Healthy Lifestyle Behaviors and Disparities Between the United States Mainland Compared to Puerto Rico, Guam, and United States Virgin Islands (i.e., United States Territories)

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ABSTRACT

Background: No studies have compared the lifestyle behaviors between Puerto Rico, Guam, and the U.S. Virgin Islands to that of the United States mainland. Documenting and addressing health disparities between these geographically and culturally distinct areas are important public health objectives. Differences in health status between and among the United States mainland and territories merit systematic and careful analyses.

Methods: Four key healthy lifestyle characteristics include tobacco use, body mass index, physical activity, and fruit/vegetable consumption. Data from the 2009 Behavioral Risk Factor Surveillance System (N=420,481) were used to examine United States mainland and territorial differences among the four key healthy lifestyle behaviors. Descriptive statistics were summarized with chi-square tests for independence and multiple adjusted logistic regression models were used to examine differences in health compliance rates while controlling for age, gender, income, and education. Frequencies determined whether Healthy People 2010 goals were met by each location.

Results: Differences were found between the United States mainland and territories for smoking rates, body mass index, physical activity, and consumption of fruit/vegetables. None of the locations met all four Healthy People 2010 goals.

Discussion: Even though, each location had unique challenges, Puerto Ricans’ health behaviors were significantly less favorable than residents in the other areas. We document prevalence rates and differences by location for each of the four healthy lifestyle characteristics. This study highlights the need for more research in these understudied areas as well as the
importance of effective health promotion and disease prevention programs for all United States citizens including the mainland and all territories.

**Keywords:** Health disparities; United States mainland; United States territories; Healthy Lifestyle Characteristics

**INTRODUCTION**

The United States’ 2014 population was 318,857,056 people, 77.4% identified as non-Hispanic white and 17.4% identified as Hispanic or Latino, making this group the largest ethnic minority in the country (Colby & Ortman, 2015). Within this population, Puerto Ricans comprise 3.4 million or 8.6 percent of all Hispanics (Aponte, 2009). Although literature examining this subgroup is growing, many questions remain as to why this ethnic group disproportionately experiences greater rates of diseases including diabetes, hypertension, and depression compared to non-Hispanic whites (Chavez, Sha, Persky, Langenberg, & Pestano-Binghay, 1994; Lai et al., 2009; Ramos, 2005; Whitman, Silva, & Shah, 2006). Two other groups of United States citizens whose health is commonly understudied are Guamanians and Virgin Islanders. Puerto Rico, Guam, and the Virgin Islands are United States territories and their residents are citizens of the United States. Despite this fact, there are limited data about these underrepresented populations.

The United States mainland and the territories of Puerto Rico, Guam, and U. S. Virgin Islands have a curious relationship (i.e., legally classified as unincorporated). They belong to the United States but are not incorporated as one of the 50 states. Most territories in the United States have their own separate laws, taxes, and representative (self) government (Roberts, 2017). However, individuals living in these territories are U.S. citizens yet they cannot vote for president (Cottle, 1995; Murriel, 2016; Perez, 2002; Pupillo, 2014; Ramos, 2005; Roberts, 2017; Steckelberg & Esteban, 2017). Territorial citizens elect nonvoting delegates to the U.S. House of Representatives and get no representation at all in the Senate (Pupillo, 2014; Steckelberg & Esteban, 2017). Although they cannot vote on the House floor, the delegates can address the House, sit and vote in congressional committees, and introduce legislation (Steckelberg & Esteban, 2017). Most residents do not pay federal income tax; but, they do pay many other federal taxes, including Social Security and Medicare (Pupillo, 2014; Roberts, 2017; Steckelberg & Esteban, 2017). Recently, Puerto Rico voted overwhelmingly to apply for statehood (Roberts, 2017). This ambivalent relationship may affect the health status of these residents. Considering this perspective, the health status of individuals living in these territories and how their health compares to individuals living on the mainland is an understudied and yet an important area of research (Felix, Bailey, & Zahran, 2015; Marynak, 2017; Ogilvie, Patel, Narayan, & Mehta, 2018).

