



Assessing the feasibility of the Healthy Life in Suriname Study: using advanced hemodynamics to evaluate cardiovascular risk

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ABSTRACT

Objectives. To determine the feasibility of assessing population cardiovascular risk with advanced hemodynamics in the Healthy Life in Suriname (HELISUR) study.

Methods. This was a preliminary study conducted in May – June 2012 using the Technical-Economic-Legal-Operational-Scheduling (TELOS) method to assess the feasibility of the HELISUR—a large-scale, cross-sectional population study of cardiovascular risk factors and disease in Suriname. Suriname, a middle-income country in South America with a population of mostly African and Asian ethnicity, has a high risk of cardiovascular disease. A total of 135 volunteers 18 – 70 years of age participated. A health questionnaire was tested in a primary health care center, and non-invasive cardiovascular evaluations were performed in an academic health center. The cardiovascular evaluation included sitting, supine, and standing blood pressure, and intermediate endpoints, such as cardiac output, peripheral vascular resistance, pulse wave velocity, and augmentation index.

Results. The TELOS testing found that communicating by cellular phone was most effective for appointment adherence, and that completion of the questionnaire often required assistance from a trained interviewer; modifications to improve the clarity of the questions are recommended. Regarding the extended cardiovascular assessments of peripheral and central hemodynamics, the findings showed these to be technically and operationally feasible and well tolerated by participants, in terms of burden and duration.

Conclusions. Findings of this feasibility assessment indicate that large-scale, detailed evaluations of cardiovascular risk, including a questionnaire and advanced central and peripheral hemodynamics, are feasible in a high-risk population in a middle-income setting.

Keywords

Feasibility studies; hemodynamics; diagnostic techniques, cardiovascular; ethnicity and health; Suriname.

Non-communicable diseases are a priority in the United Nations' development agenda (1). Steps have been

outlined to reduce non-communicable diseases, particularly in low- and middle-income countries (LMICs) where

higher rates of non-communicable diseases are expected (2–4). The Caribbean Community (CARICOM) comprises many LMICs, where the rate of cardiovascular mortality is high and preventive action is urgently needed (4). A member of CARICOM, Suriname is a middle-income country with a population of

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mostly Asian and African ethnicity (5). Despite the high cardiovascular mortality, there is a paucity of data on the population distribution of cardiovascular risk factors and subclinical target organ-damage caused by cardiovascular disease (6, 7).

To assist with planning and implementing a future large-scale, cross-sectional population study of cardiovascular disease—the Healthy Life in Suriname (HELISUR) study (7)—the present study assessed the feasibility of a health questionnaire and a physical examination with non-invasive cardiovascular measurements (8).

MATERIALS AND METHODS

The Technical–Economic–Legal–Operational–Scheduling (TELOS) method was used to assess the feasibility of two procedures planned for the HELISUR study (9). The authors determined whether or not the questionnaire had been correctly completed and whether the electronic devices functioned properly (10, 11). Furthermore, the costs of the tests and consumables were examined to determine if they were as expected, and whether there would be legal issues. In addition, it was determined whether the standard operation protocol functioned properly, and if the timelines would need adjustment. Finally, the feasibility of the assessment of intermediate cardiovascular endpoints with extensive non-invasive cardiovascular analyses was estimated, including sitting, supine, and standing blood pressure; cardiac output; peripheral vascular resistance; pulse wave velocity; and augmentation index. The outcomes of the questionnaire and the physical examination procedures are also reported as a secondary outcome.

Inclusion

The questionnaire was tested in a primary health care center in the village of Lelydorp, a small city of about 20 000 residents, east of the capital. Patients and their family members were asked to volunteer. The procedures regarding the physical examination were tested at the Academic Hospital (Paramaribo, Suriname). All participants were 18–70 years of age. To be included, volunteers had to speak Dutch, the national language. Ethnicity was self-defined.

