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Awareness of health outcomes associated with insufficient physical activity and associations with physical activity intentions and behavior

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Abstract

Introduction: Little is known about people's awareness of the link between insufficient physical activity and increased risk for multiple health outcomes.

Methods: Of 1161 respondents to an online cross-sectional survey of the U.S. population, we randomly selected 361 and used content analysis to code up to three responses to an open-ended question asking what illnesses are caused by insufficient physical activity. Chi-square and Fisher's exact tests examined relations between disease codes and socio-demographics; t-tests and Mann-Whitney U tests examined relations between codes and physical activity intentions and behavior.

Results: Ten codes emerged: Cardiovascular (63.5% of participants), Metabolic (65.8%), Musculoskeletal (10.5%), Fatigue (2.0%), Psychiatric (8.0%), Respiratory (3.4%), Gastrointestinal (0.9%), Cancer (3.4%), Other (2.8%), Unexpected interpretation (1.4%). 55.6% of participants named <3 diseases. Code frequencies were generally similar across demographic groups, $p > .05$. Physical activity intentions and behavior were higher among people who either mentioned cardiovascular ($p_{\text{intentions}} = .001$, $p_{\text{behavior}} = .001$) or metabolic ($p_{\text{intentions}} = .01$, $p_{\text{behavior}} = .005$) conditions, or who named <3 diseases ($p_{\text{intentions}} = .006$, $p_{\text{behavior}} = .001$).

Conclusion: In our socio-demographically diverse sample, awareness of diseases that are associated with insufficient physical activity was largely related to cardiovascular and metabolic problems. Future health communication efforts should raise awareness of the harms of insufficient physical activity for cancer and other diseases.

Keywords

Exercise; Physical Activity; Health Knowledge; Attitudes; Chronic Disease; Health Behavior; Risk Factors

INTRODUCTION

Insufficient physical activity is a modifiable risk factor for several of the most common noncommunicable diseases, including heart disease, stroke, diabetes, and certain cancers

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(e.g., colon, breast) (National Center for Health Statistics, 2017; World Health Organization, 2013). Nearly half (49.1%) of people in the U.S. do not meet the recommended amount of aerobic activity per week (Centers for Disease Control and Prevention, 2017; U.S. Department of Health and Human Services, 2008). People from socio-demographically disadvantaged populations experience excess morbidity and mortality from diseases associated with insufficient physical activity and also report lower levels of physical activity than other populations (Centers for Disease Control & Prevention, 2013a, 2013b). This combination of existing health disparities and low levels of physical activity is likely especially detrimental for health. Encouragingly, as little as 15–30 minutes of activity per day can confer health benefits (Wen et al., 2011). Thus, interventions that produce relatively small increases in physical activity could have large effects on public health and, potentially, contribute to reducing health disparities.

We analyzed data from a socio-demographically diverse U.S. sample to characterize the extent to which laypeople are aware of the importance of physical activity for multiple chronic diseases and the socio-demographic factors associated with awareness. We also explored the relationship between awareness and physical activity intentions and behavior.

Theoretical Support for the Link between Awareness and Health Behavior Engagement

Although behavior is influenced by factors at multiple levels of influence (Stokols, 1996), many health behavior theories acknowledge, either explicitly or implicitly, that awareness of the link between a behavior and a disease is a key first step in encouraging people to engage in a behavior for the purposes of improving health. For example, the first stage in the precaution adoption process model, “unaware,” is defined as having never thought about the hazard in question (Weinstein, 1988). Similarly, the precontemplation stage of the transtheoretical model allows for the possibility that people do not currently intend to change their behavior because they do not realize their behavior is problematic (Prochaska, Redding, & Evers, 1997). A modern conceptualization of the health behavior change process, which focuses less on theoretical constructs and more on specific intervention elements called behavior change techniques (BTCs) (Michie et al., 2011), also places importance on individual awareness of the consequences of a behavior.

