

# An undergraduate curriculum to study health risk factors of college students in Guam: The Pacific Islands Cohort of College Students (PICCS)

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## Research Article

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Abstract

**Background:** The non-communicable disease epidemic among Pacific Islanders prompted the Pacific Island Health Officers Association to declare a health emergency throughout the United States-Affiliated Pacific Islands (Resolution #48-01). Subsequently, the University of Guam Health Science Program initiated the Pacific Islands Cohort of College Students (PICCS). The purpose here is to (1) describe the PICCS development and (2) estimate 2016 baseline health indicators of participants enrolled in PICCS.

**Methods:** Research theory and application were incorporated in undergraduate core courses. Student researchers led data collection, analysis, and dissemination of a cross-sectional study of 417 college students conducted September–December 2016. Self-reported information on demographics, health risk behaviors, and awareness were ascertained. Height and weight were measured to estimate weight status. Mean (standard deviation) for ratio variables and frequency (percentages) for categorical variables were calculated.

**Results:** The PICCS curriculum resulted in multiple successes: 22 abstracts, one manuscript, five acceptances to health leadership programs, four travel awards, and one federal grant. Mean age of the 2016 PICCS research participants was 22.5 (3.6) years. Majority was female (55%). The predominant race/ethnic groups were single-race Asians (49%) and Pacific Islanders (31%) followed by Other/Mixed Ethnicity (20%). Majority reported health risk behaviors: inadequate sleep (63%), high stress (66%), frequent fast-food consumption (63%), infrequent fruit/vegetable intake (81%), and sedentary lifestyle (64%). Overweight and obesity (49%) were also a concern.

**Conclusion:** The PICCS curriculum produced multiple research successes. Integration in an undergraduate program will sustain the monitoring of college student health risk behaviors and informing of targeted intervention strategies.

Background

Noncommunicable diseases (NCDs), including cardiovascular diseases, cancer, respiratory diseases, and diabetes, remain among the leading causes of death globally. Combined NCDs account for 71% (41 of 57 million) of all deaths,<sup>1</sup> with a projected increase to 52 million by 2030. In the Pacific region, 40% of the 9.7 million residents endure NCDs while 75% of deaths are NCD-related.<sup>2</sup> To mitigate NCDs in the Pacific, stakeholders developed and circulated the NCD Roadmap suggesting a multisectoral approach to implement four key strategies: control tobacco use through increased taxes, reduce consumption of foods and drinks linked to NCDs through policies, improve efficiency and impact, and improve evidence base for decision making.<sup>3</sup> Monitoring and surveillance of NCD-related health indicators have been prioritized in many islands, including those affiliated with the United States (US).

Response to NCDs in the US Affiliated Pacific Islands

The US-Affiliated Pacific Islands (USAPIs) are home to over half-million people spread across Oceania including the islands of American Samoa, Guam, Commonwealth of Northern Marianas, Republic of the Marshalls, Republic of Palau, and the Federated States of Micronesia (Pohnpei, Chuuk, Kosrae and Yap). Representatives from the USAPIs form the Pacific Islands Health Officers’ Association (PIHOA). In 2010, PIHOA declared a Regional State of Health Emergency due to the NCD epidemic in the USAPI through Board Resolution #48 – 01.<sup>4</sup> Prior to the resolution, the Pacific Chronic Disease Council (PCDC) developed a Pacific NCD Collaborative Initiative assessing the USAPIs’ NCD-related services and expanding the population outreach.<sup>5</sup> Subsequently, Board Resolution #48 – 01 reinforced the development of an NCD strategic plan among the USAPIs. PIHOA guided the islands on development and implementation of their strategic plan through participation in an epidemiology training program for Pacific health workforce<sup>6</sup> adopted from the Pacific Data for Decision Making (DDM) Program.<sup>7</sup>

Involving undergraduate students in training, research, and service to address NCDs

Pacific DDM concepts were adopted by the University of Guam Health Science Program. During 2013 and 2014, the program piloted a health survey among students attending the university. The survey evolved into a student-centered project later named the Pacific Islands Cohort of College Students (PICCS). The Pacific DDM concepts and the PICCS activities were phased into selected Health Science Program core courses described in Table 1. Throughout the program, students were introduced to anthropometry (HS200); NCD risk factor assessment (HS216); study design and survey development (HS405); PICCS data collection (HS416), analysis (MA387), dissemination (HS451); and translation (HS491) and application (HS498) of curricular concepts.

