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Introduction

According to the latest Population and Housing Census Country Report, Belize had a population of approximately 375,000 people in 2019, with a projected population of 395,000 by 2020 (SIB Census Report, 2019). The Belize National Poverty Assessment Executive Summary Report (SIB Poverty Report, 2019) states that "poverty in Belize has increased substantially from 2000 to 2019" (pg.7); and is predicted to further increase by the time of the completed 2020 Census and Poverty reports. In fact, Belize has one of the highest incidence rates of population and household poverty in the Caribbean. (SIB, 2019; Carneiro, F.G., 2016). Generational poverty statistics suggest that Belize has seen an increase in overall poverty from 34% in 2000 to 42% in 2010; with a respective increase in critically poor populations from 9% to 10% in that time period; and with a further expected increase by the 2020 reports (Bennett, 2013; Carneiro, F.G., 2016; SIB Poverty Report, 2019).

Moreover, where overall national poverty rates are high, those rates are elevated in rural areas of the country. In particular, the rural Cayo District of Belize is one of the poorest regions in the country. San Ignacio, the largest city in the Cayo District, is Belize's second largest city, with approximately eighteen-thousand residents (Census Report, 2019). The poverty level for San Ignacio currently is estimated to be 50% (SIB Poverty Report, 2019).

The generational poverty observed in Belize is a result of numerous extenuating circumstances. One of the most significant of these variables contributing to the "overall economic stagnation that has occurred in the past years" is believed to be "government failure to adhere to the International Monetary Funds (IMF) warning to tackle national debt implications" (SIB Poverty Report, 2019, p. 3). This failure, coinciding with apparent governmental corruption, has largely perpetuated the negative economic situation unfolding in Belize (Bennett, 2013; Carneiro, F.G., 2016). As a county with a significant national debt, on the fringe of default and bankruptcy, Belize appears set for a major economic recession in the near future (Carneiro, F.G., 2016). The poverty figures, which have continuously deteriorated over the past twenty years have the potential to change even more drastically in the near future if the country is unable to avoid such an economic crisis. In the event that the Belizean recession intensifies, the Belizean Ministry of Health's already difficult job of providing adequate, affordable healthcare for the country's low SES populations will likely become unsustainable.

As the Belizean Ministry of Health is unlikely to be in a position to offer adequate, affordable healthcare to low SES populations in Belize, many of those communities have begun to turn to study abroad programs, humanitarian organizations, and other non- profit entities to implement concentrated efforts in at-risk regional locations, to ensure vulnerable populations receive appropriate healthcare (SIB Poverty Report, 2019; Marin, 2019; COBEC, 2019). The Georgia College (GC), College of Health Sciences (COHS) study abroad program, through collaboration with the Consortium for Belize Educational Cooperation (COBEC), the non-profit organization Medical Electives Belize, and the San Ignacio Town Council, initiated collaborative partnerships in 2012 with hospitals, elderly care facilities, schools, orphanages, and businesses in the San Ignacio community to provide free, adequate health screenings to underserved, low SES populations. The city of San Ignacio was intentionally chosen for the collaborative partnership due to the high poverty rates, escalating chronic disease rates, decreasing adult life expectancy rates, and the limited regional access to healthcare (SIB Poverty Report, 2010).

Data collection from the San Ignacio region during an IRB approved study conducted by GC study abroad programs in 2012 recorded average adult glucose levels approaching 100 mg/dl, cholesterol levels approaching 200 mg/dl, body mass index obesity rates approaching 40%, resting heart rates averaging 80+ bpm, and blood pressure readings averaging in the hypertensive level. Each of these recorded health metrics was found to be significantly higher in the San Ignacio region of Belize than in surrounding Central American and Caribbean countries based on comparative statistics (WHO, 2012; Barcelo, 2017); and well above the recommended levels for healthy living stated by premier medical organizations such as the American Medical Association, American Heart Association, American Diabetes Association, American College of Sports Medicine, and the Centers for Disease Control and Prevention. However, despite known correlations between such metrics and increased prevalence rates of chronic diseases such as diabetes, heart-attack, stroke and kidney failure, there has been no known authentic data collection conducted in the San Ignacio, Belize region to determine reliable and valid at-risk levels of chronic health disease measures in the local populations to substantiate the vulnerability of this low SES rural population. Moreover, no records exist of consistent, organized, structured interventions in place in the region to facilitate progressive change to remediate the continued promotion of apparent at-risk behaviors that appear to be plaguing the region.

