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Meeting physical activity guidelines and health outcomes in the elderly: Are racial differences important?

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Abstract

Physical activity guidelines for health improvement were recommended by the Centers for Disease Control and Prevention (CDC) in 2008. Today, data on individuals' adherence to the CDC guidelines are collected as part of its Behavioral Risk Factor Surveillance System (BFRSS) survey. While racial disparities in health outcomes are well documented, analyses of the BRFSS data have the potential to shed light on whether there are racial differences in the relationship between physical activity and health outcomes.

The 2015 (BRFSS) dataset contained responses from 441,456 individuals, including 42,516 over the age of 65 who had complete data on the variables that were included in this study. Self-reported days of poor physical and mental health were the outcome variables. Physical activity guidelines were the primary predictor of interest and race, sex, education, income, smoking, living in a city center, relationship status, and arthritis were considered potential confounding factors.

African Americans were found to have significantly more days of poor physical health than Whites (p=.04). However, the association between physical activity and days of poor physical or mental health did not differ by race (p=0.58 and p=0.69, respectively). For all races, meeting aerobic guidelines was associated with fewer days of poor physical and mental health. In contrast, meeting strength guidelines alone was not associated with fewer days of poor physical or mental health. More research is needed to determine the optimum amounts of physical activity in the elderly.

Keywords: physical activity, race, health outcomes, racial disparities

Meeting physical activity guidelines and health outcomes in the elderly: Are racial differences important?

In 2008, the Office of Disease Prevention and Health Promotion developed recommendations for physical activity with separate goals for both aerobic and strength related exercises. These recommendations were published on the Centers for Disease Control and Prevention (CDC) website as guidelines for physical activity. Specifically, these recommendations include 150 minutes per week of moderate aerobic exercise not related to occupation. Also, twice a week, a muscle strengthening activity working all major muscle groups was recommended. In an effort to measure overall adherence, the CDC collects and makes available population data on meeting physical activity guidelines through its Behavioral Risk Factor Surveillance System (BRFSS). The CDC also collects a large volume of additional population health data annually via this telephone survey. Among this data are self-reported physical and mental health outcomes recorded as the number of poor physical and mental health days per month.

Due to its composition, the BRFSS is a useful data source for studying the behaviors and health outcomes of members of the baby boomer generation, those individuals born between 1946 and 1964, the largest American generation ever born and currently second only to millennials in total population. Fry (2016) reports that the baby boomer generation accounts for approximately 74 million currently living people, representing over 20% of the U.S. population. Advances in health care are also contributing to longer and healthier lives. According to Kochanek, Murphy, Xu, and Tejada (2016), mortality rates for cardiopulmonary disease and cancer continue to trend downward.

In historical terms, humans previously required tremendous energy expenditures to support their hunter-gatherer existence. Blake, Mo, Malik, and Thomas (2009) reviewed the impact of increased mechanization on the physical activity of western society and found that it has reduced dramatically the number of steps humans take per day. According to Tipton (2008), the health benefits of exercise have been known for centuries; however today's humans are thought to get less exercise as daily tasks require less movement.

While increased physical activity is associated with better physical and mental health, the amount of exercise required for benefit is poorly defined. The Copenhagen heart study found that marathon runners have a similar incidence of adverse cardiovascular events as sedentary individuals (Schnohr, O'Keefe, Marott, Lange, & Jensen, 2015), while those who exercise moderately were observed to have a 30% reduction in all-cause mortality in (Schnohr et al., 2015).

In contrast, there is a large body of evidence demonstrating the positive effects of general physical activity on mental and physical health. Physical activity has been demonstrated to reduce the risk of chronic illness as summarized by Pedersen (2009**).** Metabolic syndrome is defined as the presence of three out of five risk factors for cardiovascular disease and type 2 diabetes mellitus. According to the Mayo Clinic (http://www.mayoclinic.org/diseases-conditions/metabolic-syndrome/diagnosis-treatment/diagnosis/dxc-20197530), the criteria for metabolic syndrome are: 1) Large waist circumference- a waistline that measures at least 35 inches for women and 40 inches for men; 2) High triglyceride level, at least 150 mg/dl; 3) Reduced HDL cholesterol, less than 40 mg/dL; 4) Increased blood pressure, 130/85 mm Hg or higher; and 5) Elevated fasting blood sugar, 100 mg/dL or higher. A systematic review performed by Biswas et al. (2015) concluded that physical inactivity was associated with an

increase in diabetes mellitus of 90%, cardiovascular disease of 14%, cancer of 13%, and mortality of 24%. Colon, endometrial, and breast are the cancers less likely to occur in physically active individuals compared to a matched group of sedentary individuals (Booth, Roberts, & Laye, 2012). Monozygotic twins studies show increased mortality in sedentary twins compared to their physically more active siblings (Carlsson, Andersson, Lichtenstein, Michaelsson, & Ahlbom, 2007).

Physical activity likely improves mental health outcomes, as well. Nishiguchi et al. (2015) performed a randomized controlled trial testing the benefits of a 12-week, 90 minutes per day exercise program on cognitive performance in the elderly. They found a significant improvement in the Wechsler Memory Scale in exercisers compared to non-exercisers. In addition, mental health disorders such as anxiety and depression are improved with physical activity (Mammen & Faulkner, 2013). There is also evidence that physical activity may slow the progression of Alzheimer's disease (Barnes, 2015).

It is thought that social and cultural factors may present significant barriers to physical activity and health. In one example, it is thought that the elderly have a strong desire to take care of other family members rather than themselves as more grandparents are raising grandchildren than previous generations (Clottey, Scott, & Alfonso, 2015). In support of this theory, one study found that grandparents who raise their grandchildren were found to have worse physical and mental health than elderly who were not raising grandchildren (Hadfield, 2014). Perhaps, assuming the role of caregiver may lead to more sedentary behavior in the elderly by reducing available time for leisure activity.

