ASSESSING HEALTH-RELATED QUALITY OF LIFE IN NORTHERN PLAINS AMERICAN INDIANS: PROMINENCE OF PHYSICAL ACTIVITY AS A HEALTH BEHAVIOR

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Abstract: Associations of behavioral health risks and healthy behaviors with self-reported health-related quality of life measures were investigated in a Northern Plains American Indian sample. Participants were surveyed in person using the Behavioral Risk Factor Surveillance Survey. The results showed that regular physical activity was significantly associated with better self-reported overall health, fewer mentally unhealthy and activity limitation days in the past 30 days, and with a greater number of good health days.

INTRODUCTION

Health disparities among various ethnic groups in the U.S. between 1997 and 2000 were particularly prominent among American Indians and Alaska Natives (AI/ANs), who were more likely to report higher obesity rates (BMI $\geq$ 30) than were members of other racial/ethnic groups (23.9% vs. 18.7%). They were also more likely to suffer from diabetes (9.7% vs. 5.7%), and to show higher rates of cigarette smoking (32.2% vs. 22.3%), greater lack of leisure-time physical activity (32.5% vs. 27.5%), and slightly greater rates of binge drinking (23.9% vs. 22.0% for men; 8.8% vs. 7.4% for women; (Zahran et al., 2005). The deleterious effects of these physical and behavioral factors on morbidity and mortality are well established (Blair & Brodney, 1999; Centers for Disease Control and Prevention [CDC], 1994; Koop & Luoto, 2006; Sher, Grekin, & Williams, 2005). There is also a growing body of evidence linking the above risk factors to health-related quality of life (HR-QOL) measures.

HR-QOL measures have been developed by the Centers for Disease Control and Prevention (CDC) for use in surveys and have been reaffirmed in Healthy People 2010 as a valuable tool for reaching the goals of increasing quality and years of healthy life and eliminating health disparities

(U.S. Department of Health and Human Services, 2000). HR-QOL measures have been included in the annual Behavioral Risk Factor Surveillance Survey (BRFSS) survey to assess four domains: participants' self-rated overall health, recent activity limitations, recent physical health, and recent mental health.

This four-pronged approach to health assessment has been further validated by Idler and Angel (1990), who found that, while a majority of respondents used physical health criteria in evaluating their health, many also perceived their health in terms of physical functioning, social role activities they were not capable of, and emotional or spiritual well-being. Additionally, according to a review by Idler and Benyamini (1997) self-ratings of physical and mental health consistently predicted survival beyond other health indicators of mortality risk (e.g. blood pressure, serum cholesterol level, body mass index, prescription medication use, chronic conditions). These findings suggest that subjective health ratings may be fairly accurate and useful indicators of health status.

According to the CDC BRFSS report evaluating HR-QOL between 1993 and 2001, AI/ANs reported poorer overall health and a greater number of physically and mentally unhealthy days than many other ethnic groups, as well as the highest number of activity limitation days of any ethnic group (Zahran et al., 2005). Similar findings were reported by Gilliland and Davis (1998) in a study of AIs in rural New Mexico. The investigators observed the lowest self-reported ratings on HR-QOL measures in AIs compared to the overall New Mexico and U.S. populations.

Behavioral health risks and healthy behaviors have also been found to influence HR-QOL measures. For example, Stranges et al. (2006) found that unhealthy alcohol consumption (i.e., experiencing at least one episode of intoxication in the past 30 days) was associated with poorer reported mental health in women and poorer physical health in men. Laaksonen, Rahkonen, Martikainen, Karvonen and Lahelma (2006) reported that smokers consistently gave lower ratings to their general, physical, and mental health than non-smokers, while Croghan et al. (2005) found that smokers abstaining from cigarette smoking for a year following a cessation program reported better overall health, as well as better physical and mental health, than those who continued to smoke. Recently, Kostka and Bogus (2007) reported significantly lower overall health scores for elderly (over 65 years old) overweight (BMI 25 to <30) and obese (BMI ≥ 30) community-dwelling adults compared to an age-matched normal-BMI (20 to <25) group. The researchers also observed a significant negative relationship between reported levels of moderate physical activity and overall health. Similarly, other authors have reported an inverse relationship between physical activity levels and poor HR-QOL outcomes regardless of the BMI category, age group, sex, health care coverage, education, income, or ethnicity (e.g., Phillips & Blanton, 2005; Kruger, Jones, Ainsworth, & Kohl, 2007; Abu-Omar & Robine, 2004).