PICCS is an annual cross-sectional study that will progress to an epidemiologic cohort. This paper describes the development of the PICCS curriculum, and the health indicators of participants enrolled when the curriculum was formalized in 2016.

Table 1. Selected core courses supporting the Pacific Islands Cohort of College Students (PICCS) curriculum of the B.S. Health Sciences Program, University of Guam

Course	Content
HS200 Health and Wellness	Exposure to PICCS anthropometry
HS216 Introduction to Public Health	Exposure to PICCS assessment of NCD risk factors
HS405 Epidemiology	Exposure to PICCS study design and methodology
HS416 Research in Health Sciences	Collection of PICCS data
MA387 Statistics for Sciences	Analysis of PICCS data
HS451 Research and Report Writing	Dissemination of PICCS findings
HS491 Current Topics in Health Sciences	Translation of PICCS and other health topics
HS498 Internship in Health Sciences	Application of PICCS and other program knowledge and skills

## Methods

Ethics approval has been renewed annually since 2013 by the Committee on Human Research Subjects at the University of Guam (CHRS#16–83).

## Study design, setting, and population

The PICCS Study comprised of annual cross-sectional assessments of health indicators of college students at the University of Guam (UOG). Recruitment was held every fall semester from September to December since the pilot in 2013. Interviews were conducted on campus in a designated research room all study materials and equipment were kept secured.

PICCS welcomed any registered student at least 18 years old at the time of recruitment. Pregnant females were excluded due to potential challenges with anthropometric assessments. The target sample size each year was roughly 10% of the university's student population reported annually.<sup>8</sup> The sample size in 2016 was 417 college students. Although sampling was non-random, efforts were made to recruit a representative sample of students according to the distribution of characteristics in the university fact book. Recruiters targeted all colleges and schools on campus.

## Data collection

## Training

Students majoring in Health Sciences beginning 2013 received training on the knowledge and skills pertinent to research ethics, planning, implementation, analysis, and dissemination of the PICCS through courses listed in Table 1. Initial years were spent developing the processes and establishing the infrastructure according to Fig. 1. Instructors remained principal investigators (PI) throughout. During junior and senior years, students were upgraded to co-investigators and assumed one of the following roles: 1) Coordinator - *Project Coordinator* (assisted PI with trainings, scheduling, operations, logistics) or *Data/Quality Assurance Coordinator* (assisted PI with standardization, equipment calibration, survey completion); or 2) Collector – *Recruiter* (sought participants), *Interviewer* (administered questionnaires), or *Measurer* (collected body measurements). All student co-investigators practiced role-playing the informed consent process and administering the questionnaires several times before recruitment commenced each year. Measurers were trained and standardized to collect height and weight measurements using similar protocols from the Children's Health Living Program.<sup>9</sup> Measurers who did not pass the standardization were encouraged to select from other co-investigator roles.

## Interview

Interviews were conducted in pairs (interviewer and measurer). Data collected in 2016 included physical measurements and self-reported information. The physical data included: *height* measured in centimeters with a portable stadiometer (Model PE-AIM-101, Perspective Enterprises, Portage, MI) and *weight* measured in kilograms with a portable weight scale (SECA 876, Hamburg, Germany). The measurer performed the anthropometry and reported the numbers for the interviewer to record. Measurements continued until two consecutive measurements were within  $\pm 0.2$  units.