In contrast, models that extend subjective expectancy utility theory (Savage, 1954) to health behavior, such as the theory of reasoned action (Fishbein & Ajzen, 1975), the theory of planned behavior (Ajzen, 1985), the health action process approach (Schwarzer & Fuchs, 1995), and others (Rogers, 1983; Witte, 1992), do not *require* that people be aware of the link between a behavior and a health outcome. Nevertheless, the subjective expected value function embedded in each of these theories does *allow* for awareness to be incorporated into the calculations of the strength of one’s attitudes about a behavior and, albeit distally, behavior itself. For example, attitudes about physical activity may be conceptualized as a function of all of an individual’s beliefs about the outcomes of activity and an evaluation of each outcome (e.g., (Ajzen, 1985)). If one of the beliefs includes “it is very likely that insufficient physical activity raises the risk of cancer” and cancer is evaluated negatively, then “awareness of link between insufficient activity and cancer” is incorporated into the person’s attitudes and, via intentions, their behavior.

Empirical Research and Interventions Related to Laypeople's Awareness of the Link between Physical Activity and Health

The importance of awareness of the role of physical activity in health is recognized by many researchers and practitioners, who often include educational material about the topic in individual-level interventions and mass media campaigns (for a meta-analysis and systematic review, see (Howlett, Trivedi, Troop, & Chater, 2018); see also (Casey, Coote, & Byrne, 2018; Faulkner, Yun, Tremblay, & Spence, 2018; Howlett et al., 2018; Koutoukidis et al., 2018; Sylvester, Zammit, Fong, & Sabiston, 2017; U.S. Department of Health and Human Services, U.S. Department of Agriculture, U.S. Department of Education, & U.S. Department of the Interior, 2010). However, the empirical research that examines awareness of the relationship between insufficient physical activity and disease risk is limited in three ways.

First, much of the research utilizes samples that include only people for whom the topic is immediately relevant. For example, one study of Latino and African American families in Houston with a history of diabetes reported that, whereas 85% of parents realized that their children could reduce their diabetes risk by engaging in physical activity, only 49% of parents realized that they could reduce their *personal* risk in the same way (Cullen & Buzek, 2009). One study of breast, prostate, and colorectal cancer survivors who were enrolled in the Cancer Genetics Network in Colorado reported that less than 30% of survivors were aware that insufficient physical activity was a risk factor for the cancer for which they were diagnosed (Wold, Byers, Crane, & Ahnen, 2005).

Research that relies on samples comprised of individuals who represent only a portion of the population may be useful for developing targeted or tailored interventions (e.g., (Koutoukidis et al., 2018)), but it may be less helpful for surveillance efforts that monitor awareness in the general population and across multiple demographic groups. Monitoring awareness in the population is important for identifying potential health disparities. For example, people with minority racial/ethnic ancestry and/or limited formal education are often less aware of the health benefits of physical activity than are non-minorities and people with more education (Oh et al., 2010; Ramirez, Finney Rutten, Vanderpool, Moser, & Hesse, 2013). One study reported that awareness of physical activity for colon cancer risk reduction was 8.8% among people with only a high school degree, compared to 25.1% among those with a 4-year college degree (Coups, Hay, & Ford, 2008).

The second limitation is that, although research with broader samples exists, those data were collected before 2009 (Coups et al., 2008; Oh et al., 2010; Ramirez et al., 2013; Wang, Miller, Egleston, Hay, & Weinberg, 2010). This timeframe is important because former First Lady Michelle Obama's "Let's Move" campaign was implemented in 2010 (U.S. Department of Health and Human Services et al., 2010). "Let's Move" was an extended, nationwide multi-level campaign to educate the public about the health benefits of physical activity and to encourage physical activity behavior (Bumpus, Tagtow, & Haven, 2015; McKinnon, Wiedt, Hoffnagle, & Shrimplin, 2015; Obama, 2012; U.S. Department of Health and Human Services et al., 2010). Although it has not been formally evaluated, it would be surprising if a nationwide campaign promoted by the First Lady of the United States has *not* affected awareness in the intervening years.