Morbidity & Mortality Weekly Reports include the District of Columbia, Guam, Puerto Rico, and U. S. Virgin Islands in its surveillance of health behaviors. For example, state laws regarding indoor public use, retail sales, and prices of electronic cigarettes among the United States and its territories was published in 2017 (Marynak et al., 2017). However, few published studies have compared differences related to health between the United States mainland and its territories. There are two notable exceptions. In 2015, a study assessed differences in asthma prevalence between Hispanic adults living in Puerto Rico and Hispanic adults of Puerto Rican descent living in the United States. The authors concluded that asthma was more prevalent among Puerto Rican Americans than Hispanics in Puerto Rico (Felix, Bailey, & Zahran, 2015).
In 2018, a study compared the prevalence and secular trends of four recommended diabetes care practices in the United States territories to the 50 United States and District of Columbia. The four diabetes care practices were biannual HbA1c tests, attendance of diabetes education classes, daily self-monitoring of blood glucose, and receipt of annual foot examination. The authors concluded that the United States territories lagged behind the United States mainland in diabetes care practices. Policies are needed to improve diabetes care practices in the United States territories (Ogilvie, Patel, Narayan, & Mehta, 2018).

To our knowledge, there are no studies that compare key healthy lifestyle behaviors/characteristics between residents of the United States mainland and territories. Specifically, we were interested in studying compliance to a healthy weight (i.e., BMI ≥18.5 to <25 kg/m²), physical activity (i.e., ≥150 minutes of moderate- to vigorous- physical activity/week), fruit and vegetable consumption (i.e., ≥5 servings/day), and abstinence from smoking. No research studies were found that directly compared the rates of these four Healthy Lifestyle Characteristics.

Documenting and understanding health disparities are important public health objectives. Where you live, work, and play affects your health status. Disparities are major contributors to chronic conditions and premature mortality. The Institute of Medicine (2012) emphasizes the importance of reducing and eliminating health disparities and promoting equity as critical public health objectives (McGuire, 2012).

Therefore, it is important to study and document health disparities. Furthermore, to target health disparities, it is important to understand differences and similarities among health behaviors between citizens in the mainland and its territories. Among the four Healthy Lifestyle Characteristics, the three research questions were:

1. What are similarities and differences between citizens of the mainland and the three United States territories (i.e., Puerto Rico, Guam, and the United States Virgin Islands)?
2. What are similarities and differences among the three United States territories?
3. Do the United States mainland and the three territories meet the Healthy People’s 2010 target goals for the four Healthy Lifestyle Characteristics?

We hypothesized that:

1. Citizens of United States mainland will report greater adherence to healthy lifestyle characteristics than citizens of the territories.
2. Citizens of the United States mainland will meet more of the Healthy People’s 2010 target goals than citizens of the territories.

Achieving Healthy People 2010 goals is an important objective while documenting and understanding any health disparities among different populations are equally important objectives. Public health and government officials can consider changing existing programs or implementing new programs based on whether goals are met.

**METHODS**

**Behavioral Risk Factor Surveillance System (BRFSS)**

The data set used for these analyses was the 2009 Behavioral Risk Factor Surveillance System (BRFSS), administered by the Centers for Disease Control and Prevention (CDC).
BRFSS was initiated in 1984 and by 2001, 50 states, the District of Columbia, Puerto Rico, Guam, and the U.S. Virgin Islands were participating (Centers for Disease Control and Prevention, 2008). The BRFSS is a cross-sectional survey of randomly selected individuals living throughout the United States and territories. Standardized questionnaires were administered to individuals using both landlines and cell phones. One randomly selected individual from each household with a landline is selected to participate, whereas participants with cell phones are treated as a one-person household. The standardized questionnaires are designed to estimate the prevalence of select health and risk behaviors as well as preventive health practices. The validity and reliability of the BRFSS data have been reported and are comparable to other health surveys including the National Health Interview Survey (Centers for Disease Control and Prevention, 2008; 2009). All data are weighted and ranked according to the following socio-demographic characteristics: age, race/ethnicity, and gender. However, recent studies have expanded these variables to include characteristics such as marital status and home ownership (Centers for Disease Control and Prevention, 2012).

Data manipulation

Because the Centers for Disease Control and Prevention’s definitions of overweight and obesity vary for individuals at different stages of the life cycle, excluded from the analysis were pregnant women and persons aged 21 years and younger, for a total sample of 420,481. Total household income was re-categorized to low (less than $35,000 per year), middle ($35,000 to less than $75,000), and high ($75,000 or more); these income thresholds have been reported in earlier studies (Taylor, Paxton, Fischer, & Bellows, 2015). To ensure that we had a sufficient sample size to estimate differences between areas, participants who reported did not know or refused to answer were included as a separate category.

