85.0 cm, respectively (men: mean = 86.8 cm; women: mean = 85.6 cm). Based on gender-specific WC categories, 40.0% of participants were categorized as healthy, 24.6% were at elevated risk, and 35.3% were considered to be at a very elevated risk for overall mortality as well as various obesity-related conditions such as cardiovascular disease. A greater proportion of men (73.5%) than women (34.9%) were classified as healthy based on their WC.

Post-HEVS Program Data

Post-HEVS program surveys were completed by 17,145 participants. The percentage of participants that self-reported their health status as "good" or better increased from 83.2% to 91.6%, with similar increases reported among male and female participants (Table 3). The proportion of patients that self-reported a diagnosis of hypertension significantly decreased from 16.8% to 13.4% ($p < 0.001$). This decrease was more marked among men (-5.8%; 18.5% to 12.7%) than women (-3.0%; 16.5% to 13.5%). Similarly, there was a significant decrease in the percentage of patients that self-reported a diagnosis of diabetes (-0.7%; 6.7% to 6.0%, $p < 0.001$). Men (-0.7%; 6.6% to 5.9%) and women (-0.8%; 6.8% to 6.0%) experienced similar reductions in rates of diabetes.

The proportion of participants who consumed three or more servings of fruit per day increased from 32.8% to 54.0% (+21.2%). This increase was more marked among women (+22.0%; 33.3% to 55.3%) than men (+16.5%; 29.5% to 46.0%). There was a parallel increase in vegetable consumption, with the proportion of participants consuming at least three servings per

day increasing from 29.1% to 43.2% (+14.1%). This increase was similar between genders [women = +14.4% (29.3% to 43.7%); men = +13.8% (27.6% to 40.2%)]. Overall, the percentage of participants who smoked in the previous 30 days decreased from 3.6% to 2.4% (-1.2%). These rates decreased to a greater extent in men (-5.0%; 11.6% to 6.6%) than in women (-0.7%; 2.4% to 1.7%).

Participation in the HEVS program was associated with a significant decrease in BMI ($p < 0.001$). The overall mean BMI decreased by 0.40 kg/m^2 (95% CI: 0.36-0.44 kg/m^2) from 26.3 kg/m^2 to 25.9 kg/m^2, with the median decreasing from 25.8 kg/m^2 to 25.4 kg/m^2. The proportion of participants with a healthy BMI increased 4.6% (39.8% to 44.4%) with those who were overweight and obese decreasing 1.1% (40.7% to 39.6%) and 3.2% (18.0% to 14.8%), respectively. The proportion of women with a healthy BMI increased 4.4% (38.7% to 43.1%), while those who were overweight or obese decreased 4.1% (59.9% to 55.8%). The proportion of men with a healthy BMI increased 6.3% (46.8% to 53.1%), while those who were overweight or obese decreased 6.0% (51.1% to 45.1%).

Following completion of the HEVS program, the mean WC significantly decreased by 2.24 cm (95% CI: 2.13-2.36 cm; $p<0.0001$), from 85.7 to 83.7 cm. The median WC decreased from 85.0 cm to 83.0 cm. The proportion of participants with a healthy WC increased 8.2% (40.0% to 48.2%), while those with a WC that placed them at a highly elevated risk decreased 7.0% (35.3% to 28.3%). The proportion of women with a healthy WC increased 8.5% (34.9% to 43.4%), while the proportion who had a WC that placed them at highly elevated risk decreased 7.5% (39.3% to 31.8%). The proportion of men with a healthy WC increased 6.2% (72.5% to 79.7%) over the course of the program, while the proportion of men with a WC that placed them at a highly elevated risk decreased 4.1% (9.5% to 5.9%).

Discussion

This study describes participants enrolled in the 2016 HEVS program and its impact on their health status. Enrolling more than 60,000 total participants (including those under the age of 18 who were excluded from this analysis), HEVS is a nationally-coordinated, population health program with a broad reach across all parts of Colombia. Now in its fifth year, the HEVS program has continued to expand under the guidance of Coldeportes by recruiting and engaging community members in free, group-based physical activity classes. The results of this study highlight the overall reach and positive impact of the HEVS program on the health and wellness of Colombians adults.