In AI/AN samples, a positive association has been found between physical activity and overall health (Coble & Rhodes, 2006). Furthermore, a number of studies in AI communities have shown a negative association between physical activity and BMI (e.g. Whitt, DuBose, Ainsworth, & Tudor-Locke 2004; Esparza et al., 2000). Whitmer, Hensel, Holck, Ammerman, and Will (2004) have also reported that a 12-week physical activity program significantly reduced cardiovascular risk in AN women. Additionally, research evidence suggests that physical activity in AI/ANs is strongly influenced by social support. Specifically, Thompson, Wolfe, Wilson, Pardilla, and Perez (2003) reported that those AI participants who knew people who exercised were 5 times more likely to engage in some form of physical activity than those who did not. Conversely, lack of social support has been perceived by AI women to be the greatest barrier to the increase in physical activity levels (Heesch, Brown, & Blanton, 2000).

These findings suggest multiple relationships between physical activity, HR-QOL measures, and behavioral health risks (i.e. cigarette smoking, excess alcohol consumption, high BMI). Yet comprehensive multivariate modeling of such relationships in AI/AN populations is not routinely found in research literature. Investigation of such associations in AI/AN populations can help direct public health initiatives in respective communities by focusing efforts on attenuation of specific risks and promotion of specific health behaviors. The purpose of the present study was, thus, to explore these relationships in an AI sample using personal interviews as a method of data collection. Most previous studies on health disparities in AI populations relied on combined responses from several years of BRFSS administration over the phone (e.g., Denny & Holtzman, 1999; Denny, Holtzman, & Cobb, 2003). Telephone-based survey procedures may underestimate behavioral risk factors and health problems because of selection bias, especially in ethnic minority samples residing in ethnic communities and tribal/reservation areas (Pearson, Cheadle, Wagner, Tonsberg, & Psaty 1994; Giulino et al., 1998; Donovan, Holman, Corti, & Jalleh, 1997). Additionally, the great cultural diversity of the U.S AI/AN population (there are 562 federally recognized tribes and numerous tribes not recognized by the U.S. government) can lead to inaccuracies when health data are reported in aggregate for AI/ANs from different regions.

METHOD

Participants and Sampling Procedures

A convenience sample, consisting of members of four AI tribal communities located on the Northern Plains of the U.S. (mostly North Dakota territory), participated in the present study. The study was approved by the Institutional Review Board of the University of North Dakota and the governing councils of the participating tribes. Each tribe retained ownership of its data; however, the researchers were allowed to use the data in aggregate format for report and publication purposes.

The estimated adult population of the area surveyed was 13,061 (North Dakota Indian Affairs Commission, 2005; U.S. Census Bureau, 2000). Thus, to obtain a representative sample sensitive to effect sizes of small-to-medium magnitude with the minimal power of .80, a 95% confidence level and a 5% error rate, we needed to recruit 400 participants (see the Statistical Analyses section for more information). Housing officials from each participating tribal group provided lists of tribal members' addresses within their respective geographical areas (i.e., reservations or, in one case, an Indian Health Service Area). These lists are constantly updated and maintained by tribal governments to provide information that is as accurate as possible regarding current residences of tribal members. Stratified random sampling was used to select 125 household addresses from each of the four tribal communities. Only one adult (18 years or older) in each household was eligible for inclusion in this study, so in households with more than one adult, the adult with the most recent birthday was invited to participate. Members from each of the four participating tribal communities were trained as interviewers by the project senior researchers on the premises of the School of Medicine and Health Sciences at the University of North Dakota, and interviewing was completed between February and December 2004.

Interviewers administered a computer-assisted personal interview to survey participants, who volunteered to participate and signed a corresponding consent form. Upon completion of the survey, all participating households were given $30 gift cards. All interviews were conducted one-on-one in English in the participants' homes. To the knowledge of the researchers none of the participants reported English language proficiency problems. A total of 404 participants completed the interview in its entirety. There were no incomplete interviews. Ten participants declined to participate and 86 households were considered unresponsive after three attempts to contact their members. Using the conservative method recommended by the Council of American Survey Research Organizations (American Association for Public Opinion Research, 2008), the response rate was 80.8%.

Instrument

The current study used the 2003 version of the BRFSS survey, administered in its entirety with all core sections and optional modules, and without any modifications to either the question language or question order (CDC, 2007). Questionnaire Programming Language (QPL) software version 4.1 (Dooley, 1999) was used to format the BRFSS survey as a computer-assisted personal interview, which was then installed on laptop computers used by the interviewers.