Four Healthy Lifestyle Characteristics

Reeves and Rafferty (2005) proposed four Healthy Lifestyle Characteristics: non-smoking, maintaining a healthy weight, daily consumption of five fruits and vegetables, and participation in moderate-intensity physical activity ≥30 minutes at least 5 days per week. These Healthy Lifestyle Characteristics were selected because of their importance in chronic disease prevention and reduction of all-cause mortality (Reeves & Rafferty, 2005).

Statistical Analysis

All analyses were performed in SAS, version 9.4 (SAS Institute, Cary, NC), with significance set at \( P < 0.05 \) a priori (SAS Institute, 2017). The data were summarized within each group using descriptive statistics that included means and standard deviations (i.e., PROC SURVEYMEANS), frequencies and percent (i.e., PROC SURVEYFREQ), and chi-squared tests (i.e., PROC SURVEYFREQ). Multiple adjusted logistic regression models (i.e., PROC SURVEYLOGISTIC) were used to examine differences in health compliance rates while controlling for age, gender, income, and education. Frequencies determined whether Healthy People 2010 goals were met by each location. All analyses were conducted in 2017. This research was exempt from Institutional Review Board approval because there was no contact with human participants.

RESULTS

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Several socio-demographic characteristics differed by location of residence (Table 1). Significant differences were observed for all socio-demographic variables except gender (P =

<table>
<thead>
<tr>
<th>Table 1: Study Characteristics by Location of Residence</th>
<th>Mean or Frequency</th>
<th>Percent total sample</th>
<th>Mainland</th>
<th>Guam</th>
<th>Puerto Rico</th>
<th>Virgin Islands</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Age</td>
<td>48.3 (0.1)</td>
<td>48.3 (0.1)</td>
<td>43.1 (0.5)</td>
<td>47.3 (0.3)</td>
<td>46.3 (0.4)</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Race By State Respondents</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Whites</td>
<td>331349</td>
<td>68.6%</td>
<td>69.45%</td>
<td>6.66%</td>
<td>0.77%</td>
<td>14.23%</td>
<td></td>
</tr>
<tr>
<td>Blacks</td>
<td>33264</td>
<td>10.1%</td>
<td>10.21%</td>
<td>1.33%</td>
<td>0.17%</td>
<td>67.29%</td>
<td></td>
</tr>
<tr>
<td>Hispanics</td>
<td>28681</td>
<td>14.6%</td>
<td>13.62%</td>
<td>3.04%</td>
<td>98.76%</td>
<td>14.43%</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>22979</td>
<td>6.7%</td>
<td>6.72%</td>
<td>88.97%</td>
<td>0.30%</td>
<td>4.05%</td>
<td></td>
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<tr>
<td>Marital Status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Married</td>
<td>239022</td>
<td>63.7%</td>
<td>63.86%</td>
<td>62.46%</td>
<td>54.42%</td>
<td>47.80%</td>
<td></td>
</tr>
<tr>
<td>Not Married</td>
<td>179991</td>
<td>36.3%</td>
<td>36.14%</td>
<td>37.54%</td>
<td>45.58%</td>
<td>52.20%</td>
<td></td>
</tr>
<tr>
<td>Employment Status by State Respondents</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Employed</td>
<td>210727</td>
<td>58.6%</td>
<td>58.76%</td>
<td>65.53%</td>
<td>47.66%</td>
<td>68.51%</td>
<td></td>
</tr>
<tr>
<td>Not Employed</td>
<td>208047</td>
<td>41.4%</td>
<td>41.24%</td>
<td>34.47%</td>
<td>52.34%</td>
<td>31.49%</td>
<td></td>
</tr>
<tr>
<td>Sex by State Respondents</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.233</td>
</tr>
<tr>
<td>Male</td>
<td>160053</td>
<td>48.8%</td>
<td>48.80%</td>
<td>50.67%</td>
<td>47.54%</td>
<td>46.74%</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>260428</td>
<td>51.2%</td>
<td>51.20%</td>
<td>49.33%</td>
<td>52.46%</td>
<td>53.26%</td>
<td></td>
</tr>
<tr>
<td>Education by State Respondents</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>College Graduate</td>
<td>142518</td>
<td>36.2%</td>
<td>36.29%</td>
<td>28.47%</td>
<td>31.54%</td>
<td>27.01%</td>
<td></td>
</tr>
<tr>
<td>Not College Graduate</td>
<td>276859</td>
<td>63.8%</td>
<td>63.71%</td>
<td>71.53%</td>
<td>68.46%</td>
<td>72.99%</td>
<td></td>
</tr>
<tr>
<td>Income by State Respondents</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>&lt;35k</td>
<td>106717</td>
<td>23.1%</td>
<td>22.67%</td>
<td>22.03%</td>
<td>55.67%</td>
<td>29.63%</td>
<td></td>
</tr>
<tr>
<td>35–&lt;75k</td>
<td>161127</td>
<td>36.6%</td>
<td>36.74%</td>
<td>44.00%</td>
<td>20.89%</td>
<td>39.20%</td>
<td></td>
</tr>
<tr>
<td>75+k</td>
<td>98376</td>
<td>26.6%</td>
<td>28.90%</td>
<td>16.42%</td>
<td>4.28%</td>
<td>18.26%</td>
<td></td>
</tr>
<tr>
<td>Don't Know/Refused</td>
<td>53887</td>
<td>11.8%</td>
<td>11.68%</td>
<td>17.53%</td>
<td>19.17%</td>
<td>12.90%</td>
<td></td>
</tr>
</tbody>
</table>
The U.S. Virgin Islands had the highest employment rates (69%) and proportion of Blacks (67%), but also had the lowest marriage rates (48%, All P < 0.001). The United States mainland had the largest proportion of college graduates (36%) and individuals with a total household income of $75,000 or more (All P < 0.001). Puerto Rico had the largest proportion of Hispanics (99%) and population of those in the lowest income category (i.e., <$35,000; 56%, All P < 0.001).