The HEVS program is an example of a successful, community-based physical activity program implemented across all 28 Colombian states. With classes organized at the local level, held in easily accessible public spaces such as parks, sport centers, and public squares, and tailored to population characteristics, the HEVS program is appealing to participants and positively impacts their health. The Academia das Cidades program, a Brazilian program similar to HEVS, has utilized similar program elements to achieve success.[17] Leaders of Academia das Cidades also noted that participant perception of safety was another important predictor of participation and was enhanced by public lighting or park rangers. One strength of both the HEVS and Academia das Cidades programs is the government support that they receive. The Colombian government has shown a high level of commitment to the promotion of physical activity through Coldeportes' Internal Group of Physical Activity that is responsible for guiding local programs and promoting laws to increase the impact of these interventions.[20,21]

In addition to engaging a large and growing number of Colombians in regular physical activity, our results provide preliminary evidence on the positive health impact of the HEVS

program. Our findings from the 2016 HEVS program suggest that the program was effective in helping participants reduce their bodyweight and WC. Among the 17,145 participants who completed the post-program survey, mean BMI levels decreased by 0.4 kg/m^2, a significant improvement in population health given that a reduction of mean BMI by one unit results in 28 fewer cases of chronic disease per 1000 individuals.[22] Furthermore, the proportion of participants in this study with a healthy BMI increased 4.6% (39.8% to 44.4%). This change also represents a clinically significant improvement at the population level—all cause-mortality rates are 13% and 44% greater for overweight and obese individuals, respectively, than individuals with a healthy bodyweight,[23-25] and obese men and women are 67% and 85% more likely, respectively, to experience cardiovascular disease events.[26] HEVS participants also had marked improvements in their WC (mean decrease of 2 cm). WC has been shown to be among the most accurate predictors of visceral adipose tissue,[27] with a one cm increase in WC associated with an increased relative risk of a cardiovascular disease event, as well as an elevated risk for metabolic syndrome, insulin resistance, and cancer.[28-30]

Similar changes in participant lifestyle behaviors were also observed at the conclusion of the HEVS program. The proportion of HEVS participants who identified their health status as "good" or better and those who consumed three or more daily servings of fruits or vegetables daily increased following program completion. Additionally, the proportion of individuals self-reporting hypertension, diabetes, and smoking in the previous 30 days all decreased. These changes illustrate the positive impact of the HEVS program beyond increasing physical activity levels alone. The HEVS monitors work to enhance these positive changes by incorporating messages promoting the adoption of healthy lifestyle into their physical activity classes. Further,

the promotion of physical activity often leads to the adoption of other healthy lifestyle behaviors and is associated with numerous behavioral and emotional improvements.[31,32]

The HEVS program was most successful in engaging women, who represented 86.5% of all adult participants. This is particularly encouraging given that rates of physical inactivity are higher in women than men, both globally and in Colombia.[1,33] These gender findings are similar to the Academia das Cidades program in Brazil, where 78.7% of program participants were female.[16] Previous literature has demonstrated that Latina women enjoy participating in more socially supportive and engaging environments.[34,35] Moreover, a majority of the women enrolled in the HEVS program reported being homemakers. This population has historically been hard to engage[36] and the success of the HEVS program with homemakers presents an opportunity for further research to identify the specific program components responsible for this high level of participation for replication elsewhere.

At the same time, these results suggest that the HEVS program was not as effective in engaging working individuals and men. Rates of leisure-time physical activity in Colombia are lowest among lower socioeconomic populations.[33] This may be due, in part, to the need to work multiple jobs simultaneously. Men tend to be less motivated by social activity, prefer to exercise independently, and are more interested in sports and games that are competitive in nature.[37,38] Future attempts to increase the overall reach of the HEVS program should examine strategies to increase accessibility and the involvement of working Hispanic individuals and men.

There are several other ways in which the HEVS program can improve in the future. Post-program data were only collected from 30.4% of the adults that originally enrolled. Part of this loss to follow up may have been due to a change in computer programs used by Coldeportes midway through the year. Nevertheless, improving tracking of participant outcomes in the future

will allow for more accurate reporting and robust analysis, identification of subsections of participants more likely to drop out of the program, and the use of targeted strategies to increase participant retention and adherence. HEVS program evaluation would also be enhanced by including assessment of participant baseline physical activity levels. As currently structured, the proportion of participants meeting physical activity guidelines prior to enrollment is not assessed. Closer monitoring of participation rates at each session will allow for analysis of a dose-response relationships with changes in bodyweight and health outcomes. Finally, introducing formal avenues for monitors to seek participant feedback will allow for better tailoring of the program to meet the needs of its participants in the future.