Criterion measures

Consistent with CDC recommendations (1994) five criterion variables based on four BRFSS questions related to HR-QOL were used in the study:

- *Overall health* ratings (excellent, very good, good, fair, and poor). This variable was based on the question "Would you say that in general your health is excellent, very good, good, fair, or poor?"
- *Unhealthy physical days* (number of days in the past month on which the participants' physical health was not good). This variable was based on the question "Now thinking about your physical health, which includes physical illness and injury, for how many days during the past 30 days was your physical health not good?"
- *Unhealthy mental days* (number of days in the past month on which the respondents' mental health was not good). This variable was based on the question "Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?"
- *Activity limitation days* (number of days in the past month on which the participants' poor physical or mental health interfered with their regular daily activities). This variable was based on the question "During the past 30 days, for about how many days did your poor physical or mental health keep you from doing your usual activities such as self-care, work, or recreation?"

- *Good health days* (GHD: number of days in the past month on which the respondents' overall health was good). This last variable is derived by subtracting the sum of "not good" physical health days and "not good" mental health days from 30 days, with the restriction that the number of GHDs cannot be less than zero (CDC, 1994). The BRFSS findings showed that the GHD index can identify differences in reported good health among population subgroups and in relation to key factors (e.g., annual household income, education).

Predictor Measures

Behavioral Health Risks

For the purposes of the present study, behavioral health risks were defined as behaviors and conditions that are linked with the leading causes of death—heart disease, cancer, stroke, diabetes, and injury—and with other important health issues. Cigarette smoking, as a behavioral health risk, included the following categories: *current smokers* (those who reported having smoked at least 100 cigarettes in their lifetime and now smoke either every day or some days), *never-smokers* (those who reported they had not smoked 100 cigarettes in their lifetime) and *former smokers* (those who reported having smoked at least 100 cigarettes in their lifetime and currently do not smoke).

Alcohol consumption categories included *unhealthy use* (those either at risk for binge drinking, defined as 5 or more drinks on at least one occasion in the past 30 days, or heavy alcohol use, defined as 3 or more drinks per day for men and 2 or more drinks per day for women in the past 30 days), *abstinence* (those who did not have an alcoholic beverage within the 30-day period preceding the interview), and *healthy use* (those whose alcohol consumption during the 30 days preceding the interview was within healthy limits, defined as 1-2 drinks per day for men and 1 drink per day for women).

Body Mass Index (BMI) was used in the analysis as a continuous predictor variable with raw BMI values listed for each participant.

Disease conditions

Presence of a disease condition included the following categories: *those who had one disease condition* (arthritis, diabetes, asthma, coronary heart disease, previous heart attack or stroke), *those who had two or more of the above disease conditions; those who were at risk for a disease* (reported elevated blood cholesterol or blood pressure)*;* or *those reporting no disease condition or risk.*

Healthy behaviors

In this study, healthy behaviors were defined as behaviors associated with reduced risk for many diseases, including the three leading causes of death: heart disease, cancer, and stroke. Physical activity, as a healthy behavior, included the following two categories: those who *met recommendations from the CDC and American College of Sports Medicine (AMCSM) for either moderate* (150 minutes per week: at least 30 minutes 5 times per week) *or vigorous physical activity* (60 minutes per week: at least 20 minutes 3 times per week), and *those who did not fulfill recommendations for either type of physical activity* (Pate et al., 1995). The physical activity questions used in the 2003 version of the BRFSS survey targeted daily moderate physical activity lasting for at least 10 minutes (e.g., brisk walking, bicycling, vacuuming, gardening) and vigorous physical activity lasting for at least 10 minutes (e.g., running, aerobics, heavy yard work). These types of activities are done primarily during leisure time.. To avoid potential misclassification, later that year the CDC recommended adding routine daily activities (which may include those performed at work) into the determination of whether moderate physical activity requirements have been met (Whitt, Levin, Ainsworth, & Dubose, 2003). Thus, the physical activity module was extended to include a question about activities most commonly performed at work. For example, in this study, 25.6% of the employed participants reported "mostly walking" as part of their job. Therefore, participants who did not meet the recommended criteria for either moderate or vigorous physical activity, but reported mostly walking at work, were assigned to the category of those who met physical activity requirements. Such assignment was based on the assumption that even 1 hour of walking per day at work 5 times per week would result in 300 minutes of moderate physical activity per week, which is well above the recommended minimum of 150 minutes per week.

Fruit and vegetable consumption included 2 categories: *those who consumed five or more servings of fruits and vegetables per day*, and *those who did not*. Calculation of daily servings was based on 6 questions referring to either daily, weekly, monthly, or yearly consumption of particular types of fruits and vegetables. Within each frequency category (e.g., daily, weekly), the reported number of servings was summed across all 6 questions and divided by a corresponding denominator (e.g., weekly servings were divided by 7). Cumulative daily servings for each frequency category then were summed to obtain the total number of daily servings of fruits and vegetables.