Differences among locations of residence and health behaviors

Differences in prevalence of health behaviors are reported in Table 2. Compliance to fruit and vegetable consumption (29%) and non-smoking (93%) was highest in the U.S. Virgin Islands (All P < 0.001). The United States mainland had the highest physical activity compliance (49%), while Puerto Rico had the lowest physical activity compliance rates (27%, P < 0.001). Also, Puerto Rico had the lowest fruit and vegetable compliance rates (18%; P < 0.001) and Guam had the largest proportion of adults with a healthy body mass index (BMI) (37%, P < 0.001) (Centers for Disease Control and Prevention regards a healthy body mass index (BMI) as ≥18.5 to ≤ 25 kg/m²).

<table>
<thead>
<tr>
<th>Table 2. Lifestyle Behavior Compliance Rates by Location of Residence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Fruit and vegetable compliance</td>
</tr>
<tr>
<td>Met recommendation</td>
</tr>
<tr>
<td>Did not meet recommendations</td>
</tr>
<tr>
<td>Physical activity compliance</td>
</tr>
<tr>
<td>Met recommendation</td>
</tr>
<tr>
<td>Did not meet recommendations</td>
</tr>
<tr>
<td>Overweight and obesity</td>
</tr>
<tr>
<td>Healthy BMI (≥18.5 to &lt;25 kg/m²)</td>
</tr>
<tr>
<td>Unhealthy BMI (&gt;25.0)</td>
</tr>
<tr>
<td>Smoking goal by location</td>
</tr>
<tr>
<td>Non-smokers</td>
</tr>
<tr>
<td>Smokers</td>
</tr>
</tbody>
</table>

Adjusted for confounders, comparisons among locations of residence and health behaviors

Tobacco use. When compared to the United States mainland, the odds of not smoking was higher for the U. S. Virgin Islands (P < 0.01) and Puerto Rico (P < 0.01), but lower for Guam (P < 0.001).

Overweight and obesity. When compared to the United States mainland, the odds of meeting guidelines for overweight and obesity was lower for Puerto Rico (P <0.05), but not significantly different for the U.S. Virgin Islands (P > 0.05) and Guam (P > 0.05).

Fruit and vegetable intake. When compared to the United States, the odds of meeting guidelines for fruit and vegetable intake was greater for the U.S. Virgin Islands (P < 0.01), not significantly different for Guam (P > 0.05), and lower for Puerto Rico (P < 0.01).
Physical activity. When compared to the United States mainland, the odds of meeting physical activity guidelines were lower for Puerto Rico (P < 0.01) and the U.S. Virgin Islands (P = 0.012), but not significantly different for Guam (P > 0.05).