Health questionnaire

The previously validated health questionnaire was based on studies of Surinamese immigrants in the Netherlands of Surinamese immigrants: the Study on Ethnicity and Health (SUNSET; 12) and HEalthy Life in an Urban Setting (HELIUS; 13). As part of a related HELIUS study in which Surinamese were a major part of the study population, the interviewer was trained to explore unanswered questions with the use of pre-set alternative phrases as much as possible (13). The questions considered general health, nutrition, physical activity, income and education, risk factors for cardiovascular disease, and the use of prescription drugs. The percentage of the participants able to adequately answer each question (with or without help of the interviewer) was determined. Furthermore, the willingness of volunteers to participate, the clarity of the questions, and the time needed to complete the questionnaire were evaluated.

Physical examination

The physical examination was performed at the Department of Cardiology at the Academic Hospital in Paramaribo. The room temperature was 24 °C. Physical examination included anthropometry and blood pressure measurements at rest in the sitting position, with an appropriately adjusted cuff at heart level. The mean of two consecutive blood pressure measurements was used. Blood pressure categories were defined according to the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC7) guideline (14). Hypertension was defined as sitting blood pressure ≥ 140 mm Hg systolic and/or ≥ 90 mm Hg diastolic, or the use of antihypertensive drugs. Prehypertension was defined as 120–139 mm Hg systolic and/or 80–89 mm Hg diastolic, without antihypertensive drugs. Normotension was defined as < 120 mm Hg systolic and < 80 mm Hg diastolic blood pressure. Furthermore, the Nexfin HD monitor (BMEYE, Amsterdam, the Netherlands) was used to assess cardiac output and peripheral vascular resistance by a continuous finger arterial blood pressure measurement (15). First, a 10-minute Nexfin measurement was performed in the

supine position, followed by a 5-minute measurement in the standing position. Between these two Nexfin measurements, the pulse wave velocity and augmentation index profiles in the supine position was estimated using the Arteriograph (TensioMed, Budapest, Hungary) (16). The participants received an annotated summary of the results.

Feasibility was determined in terms of the participants' willingness and ability to undergo the physical examination and to complete the assessments, and in terms of the functionality of the standard operating procedures and technical devices. In addition, time scheduling of appointments and the maximum number of participants per day were determined. Biochemical assessments of blood and urine were not included in the feasibility study.

Ethics

Ethical clearance was granted by the Ethics Committee of the Ministry of Health of Suriname, as a preliminary study for HELISUR (No. VG 021-2012). All participants gave oral informed consent that was witnessed by two investigators. All data were handled confidentially and anonymously (7).

Statistical analysis

Because feasibility was the primary outcome of the study, a formal sample size calculation was not performed. Descriptive statistics were computed for both the persons that participated in the health questionnaire, as well as for those who were physically assessed. Furthermore, the non-invasive cardiovascular outcome data for all participants was analyzed. The study planned *a priori* to report outcome data classified by ethnicity. Data were analysed with Microsoft Excel™ (Microsoft Corp., Redmond, Washington, United States), IBM SPSS Statistics software, version 20 (SPSS Inc., an IBM company, Chicago, Illinois, United States), and GraphPad Prism Software version 5 (GraphPad Software Inc., San Diego, California, United States).

RESULTS

Health questionnaire

Feasibility. The researchers approached 88 participants of whom 17 were not

included (14 declined to participate and 3 did not speak Dutch). Three participants were unable to finish the questionnaire due to either its duration and their time constraints, or an unwillingness to answer questions about their current disease. The remaining 68 participants were able to answer 58% of the questions independently and 94% with an interviewer's assistance. The main problems with answering the questions appeared to be related to small differences in preferred phrases and interpretation of the Dutch language spoken in the Netherlands versus that of Suriname.