Self-reported data included demographics, areca nut use,<sup>10</sup> sexually transmitted infections (STIs) awareness,<sup>11</sup> physical activity,<sup>12,13</sup> sleep,<sup>14</sup> stress,<sup>15</sup> and questions adopted from the Behavioral Risk Factor Surveillance System (BRFSS) including alcohol, dental visits, e-cigarettes, fruit and vegetable consumption, health care access, medical marijuana, and tobacco use.<sup>16</sup>

## Statistical analysis

Data were entered in courses MA387 or HS451 or both depending on workload. Entries were reviewed and corrected by student co-investigators beside the initial data enterer. Data were analyzed with the SPSS Statistics Software. Body mass index (BMI) was calculated ((weight in kilograms) / (height in centimeters/100)<sup>2</sup>). Weight status categories were determined as underweight (BMI < 18.5), normal weight (18.5 to 24.9), overweight (25.0 to 29.9), and obese ( $\geq 30$ ).<sup>17</sup> Ethnicity was recoded to reflect single Asian from any Asian country, single Pacific Islander from any Pacific Island, and Others including mixed ethnicity. Marital status was recoded to single, married, and other (divorced and common-law). Sleep was recoded into adequate ( $\geq 7$  hours) and inadequate (< 7 hours). Stress reflected the number of Yes responses to the stress experience assessment in Total Fitness & Wellness,<sup>15</sup> and recoded to high ( $\geq 6$  Yes responses) and low to average (< 6 Yes responses). Nutritional and physical activity variables were recoded: fast-food to frequent ( $\geq 3$  times per week) and infrequent (< 3 times per week), fruits and vegetables to frequent ( $\geq 3$  times per day) and infrequent (< 3 times per day), and physical activity via the Physical

Activity Readiness Questionnaire<sup>12,13</sup> to active (PARQ score  $\geq 5$ ) and sedentary (PARQ score  $< 5$ ). Alcohol defined as any alcohol consumption in the last 30 days including binge drinking ( $\geq 5$  drinks for men or  $\geq 4$  drinks for women on any occasion) and chronic drinking ( $\geq 60$  drinks in a month). Dental visits included frequent (within the past 12 months) and infrequent ( $> 12$  months ago). Mean and standard deviation were calculated for ratio level variables. Frequency and percentages were calculated for categorical variables.

## Results

### *PICCS curriculum*

The PICCS produced positive outcomes since the concepts were initiated in 2013. A major success was the opportunity for students and faculty to present at national and local conferences. Of 33 abstracts submitted from 2015 to 2019, 55% were accepted for presentation. One manuscript led by students was recently published.<sup>18</sup> Four student presentations were by invitation. Another success was the acceptance of students to summer programs. Of five student applicants to national public health leadership programs, 60% were accepted. Similarly, of three student applicants to a regional childhood prevention program, 67% were accepted. A final success of the PICCS framework was the acquisition of a grant award from the National Institute on Minority Health and Health Disparities in 2016.<sup>19</sup> Additional funding via travel awards to students and faculty supported presentations at conferences throughout the US.

### *Demographic characteristics, 2016*

In Table 2, the mean age of the 417 college students recruited in 2016 was  $22.5 \pm 3.6$  years. Majority was female (54.9%), single (95%), and not employed for wages (52.3%). The largest single ethnic group was Asian at 48.7% (predominantly Filipino followed by Chinese and Korean), followed by Pacific Islander at 31.4% (predominantly CHamoru followed by Chuukese, Pohnpeian, Palauan, Marshallese, and Yapese) and Other (predominantly White) and mixed ethnicity (CHamoru-Filipino) at 19.9%.

Table 2. Demographic characteristics of study participants (n = 417) in the Pacific Islands Cohort of College Students (PICCS) Study, University of Guam, 2016

	Mean $\pm$ Standard Deviation or Frequency (%)
Age, years	22.5 $\pm$ 3.6
Sex	
Female	229 (54.9%)
Male	188 (45.1%)
Ethnicity	
Asian, single race	203 (48.7%)
Pacific Islander, single race	131 (31.4%)
Other, including mixed	83 (19.9%)
Marital status	
Single	396 (95.0%)
Married	13 (3.1%)
Other	8 (1.9%)
Employed for wages	
Yes	199 (47.7%)
No	218 (52.3%)

Ethnicity: Asian groups reported in majority order were Filipino, Chinese, and Korean. Pacific Islander groups reported in majority order were CHamoru, Chuukese, Pohnpeian, Palauan, Marshallese, and Yapese. Other groups reported in majority order were Caucasian and mixed ethnicity. Predominant mixed-race group was CHamoru-Filipino. Marital status: Other includes divorced and common-law.