Third, many studies examine awareness using recognition techniques; that is, by presenting individuals with a list that includes physical activity as a cause of disease and then evaluating whether they choose physical activity off the list (e.g., (Ramirez et al., 2013; Wang et al., 2010; Wold et al., 2005)). Studies that assess awareness based on participant's open-ended recall can produce dramatically different results and may be a more realistic assessment of risk factor awareness and knowledge (Waller, McCaffery, & Wardle, 2004; Weinstein, 1999). One survey of a national sample of New Zealanders reported that, whereas 77% of respondents could recognize that physical activity reduces cancer risk when physical activity was on a list of possible risk factors, only 27.1% could generate physical activity spontaneously when asked to recall what factors could reduce cancer risk (Richards et al., 2017). Similarly low levels of recall awareness were found for a U.S. sample (Coups et al., 2008).

Empirical Research Examining the Relationship between Awareness and Physical Activity Behavior

Empirical support for the independent relationship between awareness alone and physical activity behavior is limited, despite (1) broad theoretical support for the importance of risk factor awareness in predicting engagement in volitional health behavior, and (2) the inclusion of awareness-based educational components in many individual-level physical activity interventions and mass-media campaigns. This dearth of information results from scientists who report the results of the intervention overall as a whole, rather than the results of its individual sub-components.

Even some studies that examined awareness did not model the specific relationship between an individual's awareness and his or her behavior (Cullen & Buzek, 2009; Richards et al., 2017; Wang et al., 2010; Wold et al., 2005). Those that did were limited in their ability to draw conclusions about causation. For example, one study noted that geographic areas of the U.S. that had higher awareness of the link between colon cancer and physical activity also had higher physical activity behavior (Ramirez et al., 2013). Another study found that people who did not engage in physical activity were more likely to be unaware of the link between colon cancer and physical activity than people with higher physical activity levels (Coups et al., 2008). Thus, additional research into the link between awareness of insufficient physical activity as a risk factor and physical activity behavior is needed.

Objectives and Exploratory Research Questions

Our research begins to fill some of these gaps in the literature. Our primary objective was to examine what diseases people thought were caused by insufficient physical activity. To accomplish this, we analyze data from a recent sample of the U.S. general population that oversampled socio-demographically disadvantaged groups. To increase the rigor of our definition of awareness and also reduce the likelihood that our findings would be vulnerable to acquiescence bias, we assessed awareness using participants' recall instead of recognition.

Our exploratory research questions examined whether the types of diseases people identified (1) differed by socio-demographic characteristics and (2) were associated with physical activity intentions or behavior.

METHODS

This study represents a secondary analysis of data collected for the purpose of developing an intervention that uses a smartphone-based risk assessment tool to communicate personalized risk estimates for five common health conditions associated with insufficient physical activity: heart disease, diabetes, stroke, colon cancer, and, for women only, breast cancer. Full details of the parent study's cross-sectional experimental design, methods, stimuli, procedures, and results can be found in (Janssen, Ruiter, & Waters, 2017). We describe them briefly below. All procedures and materials were approved by the Washington University IRB and participants provided electronic informed consent.

Sample Characteristics and Setting

Participants for the parent study (N=1161) were recruited between November 11, 2015 and December 7, 2015 from a nationwide Internet-based survey panel developed by GfK. The inclusion criteria (Janssen et al., 2017) were intended to maximize the possibility that the health risk information provided in the parent study would be personally relevant to potential risk assessment tool users: age 30–65 and engaging in less than 150 minutes per week of moderate intensity aerobic physical activity. We stratified recruitment to ensure that at least 50% of the sample had minority racial/ethnic backgrounds and at least 50% of the sample had no more than vocational-technical training. Of the 5926 people GfK invited, 3400 (57.4%) responded to the survey invitation. Of these, 1530 (45.0%) did not meet inclusion criteria. Of the remaining 1870 eligible individuals who responded to the invitation, 1161 (62.1%) agreed to participate.

We randomly selected 31% (n=361) of the original study sample of 1161 for the analyses reported in this manuscript.