Outcomes. The characteristics of the subjects participating in the health questionnaire feasibility study are reported in Table 1-A. There were 68 participants (23 men; 45 women) with a mean age of 46.3 years (Standard error [SE] 1.4 years). The mean years of education ranged from 7.3 (SE 0.7 years) in South Asians to 9.9 (SE 1.9 years) in other ethnic groups. Regarding the cardiovascular risk factors, 16.2% of the participants reported current smoking, while 14.7% met "the fit standard," corresponding to intensive exercise 3 times per week for at least 20 minutes. Of the 31 participants with hypertension (45.6%), 5 were of African ethnicity (16.1%), 17 of South Asian (54.8%), 8 of Javanese (25.8%), and 1 of other ethnicity (3.2%). The majority used antihypertensive drugs (77.4%). Participants of African ethnicity reported the highest proportion of hypercholesterolemia (40.0%) and diabetes (30.0%). Regarding cardiovascular disease, a history of myocardial infarction and stroke was reported by 5.9% and 1.5% of participants, respectively.

Physical examination

Feasibility. The extended cardiovascular assessments of peripheral and central hemodynamics appeared to be technically and operationally feasible. All devices functioned properly. The annotated summary of the results that participants received was much appreciated and named as an important incentive worthy of participating. Concerning organizational and scheduling feasibility, the participants were most successfully reached by cellular telephone, rather than by regular mail, e-mail, or wired phone. Making appointments through

cell phones on short notice, in combination with text message prompting, appeared to give the least no-shows. The optimal number of participants was 4–6 individuals per day.

Outcomes. The characteristics of the participants who were physically assessed are depicted in Table 1-B. There were 67 subjects (29 men; 38 women) with a mean age of 43.6 (SE 1.7 years). Mean body mass index was 28.1 (SE 0.6 kg/m²); African 29.0 (SE 1.0 kg/m²), South Asian 27.7 (SE 1.2 kg/m²), and other ethnicity 26.8 (SE 1.2 kg/m²). Only 31.3% were normotensive. Hypertensive and prehypertensive blood pressure levels were found in 38.8% and 29.9% of participants, respectively. Compared to

participants of self-defined South Asian and other ethnicity, participants of African ethnicity had higher systolic blood pressure levels (137 mm Hg in Africans versus 135 and 131 mm Hg in South Asians and people of other ethnicity, respectively) and generally more hypertension (41% vs. 35 and 40%) and prehypertension (41% vs. 22 and 20%).

Finally, non-invasive hemodynamic measurements were taken. Across the different age categories, higher pulse wave velocity and augmentation index profiles were found in South Asians compared to participants of African ethnicity (Figure 1A and B). Only in the oldest age category, participants of African ethnicity had slightly higher mean

TABLE 1-A. Self-reported clinical characteristics of subjects participating in the feasibility study of administering a cardiovascular health questionnaire, Paramaribo, Suriname, 2012

	Total n = 68	African n = 10	South Asian n = 28	Javanese n = 23	Other n = 7
Men ^a	23 (33.8)	5 (50.0)	10 (35.7)	6 (26.1)	2 (28.6)
Age in years ^b	46.3 (1.4)	52.7 (4.6)	45.8 (2.2)	43.8 (2.5)	47.6 (4.1)
Education in years ^b	8.1 (0.4)	9.2 (0.8)	7.3 (0.7)	8.1 (0.7)	9.9 (1.9)
Smokers ^a	11 (16.2)	1 (10.0)	4 (14.3)	3 (13.0)	3 (42.9)
Physically active ^{a, c}	10 (14.7)	1 (10.0)	4 (14.3)	3 (13.0)	2 (28.6)
Hypertension ^a	31 (45.6)	5 (50.0)	17 (60.7)	8 (34.8)	1 (14.3)
Treated ^a	24 (35.3)	3 (30.0)	13 (46.4)	7 (30.4)	1 (14.3)
Hypercholesterolemia ^a	15 (22.1)	4 (40.0)	8 (28.6)	3 (13.0)	0 (0.0)
Diabetes mellitus ^a	15 (22.1)	3 (30.0)	8 (28.6)	4 (17.4)	0 (0.0)
Myocardial infarction ^a	4 (5.9)	1 (10.0)	3 (10.7)	0 (0.0)	0 (0.0)
Stroke ^a	1 (1.5)	0 (0.0)	1 (3.6)	0 (0.0)	0 (0.0)

Source: Prepared by the authors from the study data.