What is known is that the World Health Organization has stated that overall, cardiovascular disease is the number one killer of both male and female adults, accounting for 25% of all the adult deaths; and that diabetes and hypertension related complications are the number three killer of adults (behind cancer) accounting for 10% of all adult deaths in Belize (WHO, 2012). Moreover, it is anticipated that approximately 26% of adult males and 18% of adult females (22% of the adult population) are at risk of premature death due to elevated blood-pressure; while approximately 24% of adult males and 44% of adult females (34% of the adult population) are at risk of premature death due to obesity (WHO, 2012). With only two hospitals, and approximately sixteen private physician clinics, operational on the western half of the country (MOH, 2019), it is exceptionally difficult for the inhabitants of the San Ignacio region to obtain adequate access to essential medical services. This access is further compromised by the fact that the hospitals lack properly trained staff, adequate equipment, necessary medications, and reliable power sources; are often only operational weekdays during business hours; are geographically difficult to access without a vehicle; have reported high rates of Healthcare Associated Infections; and are often too expensive for the vast majority of inhabitants to afford (Marin, 2019 & COBEC, 2019).

Hence, the GC COHS study abroad program designed research and instructional interventions to specifically target known factors impacting the perpetuation of chronic diseases in the San Ignacio region. Annual free health screenings and consultations were provided to San Ignacio populations regarding glucose, cholesterol, blood-pressure, heart-rate, height, weight, and body-composition measurements during two-week long study abroad program service-learning interventions. The specific aforementioned metrics were selected for data collection due to the fact that when analyzed in conjunction with one another that they tend to be powerful indicators of an individual's overall health, displaying the potential to predict an individual's quality and quantity of life (Riebe, Ehrman, Liguori & Magal, 2018). More importantly, early identification of at-risk levels of the aforementioned metrics has the potential to minimize the likelihood of the development of atherosclerosis, coronary heart disease, chronic kidney disease, cardiac arrest and diabetes, through allowing for the initiation of targeted remediation strategies designed to restore at-risk levels to healthy levels (Riebe, Ehrman, Liguori & Magal, 2018). Health screenings were provided by trained researchers with backgrounds in Nursing, Exercise Science, Athletic Training, and Public Health; who were all proficient in testing protocols and procedures. Testing occurred throughout the city of San Ignacio in open markets, hospitals, elderly care facilities, schools, and private businesses. The study was planned as a multi-year, longitudinal study, with the purposes of 1) Collecting descriptive data regarding participant health levels based on glucose, cholesterol, blood-pressure, heart-rate, height, weight, and body-composition; annually for five years (2013-2018); 2) Determining if study abroad health screenings, interventions, and educational workshops were effective in balancing health level metrics to within known ideal norm-ranges.

Methods

Participants

Each year of the study, eighteen new GC undergraduate and graduate COHS students, with backgrounds in Nursing, Exercise Science, Public Health, and Athletic Training, were required to navigate a rigorous selection process to earn a position in the study abroad program. Minimum requirements included a 3.5 GPA, prior-service learning experience, completion of certain prerequisite coursework, and demonstration of leadership abilities. Those who were selected were formally trained over the course of a spring semester on all testing procedures and protocols immediately prior to the summer study abroad service-learning initiative. Candidates were required to complete all course work; all practical training; and a series of pragmatic skills tests, demonstrating proficiency in assessment measures and prescriptive consultations; in order to be afforded the opportunity to participate in the study abroad program. Each research team contained at least one bilingual researcher, fluent in Spanish, with the ability to translate for the team when required.