In summary, our findings demonstrate that the HEVS program is a highly successful physical activity program that engaged a large number of Colombians and had a meaningful impact on participant bodyweight, WC, dietary habits, and self-reported health measures. Key factors for the success of the HEVS program include an emphasis on formalized government support, utilization of public space, free cost for participants, and tailored class structure. This combination of factors has made the HEVS program a national success and provides a guide for other community-based programs sponsored by national ministries of sports and health, as well as non-governmental organizations, to follow in achieving similar levels of reach and long-term sustainability. Ongoing efforts to evaluate the HEVS program have the potential to highlight strategies for improving accessibility, increasing recruitment, and expanding programming into additional underserved communities.

Table 1. Demographic characteristics of HEVS program participants (n = 56,472).

	Men	Women	Total
	[n (%)]	[n (%)]	[n (%)]
Age (years)			
18-34	2983 (39.0%)	17038 (34.9%)	20021 (35.5%)
35-49	1645 (21.5%)	14748 (30.2%)	16393 (29.0%)
50-64	1381 (18.1%)	11518 (23.6%)	12899 (22.8%)
65+	1642 (21.5%)	5517 (11.3%)	7159 (12.7%)
Occupation			
Student	762 (10.0%)	3244 (6.6%)	4006 (7.1%)
Employed	3694 (48.3%)	15741(32.2%)	19435 (34.4%)
Student & Employed	231 (3.0%)	1054 (2.2%)	1285 (2.3%)
Homemaker	512 (6.7%)	25316 (51.9%)	25828 (45.7%)
Looking for Work	95 (1.2%)	407 (0.8%)	502 (0.9%)
On pension	457 (6.0%)	745 (1.5%)	1202 (2.1%)
None	1900 (24.8%)	2314 (4.7%)	4214 (7.5%)

HEVS: Habitos y Estilos de Vidas Saludables (Healthy Life Habits)

Table 1. Baseline health-related variables of HEVS program participants (n = 56,472).

	Men	Women	Total
	[n (%)]	[n (%)]	[n (%)]
Self-Rated Health Status			
Excellent	963 (13.2%)	4329 (9.2%)	5292 (9.7%)
Very Good	1330 (18.2%)	7657 (16.3%)	8987 (16.5%)
Good	3812 (52.2%)	27232 (57.8%)	31044 (57.1%)
Normal	1153 (15.8%)	7603 (16.2%)	8756 (16.1%)
Poor	49 (0.7%)	268 (0.6%)	317 (0.6%)
Prior Diagnoses			
Hypertension	1351 (18.5%)	7763 (16.5%)	9114 (16.8%)
Diabetes	580 (6.6%)	3181 (6.8%)	3661 (6.7%)
Body Mass Index (BMI)			
Underweight (<18.5 kg/m^2)	151 (2.1%)	640 (1.4%)	791 (1.5%)
Healthy (18.5-24.9 kg/m^2)	3351 (46.8%)	17800 (38.7%)	21151 (39.8%)
Overweight (25.0-29.9 kg/m^2)	2840 (39.7%)	18810 (40.9%)	21650 (40.7%)
Obese (≥30 kg/m^2)	816 (11.4%)	8758 (19.0%)	9574 (18.0%)
Mean BMI (kg/m^2)	25.4 ± 3.96	26.5 ± 4.49	26.3 ± 4.43
Median BMI (kg/m^2)	25.0	26.0	25.8
Waist Circumference (WC)			
Healthy*	5382 (73.5%)	16439 (34.9%)	21821 (40.0%)
Increased Risk#	1244 (17.0%)	12154 (25.8%)	13398 (24.6%)
Very Increased Risk^	698 (9.5%)	18550 (39.3%)	19248 (35.3%)

Mean WC (cm)	86.8 ± 13.7	85.6 ± 12.7	85.7 ± 12.9
Median WC (cm)	87.0	85.0	85.0

HEVS: Habitos y Estilos de Vidas Saludables (Healthy Life Habits)

* = <95 cm in men, <81 cm in women # = 95-102 cm in men, 81-88 cm in women

^ = >102 cm in men, >88 cm in women

Table 2. Pre- and post-program health variables of HEVS participants (n = 17,145).