### *Health indicators, 2016*

In Table 3, majority of students reported access to health care (66.2%) mostly through their parents' insurance, inadequate sleep (62.6%), high stress (66.4%), frequent fast food consumption (62.8%), infrequent intake of fruits and vegetables (80.8%), sedentary activity (63.8%), alcohol consumption within the last 30 days (47%) with 19.7% binge drinking and 4.6% chronic drinking, not using areca nut (93.5%), not smoking cigarettes (90.9%), not smoking e-cigarettes (84.4%), not using medical marijuana (92.3%), not chewing smokeless tobacco (92.1%), and frequent dental visits (63.5%). A high percentage was overweight (28.8%) and obese (20.6%).

Other high-risk health indicators were uninsured (26.9%), areca nut users (5.1%), cigarette smokers (6.8%), e-cigarette smokers (14.1%), medical marijuana users (5.0%), smokeless tobacco chewers (5.5%), and those who visited their dentist infrequently (32.6%).

Table 3. Health indicators of study participants (n = 417) in the Pacific Islands Cohort of College Students (PICCS) Study, University of Guam, 2016

	Mean ± Standard Deviation or Frequency (%)
HEALTH CARE ACCESS	
No	112 (26.9%)
Yes	276 (66.2%)
Don't know	28 (6.7%)
Refused	1 (0.2%)
MENTAL HEALTH INDICATORS	
Sleep	
Adequate	156 (37.4%)
Inadequate	261 (62.6%)
Stress	
High stress	277 (66.4%)
Average stress	139 (33.3%)
Missing	1 (0.2%)
NUTRITIONAL AND PHYSICAL INDICATORS	
Fast food	
Frequent	262 (62.8%)
Infrequent	155 (37.2%)
Fruits and vegetables	
Frequent	80 (19.2%)
Infrequent	337 (80.8%)
Physical activity	
Active	150 (36.0%)
Sedentary	266 (63.8%)
Missing	1 (0.2%)
Weight status	
Underweight	9 (2.2%)
Healthy weight	190 (45.6%)
Overweight	120 (28.8%)
Obese	86 (20.6%)
Missing	12 (2.9%)
ORAL HEALTH INDICATORS	
Alcohol use	
No	193 (46.3%)
Yes	196 (47.0%)
Binge drinking	82 (19.7%)
Chronic drinking	19 (4.6%)
Don't know	18 (4.3%)
Refused/missing	10 (2.4%)
Areca nut use	
No	390 (93.5%)
Yes	21 (5.1%)
Don't know	1 (0.2%)
Refused/missing	5 (1.2%)
Cigarette smoking	
No	379 (90.9%)
Yes	28 (6.8%)
Don't know	2 (0.5%)
Refused/missing	8 (1.9%)
E-cigarette use	
No	352 (84.4%)
Yes	59 (14.1%)
Don't know	2 (0.5%)
Refused/missing	4 (1.0%)
Medical marijuana	
No	385 (92.3%)
Yes	21 (5.0%)
Don't know	5 (1.2%)

Refused/missing	6 (1.5%)
Smokeless tobacco use	131 (31.4%)
No	384 (92.1%)
Yes	23 (5.5%)
Don't know	1 (0.2%)
Refused/missing	9 (2.2%)
Visit dentist	
Frequent	265 (63.5%)
Infrequent	136 (32.6%)
Don't know	14 (3.4%)
Missing	2 (0.5%)