Procedure

For the parent study (Janssen et al., 2017), GfK randomly selected individuals from its Panel database and emailed them an invitation to participate. Those who agreed completed the online eligibility screener and, if eligible, were invited to complete the study. Individuals who consented completed Questionnaire 1, which included the items relevant for this study. Then, they read a hypothetical scenario that described the purpose of a risk assessment tool and asked them to imagine that they had just entered their information into such a tool. Next, they were randomly assigned to see one of twelve risk ladders (Sandman, Weinstein, & Miller, 1993) that provided them with hypothetical risk estimates for heart disease, stroke, diabetes, and colon cancer. Immediately afterwards, participants completed Questionnaire 2. Further discussion of the effects of the risk ladders on information comprehension, affect, and health cognitions can be found in the paper by Janssen et al., 2017.

Measures

The questionnaires, codebook, and dataset can be obtained from the corresponding author. Most of the measures were obtained from prior sources and, if necessary, adapted to be relevant for physical activity or based on feedback from pilot testing.

Two measures from Questionnaire 1 are relevant for the analyses reported here. *Minutes of physical activity obtained in the previous week* was calculated by multiplying responses from two items adapted from (National Cancer Institute, 2014) and (Colditz, 2004): “Moderate intensity physical activities make you breathe harder than normal but you are not ‘out of breath.’ You will sweat a little and can have a conversation, but you cannot sing. Examples of moderate intensity activities are walking quickly, dancing, vacuuming, mowing the lawn with a push mower, and bicycling at a regular pace. In the last 7 days, how many days did you do any physical activity of at least moderate intensity?”; and “On the days that you did any physical activity of at least moderate intensity, for how long did you do these activities?” *Awareness of physical activity-related illnesses* was assessed with one item adapted from (Weinstein, Slovic, Waters, & Gibson, 2004): “To the best of your knowledge, what illnesses, if any, are caused by not getting enough physical activity?” Participants could provide up to three responses to this open-ended question.

Questionnaire 2 included items assessing a variety of cognitive and affective responses to information provided, as well as socio-demographic and health history characteristics. The *socio-demographic* items most relevant for this study were obtained from (National Cancer Institute, 2014): sex, education, race, and ethnicity. These items were dichotomized as follows: education (high school degree or less vs. some college or more) and race/ethnicity (non-Hispanic white vs. racial/ethnic minority). *Intentions to engage in physical activity* were assessed with three items adapted from (Conner & Sparks, 1995): “I [intend/want/expect] to get regular physical activity in the next 3 months, $\alpha=.91$. [1=Do not agree; 2=Agree a little; 3=Agree some; 4=Agree a lot]”. “Regular” was defined as “getting at least 30 minutes of moderate intensity activity on 5 days a week, or at least 2½ hours per week.”

Analysis Plan

Data were analyzed from January 5, 2017 to October 17, 2017. Of the 361 randomly selected participants from the parent study, we report the analyses from the 351 participants who took at least 7 minutes to complete the entire survey (Janssen et al., 2017). We did not perform an *a priori* power analysis because the primary objective of the study was qualitative and the quantitative objective was exploratory and hypothesis-generating.

Qualitative analysis of the open-ended responses focused on identifying the manifest content/stated meaning of responses at the participant level (Graneheim & Lundman, 2004; Sandelowski, 2000). EH and EW independently reviewed all 700 responses and identified potential codes. Then, an iterative analytic strategy was used in which 5% of the responses were coded by both EH and EW, the results discussed, and the codes refined. Another 5% of the responses were coded and the results were discussed. In this second round of coding, agreement was 100% and so the codes were finalized. Each of the 700 open-ended responses was categorized into one of ten unique codes. An additional category called *No Condition Named* captured situations in which a response text box was left blank. Next, EH recoded all responses for each of the remaining participants. EW double-coded 5% of those responses to ensure accuracy and reduce bias resulting from having only one coder. Agreement was 100%. Data were organized for analysis using Microsoft Excel.