^aValues are n (%).

^bValues are mean (SE).

^cBeing physically active was defined as meeting the criteria of intensive exercise 3 times per week for at least 20 minutes, using the Short Questionnaire to Assess Health-Enhancing (SQUASH) physical activity (22).

TABLE 1-B. Clinical characteristics of subjects participating in the feasibility study on assessing non-invasive cardiovascular hemodynamics, Paramaribo, Suriname, 2012

	Total (n = 67)	African (n = 29)	South Asian (n = 23)	Others (n = 15)
Men ^a	29 (43.4)	12 (41.4)	8 (34.8)	9 (60.0)
Age in years ^b	43.6 (1.5)	44.4 (2.5)	45.2 (2.3)	39.7 (3.1)
Body Mass Index (kg/m ²) ^b	28.1 (0.6)	29.0 (1.0)	27.7 (1.2)	26.8 (1.2)
Systolic blood pressure, mmHg ^b	133 (2.0)	137 (2.7)	128 (3.0)	131 (5.3)
Diastolic blood pressure, mmHg ^b	82 (1.3)	83 (1.8)	79 (2.0)	85 (3.5)
Heart rate, beats per minute ^b	67 (1.3)	69 (2.1)	64 (1.7)	68 (2.7)
Hypertension ^{a, c}	26 (38.8)	12 (41.4)	8 (34.8)	6 (40)
Prehypertension ^{a, d}	20 (29.9)	12 (41.4)	5 (21.7)	3 (20)

Source: Prepared by the authors from the study data.

^aValues are n (%).

^bValues are mean (SE).

^cHypertension was defined as blood pressure \geq 140 mmHg systolic and/or \geq 90 mmHg diastolic, or the use of antihypertensive drugs (14).

^dPrehypertension was defined as 120–139 mmHg systolic and/or 80–89 mmHg diastolic, without the use of antihypertensive drugs (14).

pulse wave velocities than those of South Asian ethnicity (11.3 vs. 11.2 m/s). Moreover, participants of Asian ethnicity had a lower mean cardiac output (6.1 [SE 0.3] in Asians vs. 6.7 [SE 0.3] L/min in Africans) and a higher systemic vascular resistance (1302.3 [SE 78.6] vs. 1198.9 [SE 85.3] dyn·s/cm⁵) compared to participants of African ethnicity (Table 2). Upon standing, the increase in peripheral vascular resistance was higher in participants of African ethnicity, while the participants of South Asian ethnicity displayed a greater increase in cardiac parameters,

in particular heart rate and left ventricular contractility.