Table 3. Adjusted Odds Associated with Select Health Behaviors by Location of Origin

<table>
<thead>
<tr>
<th></th>
<th>Mainland</th>
<th>Guam</th>
<th>Puerto Rico</th>
<th>Virgin Islands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit and vegetable compliance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Odds ratio 95% CI</td>
<td>-1-</td>
<td>1.08</td>
<td>0.73</td>
<td>1.39</td>
</tr>
<tr>
<td>(95% CI)</td>
<td></td>
<td>(0.91 – 1.28)</td>
<td>(0.65 – 0.81)</td>
<td>(1.23 – 1.57)</td>
</tr>
<tr>
<td>Physical activity compliance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Odds ratio 95% CI</td>
<td>-1-</td>
<td>0.88</td>
<td>0.44</td>
<td>0.83</td>
</tr>
<tr>
<td>(95% CI)</td>
<td></td>
<td>(0.76 – 1.03)</td>
<td>(0.40 – 0.49)</td>
<td>(0.74 – 0.93)</td>
</tr>
<tr>
<td>Overweight and obesity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Odds ratio 95% CI</td>
<td>-1-</td>
<td>1.14</td>
<td>0.87</td>
<td>0.96</td>
</tr>
<tr>
<td>(95% CI)</td>
<td></td>
<td>(0.97 – 1.32)</td>
<td>(0.79 – 0.96)</td>
<td>(0.86 – 1.09)</td>
</tr>
<tr>
<td>Smoking goal by location</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Odds ratio 95% CI</td>
<td>-1-</td>
<td>0.79</td>
<td>2.59</td>
<td>3.86</td>
</tr>
<tr>
<td>(95% CI)</td>
<td></td>
<td>(0.66 – 0.94)</td>
<td>(2.24 – 2.99)</td>
<td>(3.12 – 4.79)</td>
</tr>
</tbody>
</table>

Healthy People 2010 target goals

Puerto Rico (11%) and the United States Virgin Islands (6.7%) were the only two locations to meet the Healthy People 2010 target goal of ≤12.0% of the adult population being non-smokers in 2009. The United States mainland and Guam continue to have high reported rates of smokers at 18.2% and 25.4%, respectively. None of the four locations met the Healthy People 2010 target goals of 60% of the adult population achieving a healthy BMI, increasing the proportion of persons aged two and older who consumed at least two fruits per day (75.0%) and three vegetables per day (50.0%) or increasing the proportion of adults who engaged in regular moderate-intensity physical activity for at least 30 minutes per day to at least 50.0%. Puerto Ricans reported the lowest rates of participation in moderate-intensity physical activity (27.2%).

Summary

Hypothesis one – (citizens of United States mainland will report greater adherence to healthy lifestyle characteristics than citizens of the territories). For hypothesis one, there was support for physical activity; two of the three territories (i.e., Puerto Rico and the U.S. Virgin Islands) had lower odds of meeting the guidelines; for one territory, there was no difference (i.e., Guam). There was limited support for healthy body mass index; one of the three territories (i.e., Puerto Rico) had lower odds of meeting the standard; there was no difference for two territories (i.e., U.S. Virgin Islands and Guam). There was no support for fruit and vegetable consumption. U.S. Virgin Islands had greater odds to meet the guidelines; no difference for Guam; lower odds for Puerto Rico. For smoking, there was no support for hypothesis one; two of three territories (i.e., U.S. Virgin Islands and Puerto Rico) had greater odds of not smoking than the United States mainland. Overall, there was partial support (two of the four characteristics) for hypothesis one.

Hypothesis two – (citizens of the mainland will meet more of the Healthy People’s 2010 target goals than citizens of the territories). For all four lifestyle characteristics, there was no support for hypothesis two. For three of the four Healthy People 2010 goals (i.e., healthy body...
DISCUSSION

The most significant differences between the mainland and territories were the percentages of those with a healthy body mass index and those who consumed recommended servings of fruits and vegetables. Significantly lower proportions of fruit and vegetable consumption and participation in recommended physical activity were reported in Puerto Rico compared to the mainland. A greater number of U.S. Virgin Islanders and U.S. mainlanders reported participation in regular physical activity than Puerto Ricans. While there were similarities in some of the rates comparing the mainland to each one of the territories, comparing the territories collectively to the mainland revealed several statistically significant differences. When comparing the three territories to each other, Puerto Rican’s participation in the Healthy Lifestyle Characteristics was much lower than Guam’s or the U.S. Virgin Islands’ except for non-smoking rates.