We began the quantitative analyses by creating 11 dichotomous variables. Each variable represented whether, for a given code, the participant did (coded 1) or did not (coded 0) identify a disease related to the code in at least one of his or her three open-ended responses to the question about diseases caused by physical inactivity. For example, if a participant left one of the three text boxes blank, then the value for the “No condition named” code would be 1. If the participant provided a condition for each of the text boxes, the value for the “No condition named” code would be 0. Then we calculated, for each of the 11 code indicator variables separately, the frequency and percentage of participants who mentioned a condition that was relevant to the code. To explore whether the frequency of each code varied by socio-demographic characteristics, we used chi-square tests and Fisher’s exact tests, as appropriate. To explore whether each code was associated with physical activity intentions or behavior, we used a series of t-tests and Mann-Whitney U tests, as appropriate, with the dichotomous disease category code as the predictor. Data were analyzed using SPSS and statistical significance was indicated at $p < .05$. Missing data were handled with pairwise deletion.

RESULTS

Participant Characteristics

Characteristics of the 351 participants included in this analysis are described in Table 1. In brief, most participants were female, and, as designed, the sample had approximately equal numbers of people who reported no more than a high school degree or equivalent vs. some college experience, and those who reported having a minority racial or ethnic background vs. no minority background. Average age was approximately 47 years. Thus, the sample was older, had less formal education, and was more racially diverse than the general U.S. population.

Qualitative Analyses

The number and the percentage of participants who are grouped into each code or category are noted in Table 1. Of the 351 participants in this analytic sample, 49 (14.0%) provided no response to any of the open-ended items asking participants to indicate what illnesses are caused by physical inactivity (i.e., they left all three text boxes blank), 60 (17.1%) provided only one response, 86 (24.5%) provided two responses, and 156 (44.4%) provided three responses (i.e., one for each available text box provided).

Responses coded as *Cardiovascular* included anything related to the heart (e.g., “heart disease,” “heart failure”), vascular issues (e.g., “stroke,” “blood clots”), and other related concerns (e.g., “cholesterol,” “arteriosclerosis”). Responses coded as *Metabolic* included anything related to obesity, diabetes, or other metabolic-related issues such as “fatness,” “sugar,” “fatty liver,” “obesity,” and “diabetes.” The *Musculoskeletal* code included items related to muscles, joints, and bones, including “osteoporosis,” “muscle loss,” “back problems,” “stiffness,” and “fractures.” The *Fatigue* code included words related to energy levels, including “slowness,” “weakness,” “tiredness,” and “fatigue.” The *Psychiatric* code included mental concerns such as “depression,” “stress,” “Alzheimer’s,” and “insomnia.” Responses coded as *Respiratory* included “shortness of breath,” “COPD,” and “asthma.”

Gastrointestinal included “digestive disorders,” “ulcers,” and “constipation.” The *Cancer* code included “cancer” and “tumors.” Responses that were health-related but did not fit into the other categories were coded as *Other* and include problems such as “dermatitis,” “colds,” “gout,” and “death.” Some responses were difficult to interpret and were coded as *Unexpected Interpretation*. Examples of these included “old,” “walking,” “breathing,” and “bad right leg.”

Quantitative Analyses

Most of the analyses examining whether the proportion of participants who mentioned a code differed by socio-demographic groups were not significant. Specifically, the frequency of a given code was generally equal between men and women, between people with and without some college experience, and between people with and without a minority racial or ethnic background (Table 2). The only exceptions were that, although 63.5% of participants mentioned illnesses that were coded as cardiovascular, this was more common among people with some college experience (72.7%) vs. no college experience (54.3%), $p=.001$, and among people who reported being non-Hispanic white (69.5%) vs. having a minority racial ethnic background (57.6%), $p=.02$. Similarly, although metabolic illnesses were mentioned by 65.8% of the overall sample, non-Hispanic whites mentioned these illnesses more often (71.3%) than racial/ethnic minorities (60.5%), $p=.03$. Participants with less formal education were more likely to have not named a condition for at least one of the text boxes (65.1%) compared to people with more formal education (46.0%), $p<.001$.