	Men (%)		**Women** (%)		**Total** (%)	
Self-Rated Health Status	**Pre-HEVS**	**Post-HEVS**	**Pre-HEVS**	**Post-HEVS**	**Pre-HEVS**	**Post-HEVS**
Excellent	13.2%	12.2%	9.2%	8.6%	9.7%	9.1%
Very Good	18.2%	25.2%	16.3%	26.4%	16.5%	26.3%
Good	52.2%	54.5%	57.8%	56.5%	57.1%	56.2%
Normal	15.8%	8.1%	16.2%	8.3%	16.1%	8.2%
Poor	0.7%	0.1%	0.6%	0.3%	0.6%	0.2%
Prior Diagnoses						
Hypertension	18.5%	12.7%	16.5%	13.5%	16.8%	13.4%
Diabetes	6.6%	5.9%	6.8%	6.0%	6.7%	6.0%
Body Mass Index (BMI)						
Underweight	2.1%	1.9%	1.4%	1.1%	1.5%	1.2%
Healthy	46.8%	53.1%	38.7%	43.1%	39.8%	44.4%
Overweight	39.7%	36.7%	40.9%	40.0%	40.7%	39.6%
Obese	11.4%	8.4%	19.0%	15.8%	18.0%	14.8%
Mean BMI	25.4	24.9	26.5	26.0	26.3	25.9
Median BMI	25.0	24.6	26.0	25.5	25.8	25.4
Waist Circumference (WC)						
Healthy*	73.5%	79.7%	34.9%	43.4%	40.0%	48.2%
Increased Risk#	17.0%	14.5%	25.8%	24.8%	24.6%	23.4%
Very Increased Risk^	9.5%	5.9%	39.3%	31.8%	35.3%	28.3%

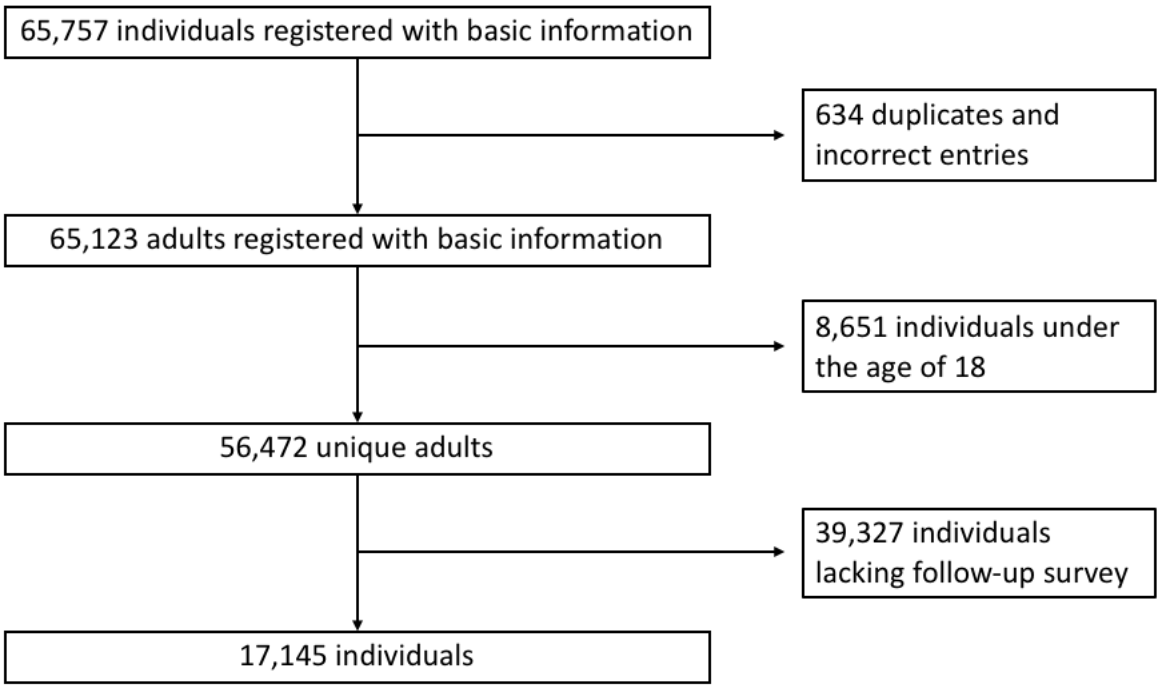
Mean WC (cm)	86.8	84.8	85.6	83.5	85.7	83.7
Median WC (cm)	87.0	84.0	85.0	83.0	85.0	83.0

HEVS: Habitos y Estilos de Vidas Saludables (Healthy Life Habits)

* = <95 cm in men, <81 cm in women # = 95-102 cm in men, 81-88 cm in women

^ = >102 cm in men, >88 cm in women

Figure 1. Schematic of inclusion criteria and participant numbers of HEVS program.



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