Demographic Variables

Other predictors included in the analyses were demographic variables such as *sex, age, marital status* (non-single, i.e., married or living with a partner, or single, i.e., never married, widowed, divorced, or separated), *education level, annual household income*, and *having a personal doctor/health care provider.*

Statistical Analyses

A series of linear multiple regressions using SPSS 15.0 (SPSS, 2006) was conducted to determine individual relationships of health risk factors, healthy behaviors, and BMI, as well as demographic variables, with each of the five HR-QOL measures. Using GPOWER 3.7 (Faul, Erdfelder, Lang, & Buchner, 2007) we determined that with 12 predictor variables, 404 participants, power of .80 and alpha level of 0.05, an omnibus R^2 test on each dependent measure was sensitive to effect sizes of small-to-medium magnitude ($f^2 = 0.05$).

RESULTS

All demographic, physical, and behavioral characteristics of the sample are presented in Table 1. Approximately 46% of the participants reported suffering from at least one of the surveyed disease conditions, approximately 55% reported being current smokers, 27% consumed alcohol in unhealthy amounts, 52% reported having a personal doctor/health care provider, 48% did not meet recommendations for either moderate or vigorous physical activity, and approximately 82% reported consuming fewer than five servings of fruits and vegetables daily.

Table 1
Descriptive Statistics for Demographic, Health Status, Behavioral, and Health Outcome Variables for American Indian Participants from the Northern Plains of the U.S. (N=404)[1]

Predictor	Percent (n)/ Mean[2]	Standard Error (%)	95% Confidence Interval	
			Lower	Upper
Sex				
Male	36.4 (147)	2.4	31.8	41.2
Female	63.6 (257)	2.4	58.8	68.2
Age	40.38	.80	38.81	41.96
Marital status				
Single	56.1 (226)	2.5	51.2	60.9
Non-single	43.9 (177)	2.5	39.1	48.8
Education				
Less than high school	25.1 (101)	2.2	21.1	29.5
High school graduate/ GED	35.0 (141)	2.4	30.5	39.8
Some college	29.5 (119)	2.3	25.3	34.2
College graduate or higher	10.4 (42)	1.5	7.8	13.8

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Table 1, Continued
Descriptive Statistics for Demographic, Health Status, Behavioral, and Health Outcome Variables for American Indian Participants from the Northern Plains of the U.S. (N=404)[1]

Predictor	Percent (n)/ Mean[2]	Standard Error (%)	95% Confidence Interval	
			Lower	Upper
Annual household income				
Under $15,000	57.7 (226)	2.5	52.7	62.5
$15,000 - $24,999	19.1 (75)	2.0	15.5	23.3
$25,000 - $34,999	7.9 (31)	1.4	5.6	11.0
$35,000 - $49,999	9.7 (38)	1.5	7.1	13.1
Over $50,000	5.6 (22)	1.2	3.7	8.4
BMI	29.98	.31	29.37	30.59
Health status				
No risk or disease	46.0 (186)	2.5	41.2	50.9
High BP or cholesterol	8.4 (34)	1.2	6.1	11.6
One disease condition present	27.5 (111)	2.2	23.3	32.1
Two or more disease conditions present	18.1 (73)	1.9	14.6	22.1
Smoking status				
Never smoker	26.4 (106)	2.2	22.3	30.9
Former smoker	18.9 (76)	2.0	15.4	23.1
Current smoker	54.7 (220)	2.5	49.8	59.6
Personal doctor	52.0 (209)	2.5	47.1	56.9
Alcohol use				
No alcohol in past 30 days	52.4 (206)	2.5	47.5	57.3
Healthy alcohol use in past 30 days	20.6 (81)	2.0	16.9	24.9
Unhealthy alcohol use in past 30 days	27.0 (106)	2.2	22.8	31.6
Physical activity				
Physically active	52.0 (210)	2.5	47.1	56.8
Sedentary	48.0 (194)	2.5	43.2	52.9
Fruits and vegetables				
Does not meet 5+ requirement	81.5 (327)	1.9	77.4	85.1
Meets 5+ requirement	18.5 (74)	1.9	14.9	22.6
Overall health rating	2.93	.06	2.82	3.03
Physically unhealthy days	4.70	.44	3.83	5.57
Mentally unhealthy days	4.92	.47	4.00	5.84
Activity limitation days	3.66	.41	2.86	4.46
Good health days	22.06	.57	20.95	23.17

[1] On some questions data were not available for all 404 participants
[2] Means are reported for continuous variables: age; BMI; overall health rating; and number of physically unhealthy days, mentally unhealthy days, activity limitation days, and good health days.

In general, the sample was composed of middle-aged (mean age = 40), obese individuals (mean BMI = 30) whose health was, on average, "good," who reported approximately 5 days in the 30 days preceding the interview on which their physical health was not good, and an equal number of mentally unhealthy days. On approximately 4 of the preceding 30 days their poor physical and/or mental health imposed limitations on their daily activities, but on approximately 22 days the participants enjoyed good health (see Table 1).