The presence or absence of a type of disease code was also largely unrelated to intentions to engage in physical activity and to minutes of physical activity obtained in the previous week (Table 3). The exceptions, once again, were the cardiovascular and metabolic codes. Intentions were higher among people who did vs. did not mention a cardiovascular illness, $p=.001$, Cohen’s $d=0.37$, and among people who did vs. did not mention a metabolic illness, $p=.01$, $d=0.37$. Past physical activity behavior was also higher among people who did vs. did not mention a cardiovascular illness, $p=.001$, $d=0.38$ and among people who did vs. did not mention a metabolic illness, $p=.005$, $d=0.32$. Participants who did not name a condition had lower intentions, $p=.006$, $d=0.27$ and engaged in fewer minutes of physical activity in the previous week, $p=.001$, $d=0.35$ than participants who provided responses for all three text boxes.

DISCUSSION

Our primary objective was to examine which types of diseases lay people thought were caused by insufficient physical activity. When asked to generate examples of diseases associated with obtaining insufficient amounts of physical activity, a large majority of our socio-demographically diverse national sample of U.S. adults mentioned diseases associated with the cardiovascular or metabolic systems. This is unsurprising, considering the emphasis many health communication campaigns have placed on using physical activity to promote “heart health” and weight loss. Very few people, however, mentioned cancer or other health problems, and more than half left at least one of the three text boxes used to collect responses blank. This limited scope of awareness of the many types of diseases that are

associated with insufficient physical activity is consistent with other research in the area (Claassen et al., 2011; Cullen & Buzek, 2009; Wang et al., 2010), particularly in the cancer domain (Coups et al., 2008; Oh et al., 2010; Wang et al., 2010; Wold et al., 2005). Our research is novel because, unlike most other research in this area, we recruited a large, highly socio-demographically diverse sample from across the U.S. This increases generalizability of our findings to potentially disadvantaged populations and extends our findings beyond small, clinic-based samples.

Overall, socio-demographic characteristics such as sex, education, and race/ethnicity were not associated with mentioning disease codes. The few exceptions were consistent with the broader literature on health disparities (Centers for Disease Control & Prevention, 2013a, 2013b): that people from potentially disadvantaged socio-demographic groups had less awareness of the link between a key risk factor and diseases for which they are disproportionately at-risk.

Significantly higher physical activity intentions and behavior were associated with mentioning a disease categorized as cardiovascular or metabolic in nature, as well as mentioning three diseases instead of leaving at least one response text box blank. This is consistent with the premise of many health behavior theories, which assert that motivation to engage in healthy behaviors is higher among people who are aware of the link between a given behavior and the benefits for its associated health outcome(s) (Ajzen, 1985; Fishbein & Ajzen, 1975; Michie et al., 2011; Prochaska et al., 1997; Rogers, 1983; Schwarzer & Fuchs, 1995; Weinstein, 1988; Witte, 1992). The absence of a link between mentioning a type of disease and intentions and behavior for the other disease codes may be due to a very low frequency of responses within many codes or uncertainty among participants in their responses.

Limitations and Future Research

The address-based sampling strategies that GfK uses to recruit panel participants reduce bias compared to opt-in panels and allows people to participate even if they do not have Internet access. Nevertheless, because this was a cross-sectional survey, it is not possible to draw causal or directional inferences about the relationship between mentioning a code and physical activity intentions or behavior. Future research using longitudinal methods and employing an intervention approach are needed. In that research, physical activity should be assessed using objective measures instead of self-report. It would also be interesting to inform people about the risks of insufficient physical activity for a variety of health problems beyond cardiovascular and metabolic diseases to see if the null associations reported here between many of the disease codes (e.g., cancer) and intentions and behavior also occur in experimental settings.

It should be noted that only a small percentage of the total number of people who were invited to participate in the parent study (Janssen et al., 2017) completed it (i.e., 1161 out of 5926, 1530 of whom did not meet inclusion criteria). It is possible that the 1161 people who agreed to participate in the parent study are different from the 3235 individuals who were eligible but did not participate. Although the 361 participants for this study were randomly selected from the 1161 total participants and had similar demographic characteristics as the

parent study (see Table 2), selection bias in the parent study sample may also be present in the sub-sample for these analyses.