When considering racial disparities, research has found evidence suggesting that health outcomes vary widely by race, even in the elderly. Specifically, African Americans at age 65

years have worse survival outcomes than Whites (RR=1.4). However, elderly Hispanics, Asian Pacific Islanders, and Native American elderly have been found to have lower mortality rates than Whites (Anderson, Bulatao, & Cohen, 2004). At about age 85 years, these disparities disappear as mortality approaches 100% for all races. As the U.S. population continues to age, and given the existence of racial disparities in health outcomes, the association between race, physical activity, and health outcomes in the elderly warrants investigation.

Statement of Purpose

The purpose of this study was to evaluate the association between race, physical activity, and self-reported physical and mental health outcomes in the elderly. Of particular interest is whether the association between physical activity and health outcomes might differ by race.

Literature Review

A Pubmed Medline database search was performed using the search terms race AND disparities AND exercise AND self- reported outcomes. There were 292 articles in the initial search. After the filters (age 65+, English language, and publication in the last ten years) were applied, there were 95 potential articles for inclusion. Additional exclusion criteria were used based on relevance to the research question. Exclusion criteria included: 1) A small or remote ethnic population; 2) Utilization of a specific procedure or test rather than physical activity as the intervention; 3) A disease process not associated with physical activity.

The remaining 65 studies were categorized in four broad categories: 1) Psychosocial - this category included subsections of cultural, religious, economic status and education level; 2) Physiologic - two subsections were included in this category, physiologic and cognitive; 3) Environmental - this section included physically located resources, and technology utilization for

physical activity monitoring and motivation; 4) Other - this category included complication or mortality studies and prevention/risk factor studies.

There were 25 articles in the psychosocial category. Of these 25, 11 were cultural, five were faith-based, seven were economic, and two had education level as the main research focus. Only five of these studies contained specific reference to elderly subjects. The physiologic/ cognitive category had six articles considered to have a primarily physiologic focus and there were only two studies with a cognitive research question. The environmental category contained a total of 15 papers, of which only two presented primarily with a technologic intervention. The remainder of the papers focused on location/living situation as a factor in physical activity and health. Finally, the other category was a collection of articles that primarily studied complications, mortality, prevention and management of risk factors for chronic diseases. There were 18 articles in this category. A narrative review of the 65 selected articles was then performed.

Cultural factors are important in understanding racial disparities in physical activity. Johnson, Carson, Affuso, Hardy, and Baskin (2014) performed a cross-sectional survey of 195 African-American women in the southern United States and found that the women received minimal social support for healthy diet and exercise from their family and friends. Harley et al. (2014) interviewed a focus group of 14 African-American women and identified three key themes in physical activity prevalence. These themes were motivation, strategies for implementation, and challenges. Another focus group identified more specific cultural barriers such as maintenance of hair style as a reason not to exercise (Huebschmann, Campbell, Brown, & Dunn, 2016). These cultural factors are not limited to the African-American population.

Native Pacific Islanders also have identified the need to incorporate the preservation of culture as a means to increase and maintain physical activity programs (McEligot et al., 2010).

Other psychosocial factors such as education, income, and gender may impact physical activity levels and physical function. Smith et al. (2015) studied a cohort of individuals 55 to 74 years of age followed for three years and found individuals of low literacy had a significantly faster decline in physical function, and in addition, low income individuals showed a low adherence to physical activity guidelines. Women with lower incomes also were less likely to adhere to physical activity guidelines than men. Sixteen percent of women met activity guidelines compared to twenty-five percent of men (Cohen et al., 2013).

There are racial disparities in physical activity as well. After adjusting for socioeconomic factors, Wang and Chen (2011) reported African Americans engage in physical activity about 10% less than Caucasians. However, Asian Americans appear to be the least likely to engage in physical activity compared to Whites, African Americans and Hispanics (Yi, Roberts, Lightstone, Shih, & Trinh-Shevrin, 2015).

Few studies were found in this literature search that evaluated racial disparities in physical activity in the elderly. August and Sorkin (2011) studied middle aged and older adults using the 2007 California Health Survey and found middle-aged minorities were significantly less likely to participate in physical activity than Whites. However, no significant disparities were found in older adults. Mobility rates in individuals ages 70 to 79 declined more in African Americans (Thorpe et al., 2011).

Faith-based physical activity programs may be beneficial in promoting and maintaining physical activity. One study observed less attrition from a faith-based physical activity program (36%) compared to a secular program (58%) (Bopp et al., 2009). Another 12-week faith-based

program showed a significant 2% bodyweight loss in program participants (Gutierrez et al., 2014**)**. It is possible these faith-based programs serve to address themes impacting physical activity participation. The program increases social support to provide motivation and a strategic plan for implementing physical activity. Also the church, temple or mosque can provide a safe environment for activity in high risk neighborhoods.

Physical activity programs that are secular may also be effective. Plescia, Herrick, and Chavis (2008) performed a study in Charlotte, North Carolina and identified the benefits of community change strategies such as lay advisor programs, community center coalitions, and community environment changes on physical activity levels. Quinn and Guion (2010) utilized a focus group format to study physical activity programs in elderly women. A primary barrier to physical activity was the lack of age appropriate programs.

The amount of total physical activity versus leisure time physical activity may also influence health benefits of non-sedentary behavior. Chen et al. (2015**)** found in a study of low, middle- and high-income Chinese individuals that low-income individuals were active in-house chores, middle-income individuals spent more time in occupational activity, and high-income individuals were most likely to participate in leisure time physical activity. Higher-income individuals had better health and more leisure time compared to low income individuals, suggesting that leisure time physical activity may provide more health benefits than occupational activities. However, there are many potential confounding factors and this conclusion has not been confirmed by experimental studies.