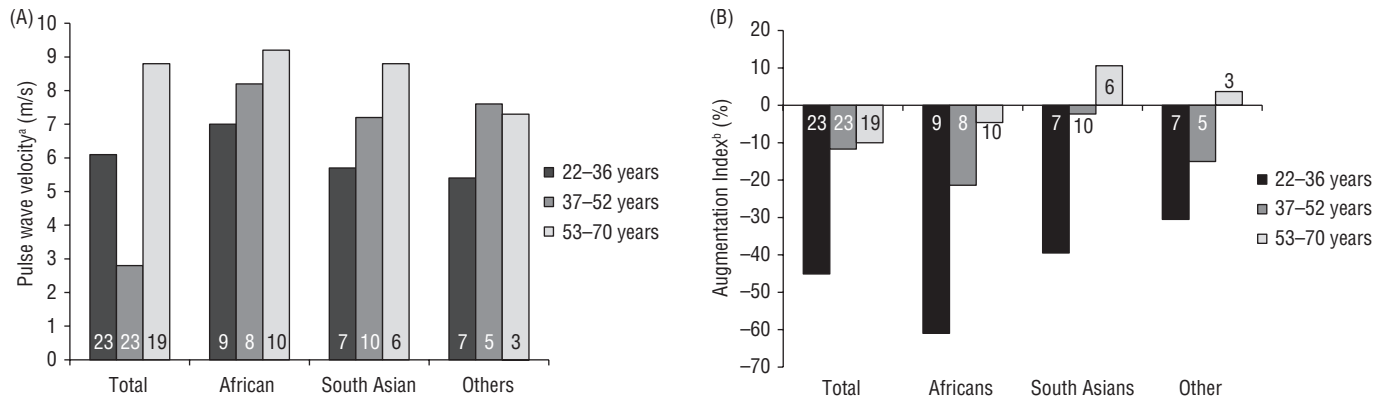
DISCUSSION

This study shows that it is feasible to study cardiovascular health in a middle-income country, with the use of an extensive health questionnaire and a physical examination that includes assessment of intermediate cardiovascular endpoints through non-invasive peripheral and central hemodynamics. Moreover, our data indicate that the help of a trained interviewer and

rephrasing of various questions was essential to successfully complete the questionnaire. It appeared that the physical examination also needed several logistic adjustments, such as making cell phones the preferred method of contacting participants.

Other findings that will be implemented are the time scheduling of appointments taking transportation characteristics into account, a maximum of six participants per day, and adjustment to the order of the measurements. The preferred method of contacting subjects through mobile phone aligned with the

FIGURE 1. (A) Mean pulse wave velocity assessed by the Arteriograph device per age category in the total group and in different ethnic groups, Paramaribo, Suriname, 2012; (B) Mean augmentation index assessed by the Arteriograph device per age category in the total group and in different ethnic groups, Paramaribo, Suriname, 2012.



Sources: Prepared by the authors from the study data.
^a Arterial stiffness is considered increased when pulse wave velocity is higher than 10 m/s (23).
^b A lower Alx indicates healthier arteries.

TABLE 2. Supine and standing hemodynamic parameters in subjects of South Asian and African ethnicity, Paramaribo, Suriname, 2012

Ethnicity	South Asian					African				
	Supine ^a	Standing ^a	Δ ^b	95% CI	%	Supine ^a	Standing ^a	Δ ^b	95% CI	%
Sample	18					20				
Men/women	7/11					8/12				
Age in years	44.1 (2.8) ^a					41.7 (3.2) ^a				
Systolic blood pressure (mm Hg)	121 (3.4)	146 (4.8)	25	(11.2 to 39.1)	20.7	124 (3.8)	141 (4.4)	17	(3.7 to 30.3)	13.7
Diastolic blood pressure (mm Hg)	73 (2.0)	89 (2.2)	16	(9.9 to 22.2)	22.1	72 (1.7)	90 (2.1)	18	(11 to 25.1)	25.0
Heart rate (beats/minute)	65 (1.8)	81 (3.3)	16	(9.4 to 21.0)	23.4	69 (2.6)	77 (2.3)	8	(-0.6 to 15.7)	11.6 ^d
Stroke volume (mL)	90.3 (4.0)	74.3 (2.6)	-16.0	(-23.5 to -8.6)	-17.8	97.0 (4.0)	68.1 (3.0)	-28.9	(-37.7 to -19.9)	-29.9 ^c
Cardiac output (L/min)	6.1 (0.3)	6.0 (0.4)	-0.1	(-0.9 to 0.4)	-1.6	6.7 (0.3)	5.2 (0.3)	-1.5	(-2.3 to -0.7)	-22.4 ^c
Left ventricular contractility (dP/dt)	680.7 (44.0)	924.1 (44.4)	243.4	(136.0 to 350.8)	35.8	724.1 (46.4)	796.4 (52.9)	72.3	(-49.5 to 194.1)	9.9 ^c
Systematic vascular resistance (dyn·s/cm ⁵)	1302.3 (78.6)	1589.1 (133.6)	286.8	(2.5 to 571.0)	22.0	1198.9 (85.3)	1785.6 (113.7)	586.7	(293.9 to 879.6)	48.9 ^d

Source: Prepared by the authors from the study data.
^a Values are mean (SE)
^b Δ = standing-supine
^c One-sided *P* < 0.05 for difference in fractional increase or decrease in cardiovascular hemodynamic parameters between subjects of South Asian vs. African ethnicity.
^d One-sided *P* < 0.10 for difference in fractional increase or decrease in cardiovascular hemodynamic parameters between subjects of South Asian vs. African ethnicity.

findings of Hartzler and colleagues (17), which showed that cell phones used in LMICs improved appointment adherence.