Multiple regression analyses revealed that a model with all 12 predictors accounted for a significant amount of variance on all dependent measures ($p < 0.01$), with multiple correlation coefficients ranging from .29 for mentally unhealthy days (9% of variance explained) to .55 for overall health (30% of variance explained). Collinearity diagnostics did not reveal any apparent multiple collinearity problems, with tolerance values ranging from .65 to .98 and variance inflation factors being close to 1.

Overall Health

The largest portion of variance in the criterion explained by the model was observed for overall health (31% of the total variance explained). Women, older respondents, and those with less education and household income, as well as those with higher BMI and presence of a disease condition, were significantly more likely to report poorer overall health. Physical activity was the only behavioral variable to reach statistical significance ($p = .007$). Those who met the recommendations for weekly moderate or vigorous physical activity were significantly more likely to report better overall health than those who did not. While controlling for other variables, physical activity accounted for approximately 2% of the variance in the overall health measure (partial r = -.146; see Table 2 for details).

Table 2
Regression Analysis Summary for Demographic, Health, and Behavioral Variables Predicting Overall Health Ratings[1]

Predictor	Bivariate Correlation	Partial Correlation	Standardized β
Sex	.101	.123	.108*
Age	.343	.155	.161*
Marital status	-.025	.103	.093
Education level	-.264	-.198	-.180*
Annual income	-.227	-.149	-.143*
Health status	.395	.244	.259*

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Table 2
Regression Analysis Summary for Demographic, Health, and Behavioral Variables Predicting Overall Health Ratings[1]

Predictor	Bivariate Correlation	Partial Correlation	Standardized β
Body Mass Index	.234	.174	.153*
Smoking status	.054	.043	.037
Personal doctor	.086	-.019	-.017
Alcohol use	-.072	.027	.025
Physical activity	-.199	-.146	-.127*
Fruits and vegetables	.007	-.005	-.004

[1] $R^2 = .31$ ($p < .01$)
* $p < .05$

Physically Unhealthy Days

The full model accounted for 15% of the variance in the physically unhealthy days variable. Those indicating presence of a disease condition or a health risk and those who reported having a personal doctor/health care provider were significantly more likely to report a greater number of days in the 30 days preceding the interview when their health was not good. None of the other demographic or behavioral variables in the model were significant (see Table 3).

Table 3
Regression Analysis Summary for Demographic, Health, and Behavioral Variables Predicting Number of Physically Unhealthy Days in Past 30 Days[1]

Predictor	Bivariate Correlation	Partial Correlation	Standardized β
Sex	.003	-.032	-.031
Age	.241	.073	.083
Marital status	-.086	-.024	-.024
Education level	-.143	-.097	-.096
Annual income	-.130	-.068	-.071
Health status	.275	.131	.151*
Body Mass Index	.149	.082	.079
Smoking status	.033	.049	.047
Personal doctor	.220	.164	.166*
Alcohol use	-.108	-.022	-.023
Physical activity	-.119	-.077	-.074
Fruits and vegetables	.077	.050	.047

[1] $R^2 = .15$ ($p < .01$)
* $p < .05$

Mentally Unhealthy Days

Approximately 9% of the variance in the mentally unhealthy days variable was explained by the predictors included in the model. Female respondents, and respondents having a personal physician/health care provider, were significantly more likely to report a greater number of mentally unhealthy days during the 30-day period preceding the interview. Greater income, on the other hand, was associated with significantly better perceived mental health. Regular physical activity was the only behavioral variable associated with significantly fewer days on which the respondents thought that their mental health was not good. It accounted for approximately 2.5% of the variance in the dependent variable, providing the largest contribution to the prediction equation (see Table 4 for details).

Table 4
Regression Analysis Summary for Demographic, Health, and Behavioral Variables Predicting Number of Mentally Unhealthy Days in Past 30 Days[1]

Predictor	Bivariate Correlation	Partial Correlation	Standardized β
Sex	.142	.111	.112*
Age	.069	.003	.003
Marital status	-.053	.014	.015
Education level	-.062	-.008	-.008
Annual income	-.166	-.120	-.131*
Health status	.093	.030	.036
Body Mass Index	.077	.058	.058
Smoking status	.021	-.010	-.010
Personal doctor	.139	.110	.114
Alcohol use	-.035	.025	.027
Physical activity	-.163	-.158	-.158*
Fruits and vegetables	.016	.014	.014

[1] $R^2 = .09$ ($p < .01$)
* $p < .05$

Activity Limitation Days

A greater number of days on which poor physical or mental health interfered with the respondents' daily activities were predicted by the presence of a disease condition/health risk, lower annual household income, and presence of a personal doctor/health care provider. Nevertheless, if participants met the recommendations for either moderate or vigorous physical activity, they were significantly more likely to report fewer days of activity limitation in the 30-day period preceding the interview. Physical activity again provided the greatest contribution to the explanation of the variance in the criterion, accounting for 3.6% of the variance, compared with 15% of the variance explained by the entire model (see Table 5).