Vigorous activity is associated with increased physical function and a higher metabolic rate. When considering race, African-American women have a lower metabolic rate than Caucasian women and 25% of this difference is explained by cardiovascular fitness, according to

Shook et al. (2014). In a separate study, Simon et al. (2015) found that highly active men have better sexual performance than sedentary men regardless of race.

Self-reported health surveys have limited reliability, especially if the study has a small sample size**.** Troiano et al. (2008) recommends using validated surveys or objective measurements such as pedometers or accelerometers when studying physical activity. Crane and Wallace (2007) found interventions measuring activity by steps may be used in older as well as younger age groups. In programs using pedometers, researchers have found reduced hip circumference and body mass index in obese African-American women (Panton et al., 2007).

Physical activity may influence cognitive performance and reduce disabilities among the elderly. This association was found to be is statistically significant among Caucasians, but according to a study it is also likely to be important among African Americans (Popa, Reynolds, & Small, 2009). Maintenance of physical activity program participation is related to self-efficacy and satisfaction with the health outcome but not self-reported habitual behaviors (Kassavou, Turner, Hamborg, & French, 2014). In addition, the researchers recommend that counseling efforts be continued for the long term since short term efforts produced short term results.

Environmental factors can also play an important role in the amount of physical activity an individual performs. Van Holle et al. (2014) found that walkable neighborhoods and safe communities are associated with increased physical activity participation by residents. Other studies identify disparities between neighborhoods in terms of activity and obesity rates. Obesity rates have been found to vary from 6.8% to 31.7% in some New York City neighborhoods (Black, Macinko, Dixon, & Fryer, 2010).

More specifically, technology may also be used to induce physical activity. Personalized computer-generated newsletters were found to be superior to preprinted pamphlets for activity promotion (Short, James, Girgis, D'Souza, & Plotnikoff, 2015). Text messaging reminders have also been shown to improve physical activity in older individuals (Kim & Glanz, 2013).

In summary, the current literature review has identified racial disparities in physical activity and health outcomes. However, there are many potential confounding factors and there is a paucity of information in the elderly regarding the interaction between race, physical activity and health outcomes.

Methods

This study was considered exempt from Institutional Review Board review because the data was de-identified and publically available using the 2015 BRFSS database (see Chart 5 in Appendix A). The BRFSS is a cross-sectional telephone survey conducted by the CDC. The data are, therefore, self-reported and not obtained by direct observation. The 2015 full dataset contained 441,456 cases and 330 variables. Based on the literature review above, the following variables were selected for analysis: the outcomes days per month of poor physical health and days per month of poor mental health; the primary predictor CDC guidelines for physical activity (PAREC; see below); and potential confounders age, sex, race, income, education, relationship status, metro status, arthritis/limited activity status, and smoking status. The exclusion criteria were all individuals under 65 years of age, and individuals with missing data for any of the above selected variables. There were 151,642 individuals over 65 years of age completing the BRFSS 2015; however, after eliminating those with missing data, the final dataset for analysis contained 42,615 cases.

The outcome variables, self- reported days/month of poor physical and mental health, were each recoded into four ordinal categories: 0 days, 1-10 days, 11-20 days, and 21-30 days of poor health. This procedure was performed because the outcome variables were not normally distributed; they were highly skewed and tended to be bunched at whole numbers, including the minimum and maximum values.

In 2008, the CDC began recommending 150 minutes of moderate aerobic physical activity per week as a guideline for improved health. In addition, a guideline of strengthening activity twice a week was also provided. The variable in BRFSS that indicates whether an individual met neither, either, or both guidelines was named PAREC. Due to inconsistency in the continuous physical activity variables in the BRFSS dataset, for this analysis, physical activity was measured by PAREC. PAREC is a combination of the PASTRNG and PAINDX variables, which ask whether individuals met strength and aerobic activity guidelines, respectively.

Ordinal logistic regression was used to assess the unadjusted and adjusted (for confounding) associations between physical activity and each health outcome. A race X PAREC interaction term was created to determine if the association between physical activity and health outcomes differed between races. Race was categorized in five levels: White, African American, Hispanic, Asian/other minorities, and multiracial. The following variables were recoded for analysis: 1) Marital status was recoded to attached (married and unmarried couple), single (divorced, separated, and never married), and widowed; 2) Education level was recoded into either no college or at least some college (regardless of graduation); 3) Income level was recoded into less than $25k/year, $25-49,999/year, $50-74,999/year and greater than $75k/year; 4) Environment was evaluated by using the metro status variable, which asks the household

location, and was recoded into either inside urban city center or outside urban city center; 5) Arthritis was categorized into three groups: having arthritis and limited usual activity, having arthritis but not limited usual activity, and not having arthritis; 6) Smoking status was categorized into current everyday smokers, current occasional smokers, former smokers, and non-smokers. BMI was not included as a confounder in this study since increased BMI is a result of physical inactivity rather than a potential cause and therefore may be a mediator of the physical activity vs. health outcome relationship rather than a confounder. Data were analyzed with IBM SPSS version 24. All tests were two-sided and conducted at the $\alpha = 0.05$ level of significance.

Results

The demographic characteristics of the study sample are summarized in Table 1. The majority (81%) of respondents were found to have met the CDC guidelines for 150 minutes of aerobic activity per week. However, there were fewer individuals (30%) who met the CDC recommendation of strength activity twice per week. Females outnumbered males 57% to 43%, and the study population was predominately White (70%) and educated (two-thirds had at least some college education). Income levels were nearly evenly distributed with 25% having income below $25,000 and 25% having income over $75,000. Approximately 51% were attached (married or unmarried couple) and a slightly majority of respondents reported residing outside the city center (55%). Approximately half of the sample had never been told they had arthritis. Those that had ever been diagnosed with arthritis were divided into those with limited activity (20%) and those whose usual activities were not limited (29%). The mean age of the study sample was 72.82 years. However, to preserve confidentiality, in the BRFSS ages above 80 years are all designated as 80 years. Therefore, the true mean age is greater than 72.82 years.