The results of the questionnaire showed a high burden of cardiovascular risk factors, including hypertension, diabetes, and lack of physical activity among participants. However, these results should be interpreted with some caution, as the sampling was non-random and the outcomes were based on self-reported data.

In the physical examination, we found evidence that participants of South Asian ethnicity showed higher age-adjusted pulse wave velocity and augmentation index values compared to those of African ethnicity; this potentially implicates ethnic differences in non-invasive hemodynamics.

Furthermore, our data suggested a differential adaptation pattern to an orthostatic challenge between South Asian and African participants with, respectively, a predominantly cardiac vs. peripheral vascular response. A recent paper (18) reported that individuals of African ethnicity had a greater response in total peripheral resistance for a given change in muscle sympathetic nerve activity during tilting. These data should be considered hypothesis-generating and will be further explored in the final study.

The main strength of this study was the use of the TELOS method for assessing feasibility. It enabled us to collect more detailed data in a structured setting. These data will help us better design the final study and optimize the use of scarce resources in a middle-income setting as described above. Furthermore, Safar and colleagues (19) have proposed that the entire blood pressure curve should be taken into consideration to evaluate

cardiovascular risk, and that pulse and aortic pulse wave velocity are useful pulsatile hemodynamics to predict cardiovascular risk in essential hypertension, renal failure, diabetes mellitus, and aging. This is of particular importance in a high-risk population where more timely, preventive measures are needed. However, to our knowledge, the blood pressure curve has not been previously studied in a LMIC population setting. Our feasibility data indicate that it should be possible to assess non-invasive hemodynamics in this setting.

Limitations

There were study limitations worth noting. A formal cost-analysis was not performed; it would have provided more complete information for the HELISUR study. Nevertheless, we did evaluate whether costs were as expected. Another limitation might be the interviewer's help required by some participants—it might have influenced the results. However, we tried to avoid this as much as possible with the use of pre-set alternative phrases when questions remained unanswered. Finally, outcome data for the secondary objective should be considered hypothesis-generating only because volunteers were self-selected. In addition, the small sample size and the single measurement cycle of the (hemodynamic) variables in time preclude conclusions regarding differences between ethnic groups. However, our local data are similar to international trends in ethnic differences in cardiovascular risk (11, 20).

Conclusions

The Pan American Health Organization recommends that more research

on non-communicable diseases and risk factors be conducted in CARICOM (4). Assessing the feasibility of cardiovascular population studies in the Caribbean, using questionnaires and costly devices, is particularly pertinent given the limited funding for research in LMICs (21). With a feasibility study, there is a greater promise of success in the final study, and less chance of scarce funding being wasted by a failed one (8).

In conclusion, cardiovascular mortality is the number one cause of death in LMICs and urgent preventive measures are needed. In order to provide data for prevention and intervention strategies, we assessed the feasibility of a health questionnaire and a physical examination including advanced central and peripheral hemodynamics in volunteers from a middle-income country. Although adaptations were necessary to optimize the data quality and quantity of the questionnaire and the physical examination, this feasibility study indicated that large-scale, detailed evaluations of cardiovascular risk are feasible in a middle-income setting, and that high-quality data can be collected to better prevent, detect, and treat cardiovascular disease in Suriname.

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RESUMEN**Evaluación de la factibilidad del estudio Vida Sana en Suriname: uso de hemodinámica avanzada para evaluar el riesgo de enfermedades cardiovasculares**

Objetivos. Determinar la factibilidad de evaluar el riesgo de enfermedades cardiovasculares en la población utilizando hemodinámica avanzada en el estudio Vida Sana en Suriname (HELISUR por su sigla en inglés).