Procedures & Protocols

Data collection was initiated in 2013, and repeated annually through 2018 for the study, following university IRB approval. Data collection was conducted in hospitals, clinics, elderly care facilities, open markets, and local businesses throughout San Ignacio, where site permission was granted by each in-country preceptor to implement all testing and consultations. Each individual preceptor site individually arranged for participant recruitment for testing. All testing was overseen by two tenured university professors from a College of Health Sciences. Testing was conducted by separate groups of eighteen trained graduate and undergraduate study abroad students each year.

The majority of participants were evaluated in open town market clinics arranged by the San Ignacio town council. Approximately 70% all participants were assessed in these venues. An additional 15% of participants were evaluated at hospitals, private physician clinics and elderly care facilities. Approximately 10% of all participants were evaluated during work-place health fairs implemented at local businesses. The remaining participants were comprised of hotel and service individuals encountered throughout the experience.

All implemented testing procedures and protocols were standardized at each site location to protect both participants and evaluators; as well as to ensure reliable and valid data collection. These procedures and protocols were rehearsed comprehensively by all GC evaluators during a semester-long training course. Each evaluator was required to navigate a series of inter- and intra-rater reliability skill check-off assessments prior to being accepted onto the study abroad experience.

Testing procedures and protocols for this study adopted recommendations from the American College of Sports Medicine (ACSM), and the National Student Nursing Association (NSNA). The following specified ACSM and NSNA protocols and procedures for the collection of glucose and cholesterol blood samples. These were implemented to minimize puncture site infection, cross contamination of bodily fluid, and blood-born pathogen transmission (Riebe, Ehrman, Liguori, & Magal, 2018; NSNA, 2019). Foremost, each evaluator was required to don a new pair of sterile, non-latex exam gloves for each participant tested. Each participant then had a finger prepped for a lancet blood draw through cleansing by an alcoholic prep pad; designed to remove any bacteria or debris from the site of the puncture. Following a thirty-second delay, allowing for the dissolving of the alcohol, the finger was punctured using a new 28 or 30 gauge safety lancet. A hanging drop of blood was placed onto both the glucose and cholesterol strips, which were then inserted into the meters for analysis. Immediately following the collection of blood, each participant's punctured finger was cleansed with a sanitary cotton ball and dressed with a standard adhesive bandage. Contaminated gloves were removed, following NSNA removal guidelines, and disposed of after every test. All soft-material (alcohol prep pads, cotton balls, and gloves) were disposed of into biohazard bags. All sharps materials (lancets and test strips) were disposed of in biohazard hard-containers. All biohazardous material was returned to the US for proper disposal as directed by the Environmental Health and Safety biohazardous waste disposal guidelines (CDC, 2003).

NSNA (2019) and ACSM (2018) protocols and procedures were also implemented during the collection of height, weight, heart-rate and blood-pressure. Height and weight measurements were conducted with shoes, so as to minimize the exposure of bare feet to hazardous ground surfaces. Blood pressure and heart rate were recorded after a three-minute rest period, with the patient seated, with feet flat and shoulder width apart, and the arm resting at heart level. Two blood pressure measurements were recorded per patient, with a three-minute latency period between assessments. Stadiometers, scales, and blood pressure cuffs were calibrated prior to each assessment session, and intermittently throughout daily testing, by trained faculty personnel. All tools were sanitized with Lysol disinfectant spray and/or wipes between individual patient assessments. Every assessor wore protective exam gloves during each aspect of testing throughout the duration of testing sessions.

ACSM guidelines for implementing the Bioelectric Impedance Analysis (BIA) were followed for participant safety (Riebe, Ehrman, Liguori & Magal, 2018). Participants' personal data were loaded into the handheld BIA by the researchers, then calculated automatically while participants stood stationary, gripping BIA sensors, with arms elevated to heart height, refraining from allowing arms to rest on the trunk. BIA’s were sanitized in-between participant testing. Participants with pacemakers or other internal defibrillators were not administered BIA, as per standardized safety precautions.