Smoking

The proportion of non-smoking United States mainlanders was significantly lower than the proportion of non-smoking U.S. Virgin Islanders and Puerto Ricans. The high non-smoking rates may be the result of extensive anti-tobacco campaigns and local government crackdown on tobacco use in the U.S. Virgin Islands (Bly, 2006). In fact, the U.S. Virgin Islands’ Health Department has become the enforcer of the smoke-free air law passed in 2011 (Associated Press, 2016). Another factor to consider as to why the smoking prevalence is greater on Guam could be the long, predominant history of military presence. The military represents approximately 15,000 individuals or nearly 9 percent of the total island population (Lee, 2009). Research shows that military personnel have been actively targeted by tobacco companies for decades, resulting in high rates of tobacco usage among this population (Arvey & Malone, 2008; Smith, & Malone, 2009). Importantly, big tobacco has been targeting youth in developing countries for decades (Doku, 2010).

Body Mass Index

A healthy body mass index (BMI) is generally accepted as ≥18.5 to ≤ 25 kg/m². Having a BMI between 25.1 and 29.9 is considered unhealthy and individuals are classified as overweight. Individuals with a BMI ≥30.0 are considered obese and at high risk for multiple health problems (American Heart Association, 2010a; Centers for Disease Control and Prevention, 2009). None of the locations met the Healthy People 2010’s target goal of 60.0 percent of the adult population having a healthy weight (United States Department of Health and Human Services, 2009). To reduce BMI, consuming fruits and vegetables and regular physical activity are essential (American Heart Association, 2010b; United States Department of Health and Human Services, 2009). One consideration for the overall healthier BMI levels reported in Guam versus the mainland and other two territories is that the natives’ traditional diet primarily consists of rice and grains. Although literature suggests that the Guamanian diet has been influenced by American culture, Guamanians
still tend to gravitate to their predominantly vegetarian diet with some meats, seafood, and lots of grains (Pollock, 1986; Pobocik, Trager, & Monson, 2008). Pobocik et al. (2008) even suggested that Guamanians consumption of more frequent meals throughout the day may decrease the tendency for overweight and obesity (Pobocik, Trager, & Monson, 2008).

Not surprising that the greater rates of unhealthy body mass indices in Puerto Rico compared to the mainland and the other two territories are consistent with lower reported consumption of fruits and vegetables and lower reported participation in physical activity compared to the mainland and the other two territories. The literature consistently shows that Puerto Ricans, both on the mainland and the island, struggle with high rates of overweight and obesity (Aponte, 2009; Ho et al., 2006; Ryan, 2007; Whitman, Silva, & Shah, 2006). These rates often lead to many health problems in this population including Type II diabetes (Aponte, 2009; Coustasse, Bae, Arvidson, Singh, & Trevino, 2009). Researchers have implicated several possible factors which likely contribute to these rates including culture, the traditional Latino diet (Associated Press, 2016; Diaz, Mainous, & Pope, 2007; Ryan, 2007; Viladrich, Yeh, Bruning, & Weiss, 2009), greater costs for healthier foods such as fruits and vegetables in Puerto Rico and the decreased intake of such foods (Immink, Sanjur, & Burgos, 1983). Moreover, the influence of American cuisine and the influx of fast food restaurant chains onto the island (Gans, 2002; Ramirez, 1991) have been cited as factors. Furthermore, Puerto Ricans reported lower rates of physical activity than any other location in the Behavioral Risk Factor Surveillance System (Chowdhury et al., 2007; Kilmer et al., 2008). Researchers have found that Puerto Ricans on the mainland as well as the island report more sedentary lifestyles (Ho, 2006; Melnik, Spence, & Hosler, 2006; Tucker, Bermudez, & Castaneda, 2000).