Table 1

Demographics

		n	%
Days of poor physical health	0	28,520	66.9
	1-10	9,294	21.8
	11-20	1,764	4.1
	21-30	3,037	7.1
Days of poor mental health	0	34,175	80.2
	1-10	6,273	14.7
	11-20	978	2.3
	21-30	1,189	2.8
Aerobic and strength guidelines (PAREC)	Met aerobic and strength	11,161	26.2
	Met aerobic only	23,357	54.8
	Met strength only	1,967	4.6
	Did not meet either	6,130	14.4
Sex	Male	18,132	42.5
	Female	24,483	57.5
Race	White	29,911	70.2
	African American	3,369	7.9
	Hispanic	5,914	13.9
	Asian /other non-Hispanic	2,643	6.2
	Multiracial	778	1.8
Education	No college	13,348	31.3
	Some college	29,267	68.7
Income	$0-24,999	10,705	25.1
	$25-49,999	13,710	32.2
	$50-74,999	7,353	17.3
	$75K+	10,847	25.5
Relationship status Attached =married or unmarried couple Single=divorced, separated, never married	Attached	21,831	51.2
	Single	8,647	20.3
	Widowed	12,137	28.5
Environment	Urban city center	19,574	45.9
	Outside city center	23,041	54.1
Arthritis	Arthritis and activity limited	8,590	20.2
	Arthritis but activity not limited	12,270	28.8
	No arthritis	21,755	51.1
Smoking status	Current everyday smoker	4,037	9.5
	Current occasional smoker	1,847	4.3
	Former smoker	12,298	28.9
	Never smoked	24,433	57.3

After controlling for the other variables, there was no significant interaction between race and physical activity (race X PAREC interaction term) for either physical health days or mental health days (p=0.58 and p=0.69, respectively). Therefore, the interaction term was removed

from both models. The results of the unadjusted and adjusted ordinal regression analyses are shown in Tables 2 and Table 3 for days of poor physical and mental health, respectively. In the following, all results are based on the analyses adjusted for confounders.

Those who met aerobic guidelines had significantly fewer days of poor physical health compared to those who met neither the aerobic nor the strength guidelines (Table 2; $p<.001$). However, just meeting the CDC guidelines for strength activity was not associated with fewer days of poor physical health ($p=0.956$). Similar findings were seen in the association between physical activity guidelines and days of poor mental health (Table 3); meeting aerobics guidelines was associated with fewer days of poor mental health compared to meeting neither guideline ($p<.001$), but meeting strength guidelines alone was not ($p=0.552$).

Table 2

Unadjusted and Adjusted Ordinal Logistic Regression Results for Days of Poor Physical Health

Variable	Level	Unadjusted parameter	*p*-value	Adjusted parameter	*p*-value	95% confidence interval Lower limit	95% confidence interval Upper Limit
PAREC	Met both aerobic and strength	-0.387	<.001	-0.279	<.001	-0.346	-0.213
	Met aerobic only	-0.383	<.001	-0.275	<.001	-0.333	-0.216
	Met strength only	-0.045	0.387	-0.003	0.956	-0.107	0.101
	Met neither	ref					
Age		0.010	<.001	0.003	0.189	-0.001	0.007
Race	Hispanic	0.070	0.353	0.041	0.593	-0.110	0.192
	African American	0.077	.040	0.080	.040	0.004	0.156
	Asian/other non-Hispanic	-0.003	0.925	-0.007	0.826	-0.067	0.054
	Multiracial	0.037	0.374	0.020	0.645	-0.065	0.105
	White	ref					
Gender	Male	-0.112	<.001	0.085	<.001	0.041	0.129
	Female	ref					
Education	Some college	0.189	<.001	-0.026	0.281	-0.074	0.021
	No college	ref					
Income	Under $25,000	0.717	<.001	0.641	<.001	0.573	0.710
	$25,000-$49,999	0.315	<.001	0.281	<.001	0.221	0.341
	$50,000-$74,999	0.163	<.001	0.142	<.001	0.075	0.209
	Over $75,000	ref					
Metro status	Lives in city center	-0.035	.089	0.025	0.238	-0.016	0.066
	Not city center	ref					
Smoking status	Current everyday	0.049	0.163	0.052	0.155	-0.020	0.123
	Current occasional	0.065	0.193	0.068	0.187	-0.033	0.168
	Former smoker	0.001	0.973	0.002	0.933	-0.045	0.049
	Non smoker	ref					
Relationship	Attached	-0.251	<.0001	-0.023	0.427	-0.080	0.034
	Widowed	-0.090	.002	-0.129	<.001	-0.190	-0.068
	Single	ref					
Arthritis	Arthritis limiting activity	1.061	<.001	1.411	<.001	1.360	1.462
	Arthritis not limiting activity	-0.390	<.001	0.383	<.001	0.334	0.432
	No arthritis	ref					

Table 3

Unadjusted and Adjusted Ordinal Logistic Regression Results for Days of Poor Mental Health