Data was collected using manual transcriptions of assessment findings on a recording instrument form. The demographic data recorded included, name, age, gender, height, weight, heart rate, blood pressure, glucose, cholesterol, body mass index and body fat percentage. Two identical copies of the data were recorded on an individual’s perforated data card instrument: one for the researchers to keep, the other for the participants' records. Participants regularly returned for annual health screenings with previous years data for comparison during consultations. Names were recorded to monitor continued participant engagement vs. program expansion.

Immediately following each individual’s health screening, each participant was provided a consultation with a researcher to evaluate the currently recorded health metrics. Recurring participants had the advantage of analyzing change over time. All participants were afforded the opportunity to discuss current exercise and dietary practices and ask informational or clarification questions regarding those topics. Prescriptive evidence-based feedback was then provided based on the data available for continuing desired behaviors and/or remediating undesired behaviors with respect to diet and exercise.

Tools

Glucose and cholesterol measurements were collected using a series of identical Accutrend-Plus hand-held meters and ancillary testing strips. Meters were calibrated using control solutions prior to every testing session, as well as intermittently throughout testing, by trained tenured faculty. As heat and humidity have the potential to distort glucose and cholesterol readings, through affecting both meter and test-strip reliability and validity, the following protocols were implemented during evaluations to negate erroneous readings. Foremost, meters were rotated out of testing every hour, and placed in a temperature/humidity controlled environment for a latency period of one hour, before being reused. Prior to reintroduction into use, each meter was recalibrated with a control solution by a trained researcher. Moreover, all testing strips were stored in a refrigerated device, in humidity controlled canisters, prior to testing. Test strips were only exposed to ambient temperatures and humidity immediately prior to testing. Any compromised test strips were disposed of with other biohazard materials.

Blood pressure and heart rate were collected using an Omron 5-series upper arm automatic blood pressure (BP) monitor. Monitors were calibrated in a nursing lab by trained physicians prior to implementation in health screenings. As BP monitors are not likely to be adversely affected by ambient temperatures and humidity, monitors were not recalibrated during health screenings. However, when unexpected readings were observed, or when measurements were recorded in the danger zone, manual assessments were conducted to validate observed readings by the monitor. A minimum latency period of three minutes was applied between original and follow-up assessments, in accordance with standard testing protocols (Riebe, Ehrman, Liguori, & Magal, 2018).

Weight was collected using a Newline digital scale. It was recorded in pounds for all study protocols; but often provided in kilograms at participant request. Scales were leveled and calibrated for testing at the onset of all testing sessions; hourly throughout testing; as well as each time a scale was relocated to a new surface. Calibration was conducted with a fifty-pound known density weight by researchers.

Height was collected using a Charder HM200P portable stadiometer. Height was recorded in inches for all study protocols; but often provided in centimeters at participant request. Stadiometers were leveled and calibrated for testing at the onset of all testing sessions, as well as each time a stadiometer was relocated to a new surface. Calibration was conducted with a telescopic ninety-inch known height ruler by researchers.

Body Mass Index (BMI) and Body Fat Percentage (BFP) were collected using Omron HBF-306C handheld body-fat loss monitors. BIA monitors were calibrated in an exercise science laboratory, by faculty, through a correlational comparison to DEXA readings prior to data collection in Belize. A 1.5-BFP margin of error was used to determine BIA reliability.

Data Analysis

All data from testing sessions was imported into SPSS for quantitative analysis. Descriptive analyses were run on all demographic data. A Repeated Measures ANOVA was calculated to compare health assessment scores over the five years of data collection. A Mixed-Design ANOVA was calculated to determine if the location of testing was a factor in the effectiveness of program interventions over the course of the study.

Results

During the initial year of data collection, two-hundred and one individuals (M=124; F=77) were evaluated. Assessments identified the average Belizean male in the San Ignacio region as being five-foot seven, weighing one-hundred and ninety-five pounds, with a resting heart rate (RHR) of 74 beats per minute (BPM), a BP level of 137/90 (Systolic/Diastolic), fasting glucose level (GC) of 90 mg/dl, total cholesterol level (CHO) of 171 mg/dl, and a body fat percentage (BF%) of 24%. The average Belizean female stood five-foot four, weighing one-hundred and sixty-eight pounds, with a RHR of 77 BPM, a BP level of 128/87, a fasting GC of 88 mg/dl, a total CHO of 169 mg/dl, and a BF% of 26% (see tables 1 and 2).