Sleep: adequate ( $\geq 7$  hours) and inadequate ( $< 7$  hours). Stress: reflects the number of *Yes* responses - high ( $\geq 6$  *Yes* responses) and low to average ( $< 6$  *Yes* responses). Fast food: frequent ( $\geq 3$  times per week) and infrequent ( $< 3$  times per week). Fruits and vegetables: frequent ( $\geq 3$  times per day) and infrequent ( $< 3$  times per day). Physical activity: active (PARQ score  $\geq 5$ ) and sedentary (PARQ score  $< 5$ ). Alcohol: defined as any alcohol in the last 30 days including binge drinking ( $\geq 5$  drinks for men or  $\geq 4$  drinks for women on any occasion) and chronic drinking ( $\geq 60$  drinks in a month). Dental visits: frequent (within the past 12 months) and infrequent ( $> 12$  months ago).

### *STI Awareness, 2016*

In Table 4, majority of students knew STI risk can be reduced by having sex with only one uninfected monogamous partner (68.1%) or by using condoms (77.7%). Most students knew a person could have/get the human immunodeficiency virus (HIV) even if the individual looked healthy (86.8%), but could not acquire HIV from toilet seats (56.1%) or by sharing food with an infected person (60%). On the contrary, some students were unaware STIs can be reduced by having sex with only one uninfected monogamous partner (17% misunderstood and 13.2% did not know) or by using condoms during every sexual encounter (12% misunderstood and 8.6% did not know). Similarly, some students were unaware a person could have/get HIV even if the individual looks healthy (4.1% misunderstood and 8.6% did not know), or could not get the HIV from toilets seats (18.9% misunderstood and 24.5% did not know) or by sharing food with an infected person (16.3% misunderstood and 23.3% did not know).

The most common source of information on STI and HIV testing and services was through a public health clinic (62.4%), followed by the University campus (55.6%), a private doctor (40.3%), and the local *Prutehi Hao* social media (17.5%). More than half of students did not obtain information on STI and HIV testing and services from a private doctor (55.9%) or *Prutehi Hao* social media (78.7%). Although students did not hear about STI and HIV testing and services on campus (40.5%), the majority reported that condoms (90.9%) and testing (78.4%) should be available on campus.

Table 4. Awareness of sexually transmitted infection among study participants (n = 417) in the Pacific Islands Cohort of College Students (PICCS) Study, University of Guam, 2016

	Mean ± Standard Deviation or Frequency (%)
<b>CAN THE RISK OF SEXUALLY TRANSMITTED INFECTIONS (STI) BE REDUCED BY:</b>	
Having sex with only one uninfected monogamous partner?	
No	71 (17%)
Yes	284 (68.1%)
Don't know	55 (13.2%)
Refused/missing	7 (1.7%)
Using a condom during sex every time?	
No	50 (12.0%)
Yes	324 (77.7%)
Don't know	36 (8.6%)
Refused/missing	7 (1.7%)
<b>CAN A PERSON HAVE OR GET THE HUMAN IMMUNODEFICIENCY VIRUS (HIV):</b>	
If the individual looks healthy?	
No	17 (4.1%)
Yes	362 (86.8%)
Don't know	36 (8.6%)
Missing	2 (0.5%)
From toilet seats?	
No	234 (56.1%)
Yes	79 (18.9%)
Don't know	102 (24.5%)
Missing	2 (0.5%)
By sharing food with someone who is infected?	
No	250 (60.0%)
Yes	68 (16.3%)
Don't know	97 (23.3%)
<b>HAVE YOU HEARD ABOUT STI AND HIV TESTING SERVICES FROM:</b>	
A private doctor?	
No	233 (55.9%)
Yes	168 (40.3%)
Missing	16 (3.8%)
A public health clinic?	
No	141 (33.8%)
Yes	260 (62.4%)
Missing	16 (3.8%)
<i>Prutehi Hao</i> (local) social media	
No	328 (78.7%)
Yes	73 (17.5%)
Missing	16 (3.8%)
On campus?	
No	169 (40.5%)
Yes	232 (55.6%)
Missing	16 (13.8%)
<b>WHAT STI AND HIV SERVICES SHOULD BE AVAILABLE FOR STUDENTS ON CAMPUS?</b>	
Condoms	
No	6 (1.4%)
Yes	379 (90.9%)
Don't know	29 (7.0%)
Refused/missing	3 (0.7%)
Testing	
No	4 (1.0%)
Yes	391 (78.4%)
Don't know	20 (4.8%)
Missing	2 (0.5%)