Variable	Level	Unadjusted parameter	*p*-value	Adjusted parameter	*p*-value	95% confidence interval Lower limit	95% confidence interval Upper Limit
PAREC	Met both aerobic and strength	-0.347	<.001	-0.179	<.001	-0.258	-0.101
	Met aerobic only	-0.234	<.001	-0.115	.001	-0.184	-0.047
	Met strength only	0.001	0.981	0.037	0.552	-0.085	0.159
	Met neither	ref					
Age		-0.025	<.001	-0.037	<.001	-0.042	-0.032
Race	Hispanic	-0.003	0.972	0.001	0.990	-0.180	0.183
	African American	0.025	0.580	0.035	0.447	-0.055	0.125
	Asian/other non-Hispanic	0.019	0.602	-0.010	0.791	-0.082	0.062
	Multiracial	-0.024	0.629	0.033	0.527	-0.068	0.133
	White	ref					
Gender	Male	-0.506	<.001	-0.346	<.001	-0.400	-0.293
	Female	ref					
Education	Some college	0.116	<.001	-0.050	.080	-0.107	0.006
	No college	ref					
Income	Under $25,000	0.649	<.001	0.508	<.001	0.426	0.589
	$25,000-$49,999	0.336	<.001	0.271	<.001	0.199	0.343
	$50,000-$74,999	0.199	<.001	0.157	<.001	0.076	0.238
	Over $75,000	ref					
Metro status	Lives in city center	0.017	0.481	0.061	.016	0.011	0.110
	Not city center	ref					
Smoking status	Current everyday	0.001	0.982	0.002	0.957	-0.083	0.087
	Current occasional	-0.055	0.366	-0.050	0.419	-0.173	0.072
	Former smoker	0.025	0.355	0.029	0.300	-0.026	0.085
	Non smoker	ref					
Relationship	Attached	-0.413	<.001	-0.148	<.001	-0.214	-0.081
	Widowed	-0.141	<.001	-0.043	0.233	-0.113	0.028
	Single	ref					
Arthritis	Arthritis limiting activity	0.687	<.001	0.899	<.001	0.840	0.958
	Arthritis not limiting activity	-0.276	<.001	0.253	<.001	0.194	0.312
	No arthritis	ref					

Age was not associated with more days of poor physical health (p=0.189*).* However, older individuals had significantly fewer days of poor mental health (p<.001).

African Americans had significantly more days of self-reported poor physical health (p=.04). Race did not have an association with self-reported mental health days. Gender differences were found. Specifically, males had significantly more days of poor physical health (p<.001), but significantly fewer days of poor mental health (p<.001). Lower income was associated with more days of both poor mental and physical health (p<.001). In addition, the parameter estimates followed a gradient, with income levels less than $25,000 associated with worse health outcomes than the $25-49,999 group, which was worse than the $50-74,999 group. The best health outcomes were reported in the highest income group (over $75,000+).

Living in an urban center was not associated with days of poor physical health (p=0.238), but was associated with more days of poor mental health (p=.016). When analyzing marital status, widowed individuals had fewer days of poor physical health than singles (p<.001), while attached respondents had fewer days of poor mental health than single respondents (p<.001). Those elderly adults with arthritis had significantly more days of poor physical and mental health compared to those without arthritis (p<.001). This was especially true for those individuals that reported arthritis was limiting their usual activities.

Discussion

After adjusting for confounding, the association between physical activity and either physical or mental health did not differ by race. This is likely due to a survivor bias in the study sample. It is possible that the majority of the racial disparities in health, particularly in African Americans are due to events that occur earlier in life. Individuals able to reach advanced age are more likely to have similar health behaviors regardless of race.

An unexpected finding was the lack of association of age with days of self-reported poor physical health. In addition, in the older individuals significantly fewer days of poor mental health were reported. The reasons for these findings are unclear but since they are self-reported it is possible older individuals have survived due to their positive mental outlook. Those individuals reaching advanced age may have become accustomed to their physical ailments and do not complain about their deteriorating physical health. The collapsing of BFRSS data for those over 80 years of age into one group also makes this variable somewhat difficult to interpret.

In our study, African-American elderly participants reported significantly more poor physical health days than White participants. Chronic illnesses are more common in African Americans **(**Hatzfeld, LaVeist, & Gaston-Johansson, 2012). August and Sorkin (2011) reviewed middle-aged and older adult respondents of the California Health Survey and found that non-Whites reported less leisure time physical activity than Whites. Brand, Alston, and Harley (2012) also found significantly lower physical activity among disabled African Americans. Asians may participate in less physical activity than either Whites or African Americans but did not have more self-reported days of poor physical health than Whites (Marshall et al., 2007).

The benefits of aerobic activity on reducing the incidence of metabolic syndrome and chronic illness were previously described in the literature review. The benefits of strength activity are sparse in the literature. Karinkanta, Kannus, Uusi-Rasi, Heinonen, and Sievanen (2015) reported the results of a randomized controlled trial of a 12-month strength and balance program in older women. They found a 74% reduced prevalence of fractures at five year follow up. While our study did not find any association between meeting CDC strength guidelines and

better self-reported physical or mental health, there may be preventive orthopedic benefits in the elderly that this analysis was unable to measure.

The association between self-reported health and aerobic activity found in this analysis was consistent with those of Zhang and Yen (2015), who reported that physical activity is associated with fewer reported days of poor mental health based on the 2011 BRFSS dataset. In addition, they found the association between increased physical activity and reduced depression to be greater in females. Our work with the 2015 BRFSS data demonstrated men reported significantly fewer days of poor mental health than women. However, elderly men also reported significantly more days of poor physical health in our study. The association with poorer self-reported physical health in men is consistent with overall poorer physical health and decreased in life expectancy in elderly men compared to women.

Yang, Spears, Zhang, Lee, and Himler (2012) demonstrated an association between income and physical activity, with high income individuals more likely to be physically active than low income individuals (OR 1.92). Our research identified a significant positive association between income and each of self-reported physical and mental health. Our finding of the association between health outcomes and income level is consistent with the research of Avendano, Glymour, Banks, and Mackenbach (2009).

Environmental factors have been recognized as an important factor in overall physical and mental health. Boslaugh, Luke, Brownson, Naleid, and Kreuter (2004), in a survey of 1,073 individuals, found that African Americans perceived their neighborhoods as less safe for physical activity than their White counterparts, regardless of the racial composition of the neighborhood. The advantages of urban living may include better access to care due to proximity to providers. However, urban neighborhoods may be less walkable than non-city

center environments. The current study did not identify a difference in physical health days between urban and non-urban city centers; however, living in a city center was associated with more poor mental health days.