Throughout subsequent years of evaluations, following annually implemented interventions, recorded health metrics consistently improved across all levels, for both genders; with obvious exceptions noted in between years one and two of data collection (see tables 1 and 2). Year five analyses identified the average Belizean male (n=288) in the San Ignacio region as being five-foot eight, weighing one-hundred and seventy-six pounds, with a RHR of 68 BPM, a BP level of 122/82, fasting GC of 81 mg/dl, total CHO of 175 mg/dl, and a BF% of 23%. At the conclusion of the study, the average Belizean female (n=313) stood five-foot four, weighing one-hundred and fifty-nine pounds, with a RHR of 70 BPM, a BP level of 129/82, a fasting GC of 85 mg/dl, a total CHO of 177 mg/dl, and a BF% of 24% (see tables 1 and 2).

TABLE 1

Annual Health Screening Metrics Male

YEAR	N	Age	HT	WT	HR	BP	GC	CHO	BF%
2013	124	39	67	195	74	137/90	90	171	24
2014	146	45	66	191	73	133/88	96	193	31
2015	202	44	67	187	71	130/84	90	182	26

2016	233	43	67	182	69	127/83	84	178	24
2017	288	46	68	176	68	122/82	81	175	23

TABLE 2

Annual Health Screening Metrics Female

YEAR	N	Age	HT	WT	HR	BP	GC	CHO	BF%
2013	77	41	64	168	77	128/87	88	169	26
2014	154	43	63	182	82	136/91	95	189	33
2015	203	42	64	172	74	132/85	91	185	29
2016	256	44	64	164	71	130/84	87	179	26
2017	313	43	64	159	70	129/82	85	177	24

A one-way repeated-measures ANOVA was calculated comparing combined health assessment scores on Weight, RHR, Systolic BP, Diastolic BP, Fasting GC, Total CHO, and BF%, over the five years of data collection. A significant effect was found for Weight ($F(4,796) = 37.466$, $p < .01$). Follow-up protected *t*-tests revealed, that aside from a noted increase in average weight from participants in year two, that there was a significant decrease in average participant weight each of the other subsequent years. A significant effect was found for RHR ($F(4,796) = 49.793$, $p < .01$). Follow-up protected *t*-tests revealed, that aside from a noted increase in average RHR from participants in year two, that there was a significant decrease in average participant RHR each of the other subsequent years. A significant effect was found for Systolic BP levels ($F(4,796) = 35.073$, $p < .01$). Follow-up protected *t*-tests revealed, that aside from a noted increase in average Systolic BP from participants in year two, that there was a significant decrease in average Systolic levels each of the other subsequent years. A significant effect was found for Diastolic BP levels ($F(4,796) = 68.667$, $p < .01$). Follow-up protected *t*-tests revealed, that aside from a noted increase in average Diastolic BP from participants in year two, that there was a significant decrease in average Diastolic levels each of the other subsequent years. A significant effect was found for Fasting GC levels ($F(4,796) = 8.502$, $p < .01$). Follow-up protected *t*-tests revealed, that aside from a noted increase in Fasting GC from participants in year two, that there was a significant decrease in average Fasting GC levels each of the other subsequent years. A significant effect was found for Total CHO levels ($F(4,796) = 33.003$, $p < .01$). Follow-up protected *t*-tests revealed, that aside from a noted increase in Total CHO from participants in year two, that there was a significant decrease in average Total CHO levels each of the other subsequent years. A significant effect was found for BF% ($F(4,796) = 27.020$, $p < .01$). Follow-up protected *t*-tests revealed, that aside from a noted increase in BF% from participants in year two, that there was a significant decrease in average BF% levels each of the other subsequent years (see table 3).