Table 5
Regression Analysis Summary for Demographic, Health, and Behavioral Variables Predicting Number of Activity Limitation Days in Past 30 Days[1]

Predictor	Bivariate Correlation	Partial Correlation	Standardized β
Sex	.032	-.008	-.007
Age	.142	-.001	-.001
Marital status	-.063	.006	.006
Education level	-.106	-.048	-.047
Annual income	-.164	-.109	-.115*
Health status	.207	.111	.128
Body Mass Index	.144	.093	.090
Smoking status	.082	.060	.058
Personal doctor	.216	.195	.198*
Alcohol use	-.044	.021	.022
Physical activity	-.212	-.192	-.186
Fruits and vegetables	-.002	-.018	-.017

[1] $R^2 = .15$ ($p < .01$)
* $p < .05$

Good Health Days

The overall model was effective in explaining approximately 13% of the variance in the variable associated with days on which the participants were considered to be in good health. Presence of a personal doctor/health care provider, higher BMI, and lower annual household income were associated with significantly fewer good health days. Those participants who did meet the recommendations for either moderate or vigorous physical activity were, again, significantly more likely to enjoy a greater number of good health days than those who did not. Physical activity accounted for approximately 1.4% of the overall variance in the dependent variable (see Table 6).

Table 6
Regression Analysis Summary for Demographic, Health, and Behavioral Variables Predicting Number of Good Health Days in Past 30 Days

Predictor	Bivariate Correlation	Partial Correlation	Standardized β
Sex	-.103	-.068	-.067
Age	-.151	-.024	-.028
Marital status	.073	-.002	-.002
Education level	.105	.047	.047
Annual income	.183	.124	.133
Health status	-.202	-.094	-.110
Body Mass Index	-.159	-.114	-.112*
Smoking status	-.050	-.042	-.041
Personal doctor	-.192	-.142	-.144*
Alcohol use	.073	.000	.000
Physical activity	.142	.117	.113*
Fruits and vegetables	-.036	-.023	-.022

[1] $R^2 = .13$ ($p < .01$)

* $p < .05$

DISCUSSION

The findings of poorer outcomes on HR-QOL measures associated with sex, annual household income, age, and BMI are not unexpected and are consistent with previously reported findings from the CDC (CDC, 1994; Zahran et al., 2005). Several findings warrant further discussion, including the absence of significant self-reported HR-QOL deterioration associated with either unhealthy alcohol or tobacco use, poorer HR-QOL outcomes in persons having a personal doctor/health care provider, and the apparent prominence of physical activity in contributing to perceived good health.

The lack of significant associations between smoking status and any of the HR-QOL measures could be explained, in part, by the absence of questions in the 2003 BRFSS version that assess smoking intensity. A previous CDC report indicated that a significant negative relationship between good health days and smoking status was observed only for persons who reported smoking 20 or more cigarettes per day (CDC, 1994). Similarly, Laaksonen et al. (2006) found that heavy smokers (defined as those smoking 20 or more cigarettes per day) reported poorer overall, physical, and mental health than either non-smokers or moderate smokers. Studies of mortality have likewise shown a dose-response relationship with the amount of smoking (Doll, Peto, Boreham, & Sutherland, 2004). Nevertheless, in 2001 the CDC shortened the BRFSS Tobacco Use module by excluding (among others) questions that addressed the number of cigarettes smoked per day, and subsequent versions of the instrument no longer contained such questions (CDC, 2008). While this modification may be warranted by an observed downward trend in cigarette smoking in the general population (CDC, 2005), questions assessing daily quantities of smoked cigarettes may be informative for researchers targeting subpopulations with higher prevalence of tobacco use (e.g., some AI/AN communities).

Furthermore, Hodge and Struthers (2006) reported tolerant attitudes toward and low perceived risk from cigarette smoking, as well as partiality and ritualistic behaviors associated with tobacco use among Northern Plains AIs. In combination, these factors may contribute to low perceived harmful effects of tobacco use on HR-QOL measures in our AI sample.