Unexpectedly, after adjusting for the other variables, smoking was not associated with either physical or mental health. However, as 90% of the sample was either a never smoker or former smoker, this lack of association may be due to survivor bias.

Married individuals tend to have better overall health than single individuals (Su, Stimpson, & Wilson, 2015). In our study, single individuals reported significantly worse physical health than those who were widowed, and significantly worse mental health than those who were currently attached.

In addition, our study showed respondents with arthritis reported significantly more days of poor physical and mental health, and the difference from those with no arthritis was greater among arthritic patients who have limited activity. Song et al. (2017) also demonstrated reduced disability in arthritic patients who met the CDC guidelines of 150 minutes of activity per week. The current research does not determine whether the arthritis led to the inactivity or the inactivity made the arthritis worse. However, both are likely true. Pain from arthritis makes it more difficult to exercise. Gill and McBurney (2013**)** reviewed the literature on the impact of physical activity in patients awaiting joint replacement. It appears physical activity may delay the need for joint replacement and improve physical function.

This study has several limitations. First, 80% of the sample met the CDC aerobic activity guidelines of 150 minutes per week. This percentage was much higher than previously reported in BRFSS. This was probably due to selection bias. Also, to achieve a population with complete data for all variables in the study, the majority of cases were excluded. Most of the missing

cases were lacking physical activity data and it is possible those respondents were not exercising. However, the BRFSS also seems to overestimate the amount of physical activity compared to other health questionnaires such as NHANES, as reported by Keadle, McKinnon, Graubard, and Troiano (2016). This could be due to the fact that the BRFSS physical activity variables are calculated differently than other self-reported health questionnaires which may also add to unusually high physical activity participation by BFRSS respondents. Dyrstad, Hansen, Holme, and Anderssen (2014) compared self-reported physical activity to accelerometer data and found overestimation of physical activity in the self-report group. This effect was most significant in men and in those over 65 years in age.

Unsurprisingly, older individuals reported significantly more days of poor physical and mental health. Unfortunately, the collapsing of the over 80 years age group in BFRSS precludes more detailed analysis in this dataset of a demographic that is becoming more prevalent.

In this era of rising healthcare costs, the benefits of physical activity to an individual's health could potentially decrease healthcare expenditures by reducing costly chronic illnesses such as diabetes, hypertension and hypercholesterolemia. Chevan and Roberts (2014) studied the association of physical activity to health care expenditures using National Health Survey unadjusted data and found fewer expenditures among exercisers. However, after adjusting for age and income they found no difference between activity groups. Unfortunately, this study involved only a short-term follow-up period whereas the health benefits could take longer to manifest. Some of the limitations of their study are similar to the limitations in this study, namely recall bias and self-reported data. In addition, there is some suggestion that 150 minutes per week of aerobic activity is not enough alone to make a significant positive impact on health. The optimum amount of exercise remains a controversial issue.

Conclusion

For elderly participants in the 2015 BFRSS, meeting the CDC guidelines for aerobic physical activity was associated with fewer self-reported days of poor physical and mental health. However, there was no difference among races in this association. We also did not find performance of a strengthening activity twice a week to be associated with fewer days of poor physical or mental health in the elderly. A final observation given our research and our review of the literature is that the optimal amount of physical activity for elderly individuals remains undetermined.

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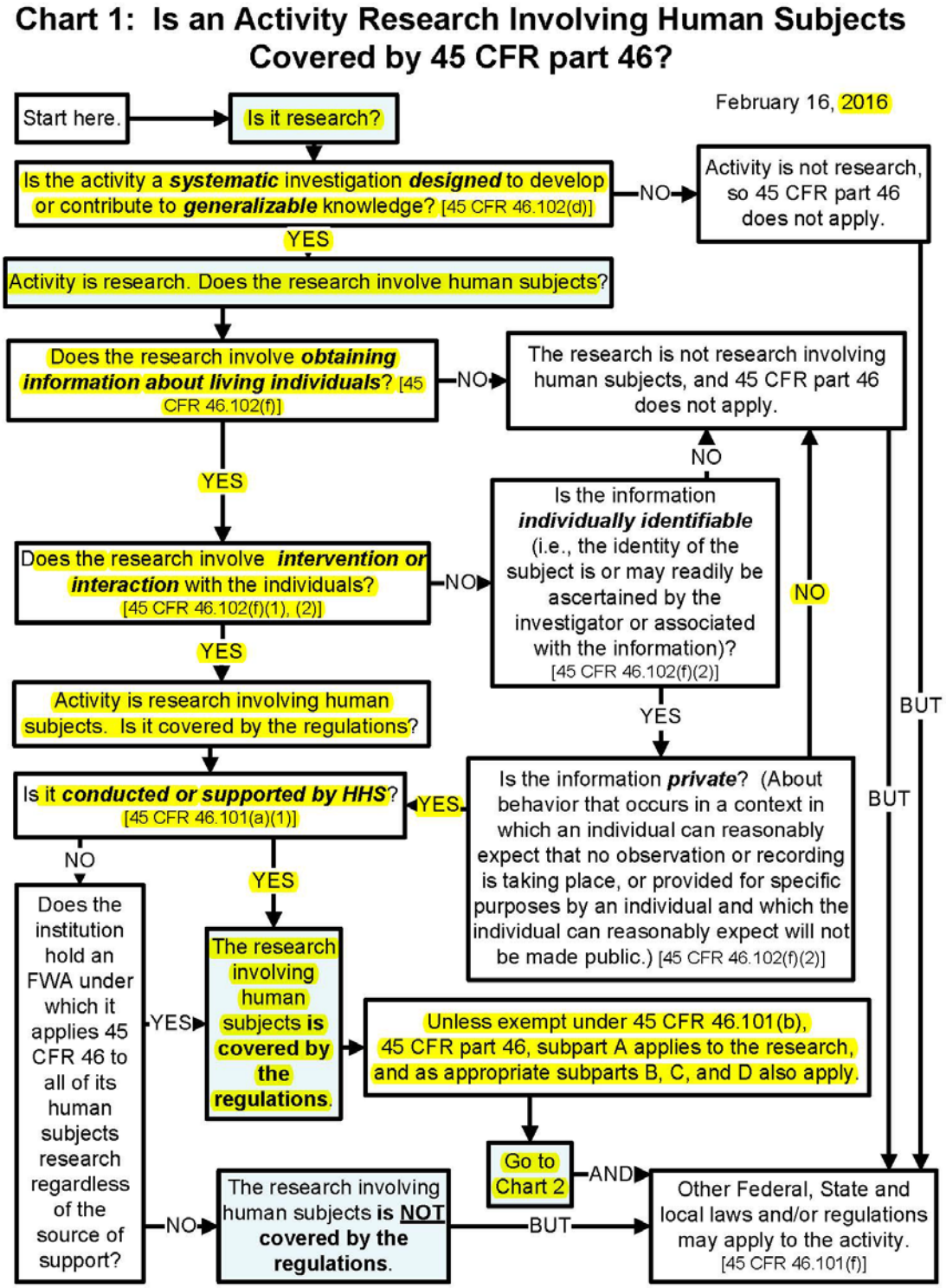
Appendix A: IRB Exempt Decision Tree