## Discussion

# Teaching research to undergraduate students through the PICCS

NCD morbidity and mortality are problematic even in the remote areas of the Pacific where challenges are further exacerbated by distance and limited resources. Incorporation of the PICCS in an undergraduate curriculum provided students with didactic and field training, thereby preparing them for graduate studies or the workforce. With guidance from program faculty, students were encouraged to identify relevant community health problems and suggest solutions through research and translation. Students took other non-core courses (e.g., BI100 Environmental Biology, PA210 Public Administration and Management Concepts, HS322 Kinesiology, and AL439 Community Nutrition) to supplement their interest. This interdisciplinary offering is reflective of “infusing public health education in the undergraduate curriculum” described by Rose in 2009.<sup>20</sup> The PICCS curriculum provided most students their initial undergraduate research and leadership experience. Unlike the Centers for Disease Control and Prevention Undergraduate Public Health Scholars Program,<sup>21</sup> the PICCS curriculum engages students over multiple undergraduate years.

## Identifying health risk behaviors of college students

The 2016 PICCS data revealed that majority of students experienced several health risk behaviors including inadequate sleep (63%), high stress (66%), frequent fast-food consumption (63%), infrequent fruit and vegetable intake (81%), and sedentary activity levels (64%). Overweight and obesity (49%) was also a concern. Previous PICCS-related literature reported similar oral health behaviors, including alcohol consumption, smoking and smokeless tobacco use, and areca nut use;<sup>18</sup> however, this paper is the first to document chronic drinking (5%), electronic cigarette use (14%), and medical marijuana use (5%) among the PICCS participants.

## Inadequate sleep and high stress

Sleep and stress are factors linked through biological mechanisms that researchers continue to investigate. According to the American Academy of Sleep Medicine and Sleep Research Society, seven hours of sleep in adults is the minimum threshold for optimal health.<sup>22</sup> The 63% of students reporting inadequate sleep (< 7 hours per day) in the PICCS was above the one-third reported by adults in the 2014 US BRFSS even among those 18–24 years old.<sup>23</sup> Interestingly, the inadequate sleep patterns in the PICCS fell in the adequate sleep patterns range of 56% in Hawaii to 72% in Colorado and South Dakota.<sup>23</sup> Compared to other studies of college students, inadequate sleep in the PICCS (63%) was still higher than other 18–24 year-old students across universities in the United States (46%)<sup>24</sup> and among student athletes (39%).<sup>25</sup>

High stress was also reported in the PICCS. The relationship between sleep and stress has been suggested among healthy adults,<sup>26</sup> medical students,<sup>27,28</sup> mothers,<sup>29</sup> and men,<sup>30</sup> to name a few. The 66% of students reporting high stress in the PICCS was more than previous reports of college students in Guam<sup>31</sup> and elsewhere,<sup>27,32</sup> however, the tools used to measure stress varied between studies. The PICCS subsequently adopted the Depression Anxiety Stress Scale (DASS) to allow for comparability across studies. Work is underway to validate the DASS in the PICCS population.

## Poor nutrition, physical inactivity, and overweight and obesity

Poor nutrition and physical inactivity are considered “public health enemy number two” (tobacco is number one)<sup>33</sup> through obesity. The 21% of PICCS participants classified as obese was lower than the 2016 BRFSS Guam (28%) and U.S. median (30%);<sup>38</sup> however, the PICCS represented measured height and weight while the BRFSS measurements were self-reported. Frequent fast-food consumption (63%), infrequent fruit and vegetable intake (81%), and sedentary activity levels (64%) among PICCS participants are alarming and consistent with other college students in high fast-food consumption,<sup>34</sup> low fruit and vegetable intake,<sup>35</sup> and high sedentary behaviors.<sup>36</sup> Obesity remains a global threat. To reverse the epidemic in the US, the CDC developed prevention strategies including nutrition and physical activity guidelines.<sup>37</sup> These strategies should be considered, with input from college students, in interventions targeting college campuses.