When assessing alcohol consumption, it may be important to distinguish between lifetime abstinence and non-current alcohol use, as the latter has been linked to the poorest self-reported physical and mental health, possibly due to prior unhealthy alcohol history (Stranges et al., 2006). In this study, we were unable to distinguish between the two groups, as the BRFSS questions addressing alcohol intake only referred to the 30 days preceding the interview. Independent sample *t*-tests between abstainers (n = 206) and problem drinkers (n = 106) in our sample revealed that problem drinkers reported better perceived health on virtually all HR-QOL measures. These differences reached statistical significance (alpha = 0.05) for measures of physical health and good health days. Consistent with the findings of Stranges et al., it is thus possible that the majority of the 30-day abstainers in this study were not lifetime abstainers.

Consumption of five or more servings of fruits and vegetables per day in the 30 days preceding the interview also did not have any apparent association with any of the HR-QOL variables. However, it is highly unlikely that compliance with the minimum recommended daily intake of fruits and vegetables in the preceding month could result in significant short-term benefits on self-reported measures of health. Thus, a more extended period of surveillance, covered by an appropriate question in the survey, may be necessary to detect any significant self-reported changes on these measures.

In this study, presence of a personal doctor/health care provider was associated with a significantly greater number of physically and mentally unhealthy days and activity limitation days, as well as fewer good health days. These results contradict the findings of Zahran et al. (2005), who reported poorer HR-QOL outcomes in the general population for those without health insurance and/or a personal doctor/health care provider. All respondents in the present study had free access to Indian Health Service (IHS) care, which generally addresses more acute and emergent conditions. Zuckerman, Haley, Roubideaux, and Lillie-Blanton (2004) reported that AI/ANs with only IHS coverage were significantly less likely than insured Whites to have had preventive services. AI/ANs in Zuckerman et al.'s study were also less likely than Whites to use basic medical care, including health professional/doctor visits, and were significantly more likely to visit an emergency room. Thus, those AI/ANs in Zuckerman et al.'s study who reported having a personal doctor/health care provider may have been more likely to suffer from a chronic physical or mental condition than those who did not. Consistent with this assumption, in our sample those participants who reported having a personal doctor/health care provider were significantly more likely to have one or more chronic medical conditions or health risks ($\chi = 9.85$, $p < .01$).

The only behavioral variable to reach statistical significance in predicting HR-QOL was sufficient weekly physical activity. This finding is particularly robust in view of the fact that, in our model, we controlled for underlying reported chronic illness and BMI, the two factors that have been found to predict a decline in physical activity levels in AIs (Fischer, Bialek, Homan, Livingston, & McMahon, 1999).

The results are consistent with the findings of Kruger et al. (2007) who showed an inverse relationship between physical activity levels and poor HR-QOL outcomes regardless of BMI and age group. Additionally, Phillips and Blanton (2005) found that after controlling for age, sex, health care coverage, education, income, ethnicity, BMI, diabetes, and arthritis, those individuals who did not report any type of leisure-time physical activity in the 2003 BRFSS data set for Texas were twice as likely to report fair or poor overall health than those who reported exercising in their leisure time. Similar findings were observed in national samples of countries within the European Union that were surveyed using the International Physical Activity Questionnaire (Abu-Omar & Robine, 2004). The results indicated a positive relationship between physical activity and self-rated overall health.

The positive effect of physical activity on HR-QOL measures may be of particular significance considering that the participants in this study reported a higher prevalence of obesity (49.4%), diabetes (13.8%), and coronary heart disease (6.6%) than were observed in the general population in North Dakota in 2004 and 2005 (24.6%, 5.9%, and 4.3%, respectively; Holm, Vogeltanz-Holm, Poltavski, & McDonald, 2010). Since the benefits of physical activity for the above conditions have been well established both in the general population and in AI populations (Imperatore, Cheng, Williams, Fulton, & Gregg, 2006; Irwin et al. 2000; Whitt et al., 2003; Yurgalevitch et al., 1998), promotion of physical activity in AI communities should become an important and urgent public health initiative. Moreover, according to the U.S. Department of Health and Human Services (2000), 46% of AIs report no leisure time physical activity, compared to 38% of their non-minority counterparts; similarly, in our sample, 48% of the respondents were classified as sedentary despite the inclusion of walking at work in the activity definition (see Table 1). This disparity mandates further emphasis on promotion of physical activity in this minority group.

However, research evidence suggests that there are multiple barriers to increasing regular physical activity in AI communities, some of which may be environmental or culture-specific. For instance, in one survey, Lakota adults residing on reservations in South Dakota identified fear of traffic while walking, lack of childcare facilities while exercising, and safety concerns associated with snake and dog attacks during outdoor physical activities, as well as social stigma (e.g., being teased by others for exercising), as some of the barriers preventing them from engaging in physical activity. In addition, they also identified more general barriers, such as lack of time, lack of willpower or motivation, and inclement weather (Harnack, Story, & Rock, 1999). Negative social stigma associated with physical activity in some AI communities may be related to perceptions of exercise as something done during leisure time outside of one's home and family responsibilities—something that was found to be incompatible with the lives of many AI women in a study by Tudor-Locke et al. (2003).