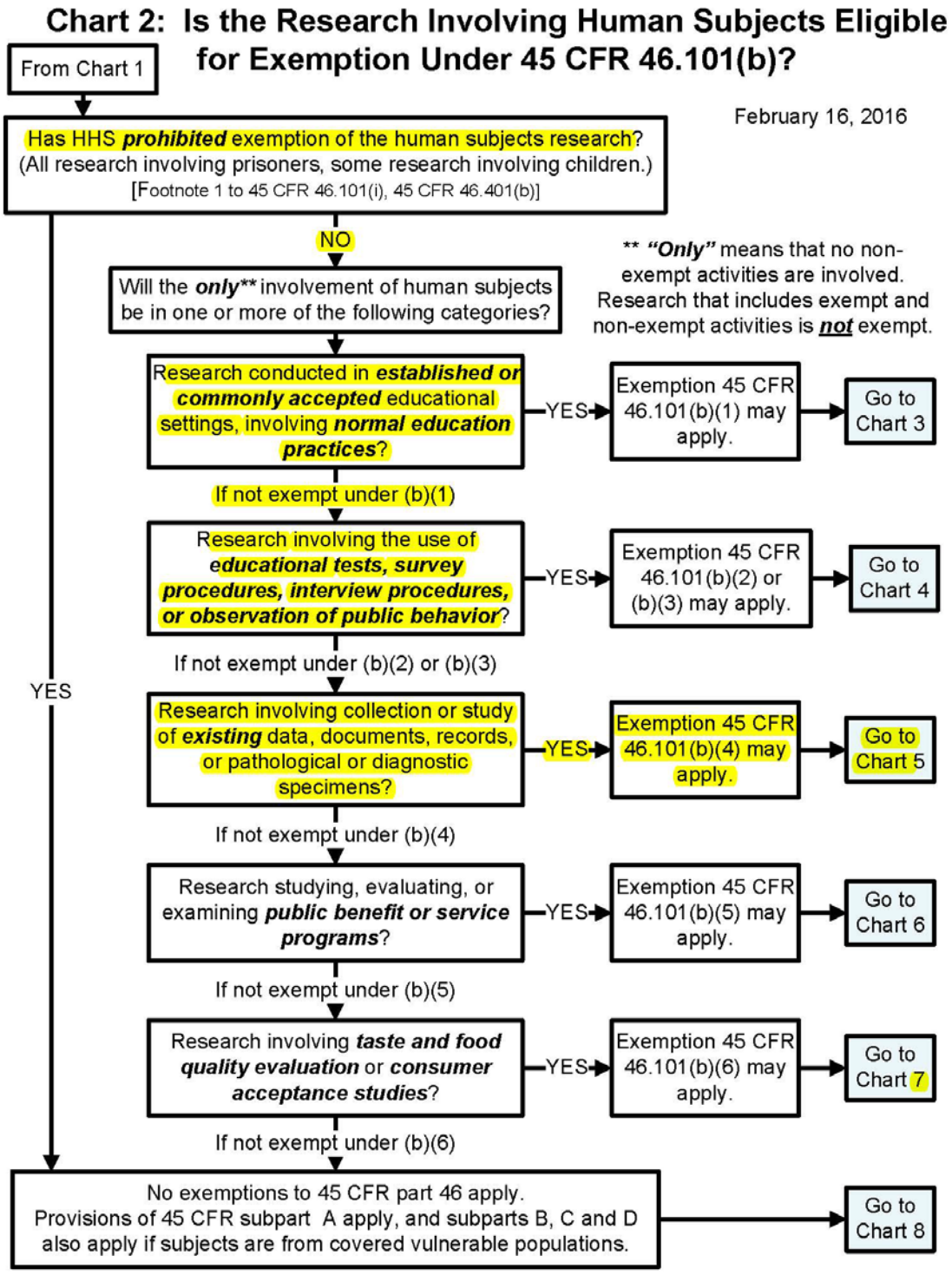
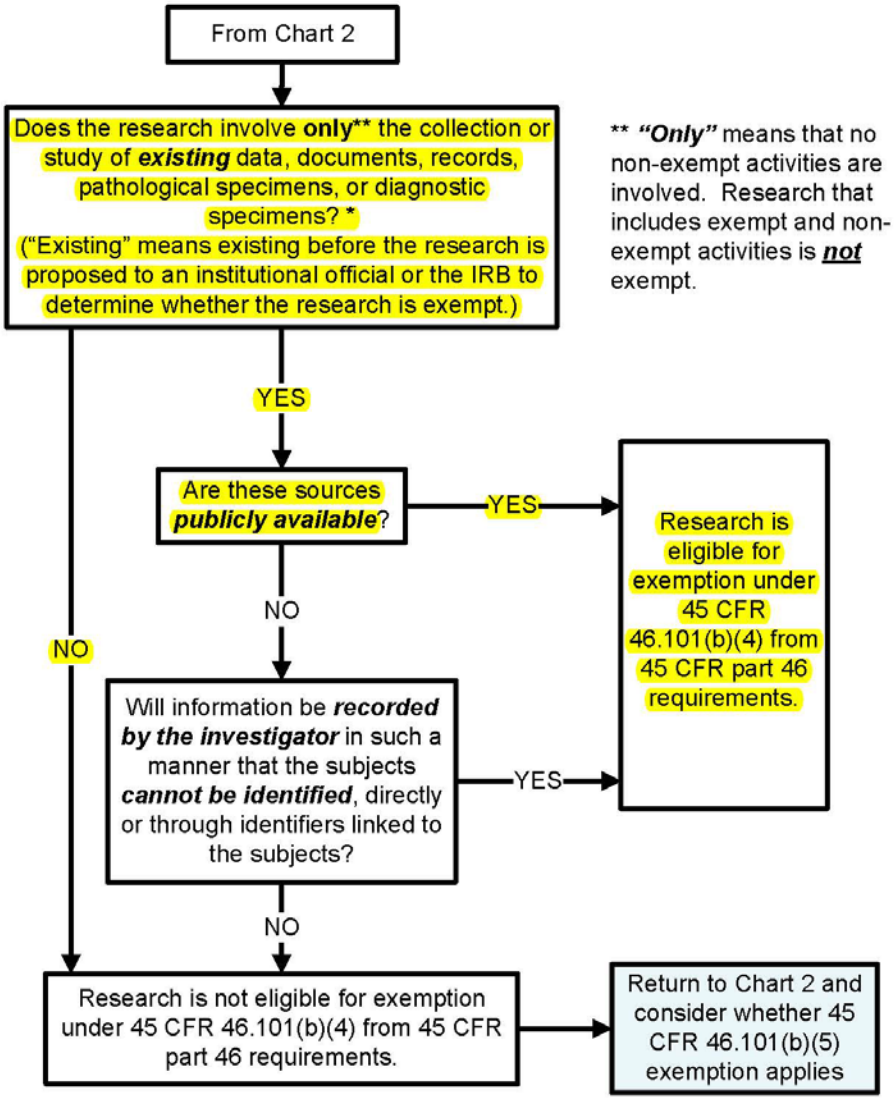