Fruit and Vegetable Consumption

Of the four locations, United States Virgin Islanders consumed more fruits and vegetables than any of the other areas while reported fruit and vegetable consumption on Guam was similar to mainlanders. This finding may be because of the abundance of agricultural products available on the islands including many different fruits. The consistently mild temperatures coupled with volcanic soil allow for optimum growing conditions in very fertile soil (Arnalds & Stahr, 2004; Shoji & Takashasi, 2002). As previously discussed, the Guamanian diet is largely vegetarian which might account for the greater rate of fruit and vegetable consumption (23.6%) in this population as compared to the Puerto Ricans (17.5%) whose diet is high in fat, carbohydrates, and sugars as noted earlier. The overall rates of fruit and vegetable consumption among the United States mainland, Guam, and the U.S. Virgin Islands, although greater than Puerto Rico’s rates of consumption, did not meet the Healthy People 2010 goal of a 50.0% to 75.0% consumption rate (United States Department of Health and Human Services, 2009).

Physical Activity

Individuals living in Guam reported greater percentages of healthy body mass indices as well as greater participation in regular physical activity as compared to Puerto Rico and the U.S. Virgin Islands. Again, the high military presence on Guam is a possible explanation, particularly for physical activity, when comparing Guam versus Puerto Rico and the U.S. Virgin Islands. As noted earlier, military personnel have been actively targeted by tobacco companies. However, it is known and documented that military personnel have a standard appearance policy to which they must conform (Naghii, 2006). Not only is it desirable for soldiers to look physically fit, better health means greater capability to perform job requirements as well as reduced healthcare costs.
costs related to overweight and obese personnel (Naghii, 2006). In order to help soldiers maintain a healthy BMI, military drills that include physical activity are a consistent part of their day. The significant differences in reported physical activity participation levels between U.S. Virgin Islanders versus mainlanders and Guamanians may be attributed to the extremely high rates of poverty as well as low education levels among U.S. Virgin Islanders. Research indicates 28.9% of the U.S. Virgin Islands’ population lives below the poverty line and the U.S. Virgin Islands ranks 192 out of 233 countries with adults in the labor force, with as much as 13% of the island’s workers being unemployed (Central Intelligence Agency, 2017; U.S. Virgin Islands Bureau of Economic Research, 2016).

**Limitations**

Limitations are that the variables selected from the Behavioral Risk Factor Surveillance Survey (BRFSS) were self-reported. Participants may have over- or under-estimated their consumption of fruits and vegetables as well as physical activity. Additionally, participants could have over- or under-estimated their height and weight which would affect their calculated BMI. Another limitation is that the survey was conducted via telephone. This procedure may have excluded willing participants who did not have a home telephone number. To account for this possibility, the data were weighted to maximize generalizability to the entire population.

**Strengths**

Strengths of the study are using the only known national survey with data available to analyze all four locations. The use of the same dataset ensures consistency and validity. Potential confounders such as gender, age, education, and income levels were controlled for in this analysis. This research is the first known study to compare the four characteristics (considered essential for health) between the mainland and three United States territories. We recommend future studies replicate the procedures in this study with Healthy People 2020 and more recent versions of BRFSS when all four areas and all four health behaviors are included which has not been the case since 2009. Longitudinal studies can evaluate trends over time and assess the effectiveness of health promotion initiatives. In addition, the analysis used in this study can be applied to other areas related to the United States such as American Samoa and Northern Mariana Islands.

**CONCLUSION**

Because of their status as territories of the United States, Puerto Ricans as well as Guamanians have frequently struggled with a lack of parity when compared to their peers on the mainland (Crespo et al., 2002; Kinzer, 2006; Landale & Oropesa, 2002; Perez, 2002; Pimentel, 2008; Statham, 1998; Roman, 2002). Results of this study confirmed some differences between the mainland population’s health and that of territorial residents. Additionally, this research found that none of the locations achieved all Healthy People 2010 target goals for non-smoking, maintaining a healthy weight, consuming fruit and vegetables, or participating in regular, moderate-intensity physical activity.

Furthermore, using the four characteristics, Puerto Ricans’ health experiences were very different (less favorable) compared to the United States mainland, Guam, and the U.S. Virgin Islands. Fundamental needs such as shortages of health care, funding inequities, and costs of living require urgent attention (Pupillo, 2014). As Puerto Ricans recover from Hurricane Maria...
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(September 2017) and strive to establish stability, long range planning can examine the environment, programs, and policies to promote healthy lifestyles. The curious relationship between the territories and the United States mainland is amplified by debates in the United States Congress about funding to Puerto Rico for category 4 – Hurricane Maria.

Overall, this research supports the need for continued public health promotion and disease prevention programs. The findings demonstrate the need for ongoing programs that provide education and effective interventions to promote healthy lifestyle behaviors for all United States citizens, including the mainland and all territories.

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