Thus, health promotion initiatives targeting physical activity for AIs should be community and culture-specific and should address both educational aspects of activity promotion (which may be necessary to counteract possible negative perceptions of exercise) and environmental limitations (e.g., opening of community centers, creation of outdoor walking trails, and either development of family-oriented physical activity programs or provision of child care for adults who are willing to exercise). Additionally, evaluation of physical activity should not necessarily be restricted to leisure-time activity only, and the very word 'leisure' could either be avoided altogether or be replaced by a more culturally acceptable term or phrase.

LIMITATIONS

These results must be considered in the context of certain limitations. First, our entire model was able to explain only a small portion of the variance on all HR-QOL measures, with physical activity accounting for only 3% of the variance at best. Other factors that were not included in the model may potentially be better predictors of HR-QOL outcomes than physical activity. For example, despite the fact that we administered the 2003 version of the BRFSS survey in its entirety, including optional modules, the survey contains questions about a limited number of physical conditions (e.g., diabetes, hypertension, hyperlipidemia, asthma, arthritis, cardiovascular disease, heart attack and stroke, HIV/AIDs). Other disease conditions not mentioned in the survey—including psychiatric disorders—may also affect HR-QOL measures. For instance, chronic liver disease, chronic kidney disease, certain types of cancer, substance abuse, sleep disorders, and depression significantly contribute to morbidity and mortality in AI/AN populations (Fischer et al., 2009; Jolly et al. 2008; Weir, Jim, Marrett, & Fairley, 2008; CDC 2008; Froese et al., 2008), and may thus affect scores on HR-QOL measures. Yet, the instrument did not contain specific questions pertaining to these conditions, and the authors did not screen participants for any psychiatric or cognitive disorders.

Second, the purpose of this study was to address health disparities faced by AIs residing in rural Northern Plains tribal communities; as such, the results do not address health disparities among AI/ANs living in non-reservation communities or other parts of the U.S. For example, the prevalence of cigarette smoking in southwest tribes has been reported to be less than half the prevalence found in northern plains tribes (Denny et al., 2003).

Finally, self-reported information can reflect various recall biases and a tendency toward socially acceptable/favorable answers; however, some studies have found self-report to be a reliable means of gathering data about the prevalence of some health concerns and behavioral risk factors assessed in this study, i.e., cardiovascular diseases, diabetes, hypertension, and cigarette smoking (Jackson, Jatulis, & Fortmann, 1992; Kehoe, Wu, Leske, & Chylack, 1994; Martin, Leff, Calonge, Garrett, & Nelson, 2000). In addition, the degree of error in assessing one's health based on self-reports may be influenced by cultural differences. Garroutte, Sarkisian, Arguelles, Goldberg, and Buchwald (2006) reported that older AI respondents perceived their overall health to be worse than their health providers did in 40% of cases, whereas in the general population the trend seems to be reversed, with older patients perceiving their health to be better than their providers do. The researchers further noted that the discrepancy was significantly related to the degree of majority-culture acculturation, with higher acculturation scores corresponding to less discordant overall health ratings.

Nevertheless, gathering self-report information using face-to-face interviewing, as was done in this study, has been shown to be a more effective method than telephone interviewing for rural, socioeconomically deprived participants and/or ethnic minorities; it results in a higher response rate and, perhaps, a greater willingness to reveal negative information (Donovan et al., 1997; Nebot et al., 1994; Aquilino, 1992). Furthermore, Letiecq and Bailey (2004) reported that members of many AI/AN cultures prefer face-to-face interviews to any other form of data collection, including letters, telephone calls, or e-mails.

Research evaluating health behaviors in AI/ANs is nascent at best. More studies are needed to investigate relationships of various health behaviors (including physical activity and nutrition), health risks, and demographic characteristics to health outcomes and HR-QOL measures. Administration of standardized surveys such as the BRFSS or the National Health and Nutrition Examination Survey to AI/ANs may be informative, but these instruments may require some modification to be more culturally appropriate and more sensitive to a particular research topic.

CONCLUSION

Overall, the study showed that, even in the presence of adverse socio-demographic (e.g., low income, low education level, older age), physical (e.g., high BMI, presence of one or more disease conditions) and behavioral (e.g., cigarette smoking, alcohol consumption, poor nutrition) factors, regular physical activity may still exert a positive influence on most HR-QOL measures. Northern Plains AIs may significantly improve their quality of life by increasing their participation in any type of physical activity to at least the level currently recommended by the CDC and the American College of Sports Medicine (Pate et al., 1995).

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