Chart 2: Is the Research Involving Human Subjects Eligible for Exemption Under 45 CFR 46.101(b)?
From Chart 1
February 16, 2016
Has HHS prohibited exemption of the human subjects research? (All research involving prisoners, some research involving children.) [Footnote 1 to 45 CFR 46.101(i), 45 CFR 46.401(b)]
NO
YES
** "Only" means that no non-exempt activities are involved. Research that includes exempt and non-exempt activities is not exempt.
Will the only** involvement of human subjects be in one or more of the following categories?
Research conducted in established or commonly accepted educational settings, involving normal education practices?
YES
Exemption 45 CFR 46.101(b)(1) may apply.
Go to Chart 3
If not exempt under (b)(1)
Research involving the use of educational tests, survey procedures, interview procedures, or observation of public behavior?
YES
Exemption 45 CFR 46.101(b)(2) or (b)(3) may apply.
Go to Chart 4
If not exempt under (b)(2) or (b)(3)
Research involving collection or study of existing data, documents, records, or pathological or diagnostic specimens?
YES
Exemption 45 CFR 46.101(b)(4) may apply.
Go to Chart 5
If not exempt under (b)(4)
Research studying, evaluating, or examining public benefit or service programs?
YES
Exemption 45 CFR 46.101(b)(5) may apply.
Go to Chart 6
If not exempt under (b)(5)
Research involving taste and food quality evaluation or consumer acceptance studies?
YES
Exemption 45 CFR 46.101(b)(6) may apply.
Go to Chart 7
If not exempt under (b)(6)
No exemptions to 45 CFR part 46 apply.
Provisions of 45 CFR subpart A apply, and subparts B, C and D also apply if subjects are from covered vulnerable populations.
Go to Chart 8

Chart 5: Does Exemption 45 CFR 46.101(b)(4) (for Existing Data Documents and Specimens) Apply?



* Note: See **OHRP** guidance on research use of stored data or tissues and on stem cells at http://www.hhs.gov/ohrp/regulations-and-policy/guidance/guidance-on-research-involving-stem-cells/index.html, and on coded data or specimens at http://www.hhs.gov/ohrp/regulations-and-policy/guidance/research-involving-coded-private-information/index.html for further information on those topics.

February 16, 2016

Appendix B: List of Competencies Met in CE

Wright State Program Public Health Competencies Checklist

Assess and utilize quantitative and qualitative data.
Apply analytical reasoning and methods in data analysis to describe the health of a community.
Describe how policies, systems, and environment affect the health of populations.
Address population diversity when developing policies, programs, and services.
Evaluate and interpret evidence, including strengths, limitations, and practical implications.

Concentration Specific Competencies Checklist

Public Health Management
Have a knowledge of successful program implementation principles
Have a knowledge of systems thinking principles
Have a knowledge of human resource principles to enhance organizational management, motivate personnel and resolve conflict
Have an understanding of effective mentoring methods
A knowledge of ethical principles relative to data collection, usage, and reporting results
A knowledge of ethical standards for program development