## Initial reports of health risk behaviors by the PICCS

This study documents the first reports of chronic drinking, e-cigarette use, medical marijuana use, and STI awareness among students in the PICCS. Most striking is e-cigarette use in the PICCS (14%) was nearly twice that of Guam adults and nearly triple that of US adults in 2016.<sup>38</sup> In contrast, medical marijuana use in the PICCS (5%) was slightly lower than current use among US adults with (9%) and without (8%) medical conditions in 2016.<sup>39</sup>

STI awareness in this study represents the first collaborative research efforts on STIs between the University of Guam and the STI/HIV Program of the local health department. According to the CDC, adolescents and young adults aged 15–24 years comprised half of the new STI cases and two most common STIs were chlamydia and gonorrhea.<sup>40</sup> Rate of reported chlamydia cases in Guam increased per 100,000 from 521 in 2014 to 662 in 2017, followed by a decrease to 564 in 2018.<sup>40</sup> Rate of reported gonorrhea cases also increased every year within the 5-year period, from 62 to 156 per 100,000.<sup>40</sup>

During the pilot test years of the PICCS, the health department’s STI/HIV Program requested to assess STI awareness among college students who comprise the program’s target population. Current PICCS findings suggest a lack of STI awareness (misconception or simply not knowing) exists among the college students. There is room for improvement in STI education and awareness efforts. STI outreach may be expanded to private doctors (for the 66% with health insurance access) and the public health clinic (for the 27% without health insurance). Despite its presence on social media, *Prutehi Hao* is not reaching the student population. The university is presented with an opportunity to improve STI education and awareness efforts, especially as most students support the distribution of condoms (91%) and provision of STI testing services (78%) on campus. Discussions are underway to incorporate STI testing as an option in the PICCS.

## Strengths and limitations



Success of PICCS is attributed to its incorporation into the Health Science Program resulting in the sustainability of continuous collection, analysis, dissemination, and translation of health indicators of college students in Guam. The curriculum provides a hands-on approach to research from planning to dissemination with the opportunity to inform improvement. In exchange for their efforts, students receive undergraduate research experience that enhances their leadership capabilities, research and presentation skills, travel award and publication records, and confidence to enter the workforce or graduate/post-baccalaureate programs. The PICCS framework provides the organizational structure and documented tools, protocols, roles, and responsibilities to ensure consistency and reproducibility.

The limitations are viewed as opportunities for improvement, such as the implementation of a longitudinal follow-up. The curriculum currently employs a cross-sectional study design limiting the interpretation of findings. A prospective follow-up will strengthen the study by allowing for incidence and risk measures. Other limitations included the non-random selection of students into the study and lengthy interviewer/interviewee interaction. Despite the non-random selection of students, the stratified sampling approach resulted in a demographic distribution like the university's student enrollment. To improve sampling efforts and reduce interview time, the PICCS team will explore recruitment via the registration office and conversion to online surveys.

## Conclusion

The PICCS curriculum has resulted in multiple research successes including, 22 abstract presentations, one manuscript, five acceptances to summer health-leadership programs, four travel awards and one federal grant. Predominant health risk behaviors in 2016 were inadequate sleep (63%), high stress (66%), frequent fast-food consumption (63%), infrequent fruit and vegetable intake (81%), and sedentary lifestyle (64%). Overweight and obesity (49%) were also a concern. Incorporation of PICCS into an undergraduate curriculum presents an opportunity to monitor health risk behaviors among students and inform targeted intervention strategies.

## Declarations

### *Ethics approval and consent to participate*

This study was approved by the Committee on Human Research Subjects at the University of Guam (CHRS#16-83). All protocols were carried out in accordance with relevant guidelines and regulations. Written informed consent was obtained from all participants in this study.