Métodos. Este fue un estudio preliminar realizado de mayo a junio del 2012 empleando el método de factibilidad técnica, económica, legal, operativa y de programación (TELOS) para evaluar la factibilidad del HELISUR, un estudio poblacional transversal a gran escala de factores de riesgo y enfermedades cardiovasculares en Suriname. Suriname, un país de ingresos medianos de América del Sur, con una población de etnicidad principalmente africana y asiática, presenta un riesgo alto de enfermedades cardiovasculares. En el estudio participó un total de 135 voluntarios de 18 a 70 años de edad. Se puso a prueba un cuestionario de salud en un centro de atención primaria de salud, y se realizaron evaluaciones cardiovasculares no invasoras en un centro de salud académico. La evaluación cardiovascular incluyó mediciones de presión arterial en posición sentada, supina y de pie, y los criterios de valoración intermedios, como el gasto cardíaco, la resistencia vascular periférica, la velocidad de la onda de pulso y el índice de aumento.

Resultados. En las pruebas del método TELOS se encontró que la comunicación por teléfono celular era la más eficaz para asegurar la asistencia a las citas y que a menudo se requería la presencia de un entrevistador capacitado para ayudar a los voluntarios a llenar el cuestionario; se recomienda modificar las preguntas para que sean más claras. Con respecto a las evaluaciones cardiovasculares prolongadas de hemodinámica periférica y central, los resultados demostraron que eran técnica y operativamente factibles, y bien toleradas por los participantes en cuanto a la carga y duración.

Conclusiones. Los resultados de esta evaluación de factibilidad indican que las evaluaciones detalladas y a gran escala del riesgo de enfermedades cardiovasculares, que incluyen un cuestionario y hemodinámica central y periférica avanzada, son factibles para una población de alto riesgo en un país de ingresos medianos.

Palabras clave

Estudios de factibilidad; hemodinámica; técnicas de diagnóstico cardiovascular; origen étnico y salud; Suriname.

RESUMO	<p>Objetivos. Determinar a viabilidade de avaliar o risco cardiovascular da população por meio de avaliação hemodinâmica avançada no Estudo de Vida Saudável no Suriname (HELISUR).</p> <p>Métodos. Estudo preliminar realizado em maio-junho de 2012 com o uso da metodologia TELOS (análise técnica, financeira, jurídica, operacional e do cronograma) para avaliar a viabilidade do HELISUR – estudo transversal de base populacional em grande escala dos fatores de risco e doenças cardiovasculares no Suriname. O Suriname é um país sul-americano de renda média de população majoritariamente de origem afro-asiática com alto risco da doença cardiovascular. Participaram do estudo 135 voluntários com 18 a 70 anos de idade. O questionário sobre saúde foi testado em uma unidade básica de saúde e avaliações cardiovasculares não invasivas foram realizadas em um centro de saúde acadêmico. A avaliação cardiovascular consistiu da medida da pressão arterial em posição sentada, supino e em pé, e da medida de parâmetros (end-points) intermediários como débito cardíaco, resistência vascular periférica, velocidade da onda de pulso e índice de amplificação.</p> <p>Resultados. A análise TELOS indicou maior eficiência na adesão às consultas com a comunicação por celular e a necessidade frequente de auxílio de um entrevistador treinado para o preenchimento do questionário. Modificações para melhorar a compreensão das perguntas são recomendadas. Também se demonstrou que o amplo estudo da hemodinâmica central e periférica é viável do ponto de vista técnico e operacional e que os participantes toleram bem o incômodo e o tempo de avaliação.</p> <p>Conclusões. Os resultados da avaliação de viabilidade indicam que a avaliação aprofundada do risco cardiovascular em grande escala, incluindo a administração de questionário e estudos de hemodinâmica avançada central e periférica, é viável em uma população de renda média com alto risco.</p>
Avaliação da viabilidade do Estudo de Vida Saudável no Suriname: uso de hemodinâmica avançada para avaliar o risco cardiovascular	
Palavras-chave	Estudos de viabilidade; hemodinâmica; técnicas de diagnóstico cardiovascular; origem étnica e saúde; Suriname.