TABLE 3

Annual change for combined genders

	2013	2014	2015	2016	2017
WT	M= 185 SD=19.6	M= 186 SD=18.7	M= 179 SD= 17.9	M= 171 SD= 18.9	M= 164 SD= 16.7
RHR	M=75 SD=8.6	M=78 SD=10.7	M= 72 SD= 11.9	M= 70 SD= 8.9	M= 69 SD= 8.7
SysBP	M=133 SD=14.7	M= 135 SD=17.4	M= 131 SD= 14.2	M= 129 SD= 13.9	M= 126 SD= 12.4
DisBP	M=89 SD=9.2	M= 90 SD= 10.6	M= 85 SD= 8.3	M= 84 SD= 8.9	M= 83 SD= 7.9
GC	M=89 SD=11.5	M= 95 SD= 21.2	M= 90 SD= 24.3	M= 86 SD= 25.8	M= 83 SD= 24.6
CHO	M=170 SD=11.1	M= 191 SD= 24.9	M= 183 SD= 24.6	M= 179 SD= 19.8	M= 176 SD= 16.0

BF%	M=25 SD=6.9	M= 32 SD= 9.1	M= 28 SD= 6.2	M= 25 SD= 5.9	M= 23 SD= 6.6

A 4x7 mixed-design ANOVA was calculated to examine the possible effects of location (Open Markets, Hospital/Clinics, Private Businesses, and Hotels/Restaurants) over time, on each separate health screening metric. For weight, a significant main effect for time was found ($F(4,784) = 17.047$, $p<.01$). However, the main effect for location ($F(3,196) = 2.061$, $p>.05$) and the time x location interaction ($F(12,784) = 1.380$, $p>.05$) were not significant. For RHR, a significant main effect for time was found ($F(4,784) = 22.371$, $p<.01$). However, the main effect for location ($F(3,196) = .042$, $p>.05$) and the time x location interaction ($F(12,784) = .289$, $p>.05$) were not significant. For systolic BP, a significant main effect for time was found ($F(4,784) = 13.273$, $p<.01$). However, the main effect for location ($F(3,196) = .301$, $p>.05$) and the time x location interaction ($F(12,784) = .896$, $p>.05$) were not significant. For diastolic BP, a significant main effect for time was found ($F(4,784) = 29.396$, $p<.01$). However, the main effect for location ($F(3,196) = .907$, $p>.05$) and the time x location interaction ($F(12,784) = .634$, $p>.05$) were not significant. For GC, a significant main effect for time was found ($F(4,784) = 3.595$, $p<.01$). However, the main effect for location ($F(3,196) = .464$, $p>.05$) and the time x location interaction ($F(12,784) = 1.145$, $p>.05$) were not significant. For CHO, a significant main effect for time was found ($F(4,784) = 19.509$, $p<.01$). However, the main effect for location ($F(3,196) = .780$, $p>.05$) and the time x location interaction ($F(12,784) = 1.249$, $p>.05$) were not significant. For BF%, a significant main effect for time was found ($F(4,784) = 37.162$, $p<.01$), a significant main effect for location was found ($F(3,196) = 5.263$, $p<.05$), and a significant interaction for time x location was found ($F(12,784) = 5.562$, $p<.05$). Thus, it appears, where all scores were affected by time, only BF% appears to have been affected by specific locations of testing.

Discussion

Belize has been identified by the WHO and Belizean Ministry of Health (BMH) as a location with excessively high diabetes prevalence rates. The data accrued during this study has suggested otherwise. Recorded fasting glucose and cholesterol levels were lower than anticipated based on WHO and BMH statistical reports. In particular, during the first year of data collection the majority of participants tested in the healthy zone. These findings may be attributed to the possibility that the initial year of testing drew an unrepresentative sample of the community. It became apparent to researchers over time as reciprocal relationships were solidified, that local community members were initially hesitant and reserved to partake in testing, due to a general distrust associated with "foreign doctors" from the United States. As such, the intervention likely drew younger, healthier, more trusting individuals in the first year, which was noted in the demographic data; as opposed to a more representative sample of the overall community population. Over the subsequent years, the program began attracting a more diverse sample of community members; but still more likely healthy community members. This was due to a study limitation of conducting the majority of assessments in open, community locations, where individuals had to be healthy enough to be present. In an attempt to obtain a more representative sample, testing locations were arranged in hospitals and clinics. However, as the vast majority of community members cannot afford professional medical services, the number of participants tested in these locations was limited. Yet, what is worthy of notice is that over the years, the study attracted a very consistent group of community members, who were invested in remediating lifestyle behaviors associated with diet and exercise to improve fasting glucose levels. Of 147 community members, who were tested at least three times over the five years, 92% lowered fasting glucose levels by at least 12 mg/dl.