### *Consent for publication*

Not applicable.

### *Availability of data and materials*

Access to the PICCS data can be requested through the University of Guam, given compliance with ethical review requirements. Contact the corresponding author at paulinoy@triton.uog.edu.

### *Competing interests*

The authors declare that they have no competing interests.

### *Funding*

Not applicable.

### *Authors' contributions*

Y.P. conceptualized the PICCS study, co-led the curriculum, and led the initial manuscript draft. A.A. co-led the PICCS study and curriculum. J.D. coordinated data collection and assisted with data analysis. E.B. assisted with data collection and data visual. K.C. assisted with data collection and data visual. B.C. assisted with data collection and literature review. A.D. coordinated data collection and assisted with data analysis. L.E. assisted with data collection and literature review. V.F. led manuscript revisions and formatting for submission. G.B. co-led the PICCS curriculum related to data analysis. M.U. co-led the PICCS curriculum. All authors critically reviewed the manuscript, provided feedback, and approved the manuscript.

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## Abbreviations

PICCS	Pacific Islands Cohort of College Students
NCDs	Noncommunicable diseases

USAPIs	US-Affiliated Pacific Islands
PIHOA	Pacific Health Officers' Association
PCDC	Pacific Chronic Disease Council
DDM	Pacific Data for Decision Making Program
HS200	Health and Wellness
HS216	Introduction to Public Health
HS405	Epidemiology
HS416	Research in Health Sciences
MA387	Statistics for Sciences
HS451	Research and Report Writing
HS491	Current Topics in Health Sciences
HS498	Internship in Health Sciences
UOG	University of Guam
PI	Principal investigator
STIs	Sexually transmitted diseases
BRFSS	Behavioral Risk Factor Surveillance System
BMI	Body Mass Index
PARQ	Physical Activity Readiness Questionnaire
HIV	Human immunodeficiency virus
BI100	Environmental Biology
PA210	Public Administration and Management Concepts
HS322	Kinesiology
AL439	Community Nutrition
DASS	Depression Anxiety Stress Scale

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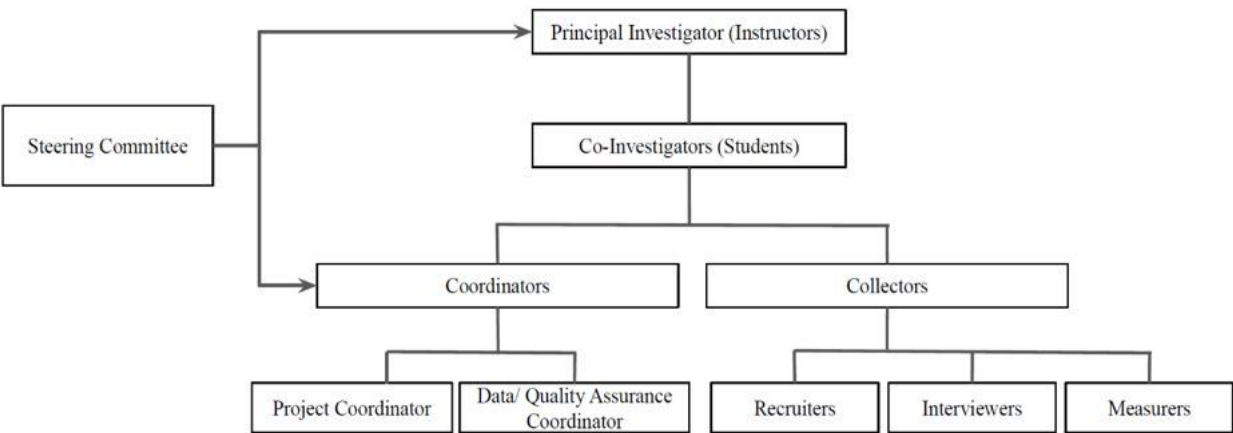
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Figures



**Figure 1**

Organizational framework of the data collection team of the Pacific Islands Cohort of College Students (PICCS) curriculum of the B.S. Health Sciences Program, University of Guam