In conjunction with improved fasting glucose scores, study data depicted a drastic change in weight and body fat percent for participants. Of 147 community members, who were tested at least three times over the five years, the average body composition enhancement was noted by >4% body fat loss; with 88% percent improving from a morbidly obese or obese designation to an overweight or healthy designation based on body fat percent. An overwhelming number of participants attributed the changes in weight and body fat to prescriptive interventions implemented by the research team during consultations focused on calculating basal metabolic rate; calculating caloric intake and expenditure; healthy food preparation techniques; micro and macro nutrient intake designations; and hydration status.

Where the study intervention appeared to be least effective was in the area of balancing blood pressure. Blood pressure recordings were consistently noted in the prehypertensive and hypertensive range in the vast majority of community members. The observed readings could be attributed to a number of factors such as the excessive heat and humidity in Belize, hydration status of participants, nervousness, and other extraneous factors. Hence, although significant overall improvements were noted in blood pressure readings, the majority of participants were still displaying elevated blood pressure readings at the culmination of the study.

As previously noted, it became apparent early in the study that many community members were apprehensive and hesitant to participate due to a level of general distrust. Many community members assumed the “blood testing” offered was HIV and or STD/STI testing, not glucose and cholesterol testing. As both HIV and STD/STI prevalence rates are high in Belize, and as both are still considered taboo, much of the population does not want to know those results out of fear of being stigmatized. Therefore, it was not until after gaining community trust and establishing reciprocal relationships with many local community organizations, that the intervention was able to gain access to a more representative sample of the community population. Hence, the data represented in years two through five is likely a more representative sample of the community. During those years, records indicate that the intervention was able to maintain a very consistent participant return rate. In fact, approximately 35% of all community participants were tested at least twice, in consecutive years. Moreover, participants from hospitals, clinics, elderly care facilities and hotels, had a much higher return rate, with approximately 82% of those individuals being tested at least three times during the last four years of the study. The overwhelming majority of participants relayed the importance and benefits of the intervention to researchers: often sharing personal stories regarding diet and exercise modifications to daily routines; work-place modification to promote healthy lifestyles; group challenges to monitor activity and diet; and school-based interventions regarding nutrition and daily recommended exercise to encourage youth healthy habits, among others.

Overall, the data suggest that the annual interventions appeared to prompt change in behavior among participants that allowed for progressive improvement in all areas of health assessments. Interventions appeared to be effective with facilitating appropriate remediation strategies into daily regimens, possibly enhancing both the quality and quantity of life of participants.

Limitations:

A series of logistical and conceptual pragmatic limitations could not be avoided in the implementation of this study. The heat and humidity effects on instruments in outdoor locations were unavoidable; although consistent calibration and rotation of equipment was applied to minimize reliability and validity concerns. Participant recruitment, largely conducted by in-country preceptors, likely skewed the sample population, as did time of year, weather, testing locations, and other factors; making it very difficult to say the sample is representative of the population. Fasting conditions were entirely based on self-report data; hence it was difficult to ensure glucose and cholesterol readings were accrued at true fasting periods.

Follow up

Following the conclusion of the study, the program continued to improve upon annual program interventions. Assessment measures were expanded to include vision testing, grip strength, enhanced BIA analyses incorporating muscle mass assessments, and enhanced blood chemistry analyses differentiating HDL, LDL, and triglyceride scores. The program also sought out, and was awarded, grant funding to purchase testing supplies allowing for a two-fold increase in annual participant assessment. The current trends in the continuation data of this second five-year analysis suggest the program continues to have resounding positive effects on the community.

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