We conducted a large number of statistical tests and did not correct for Type I error. We made this decision because we view this study as exploratory and hypothesis-generating. One example hypothesis, based on the means in Table 3, is that providing people with information about the risks of physical inactivity for cardiovascular disease will increase physical activity intentions and behavior to a greater extent than providing them with information about the relationship between physical inactivity and musculoskeletal problems, or even between physical inactivity and cancer. Future research should test this hypothesis and explore possible cognitive or affective mechanisms driving any effect.

Other possibilities for future research should also be explored. It would be worthwhile to explore whether framing messages as “gains” (i.e., the benefits of physical activity) is more or less motivating than the current loss framing (O’Keefe & Jensen, 2007). Future research should also examine whether health communications that explain in lay terms the biological mechanisms linking physical inactivity to increased cancer risk might increase motivation to obtain physical activity (Cameron, Marteau, Brown, Klein, & Sherman, 2012; Lee, Cameron, Wunsche, & Stevens, 2011). Furthermore, it is not possible to determine whether participants who left response options blank did so because they did not know of any diseases related to insufficient physical activity or because they were not motivated enough to provide an open-ended response. We also asked participants to reflect on the “illnesses” caused by insufficient physical activity, but it is possible that responses might differ if the question was framed as “disease.” These possibilities should be investigated in the future.

Notably, although health behavior theories assert a link between risk awareness/knowledge and behavior, the link is not completely deterministic. This is similar to findings reported in risk perception research; interventions that increase perceived risk can increase engagement in physical activity (Sheeran, Harris, & Epton, 2014), but there are many other influences on behavior as well. Bridging such “knowledge-practice gaps” by supplementing information-based interventions with other components, such as those that target multiple levels of influence (Stokols, 1996). For example, interventions that target an individual’s self-regulation practices and interpersonal factors by implementing a “walking buddy” program may be more effective than increasing awareness and knowledge alone. Workplace walking programs, city policies to increase the walkability of neighborhoods, and rebates for fitness club memberships by private and public health insurers may also be beneficial.

Conclusion

Among socio-demographically diverse U.S. adults, awareness of diseases that are associated with insufficient physical activity was largely focused cardiovascular and metabolic problems. To ensure that lay people understand the full impact of physical activity on their health, health communication researchers and practitioners should consider broadening their interventions to raise awareness that insufficient physical activity may increase the risk of not only cardiovascular diseases and diabetes, but many other diseases as well, and that increasing physical activity can improve overall health and well-being. These efforts to

increase awareness can then be supplemented with individual-level and multi-level interventions in order to help people bridge the gap between awareness and behavior.

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Table 1.

Participant Characteristics, Frequency of Diseases Identified, and Means and SDs of Behavioral Outcomes

Variable	n (%) of subsample (N=351) ^a	n (%) of entire sample (N=1161)
Age (M, SD)	47.3 (10.6)	48.2 (10.3)
Gender		
Male	144 (41.0)	488 (42.0)
Female	206 (58.7)	658 (56.7)
Missing	1 (0.3)	15 (1.3)
Education		
High school degree/equivalent or less	175 (49.9)	599 (51.6)
Some college or more	176 (50.1)	562 (48.4)
White		
White non-Hispanic	174 (49.6)	581 (50.0)
Racial/ethnic minority	177 (50.4)	580 (50.0)
Black or African American non-Hispanic	56 (16.0)	221 (19.0)
Other, non-Hispanic ^b	26 (7.4)	79 (6.8)
Multiracial, non-Hispanic	19 (5.4)	61 (5.3)
Hispanic	76 (21.7)	219 (18.9)
Disease Code^{c, d}		
Cardiovascular	223 (63.5)	
Metabolic	231 (65.8)	
Musculoskeletal	37 (10.5)	
Fatigue	7 (2.0)	
Psychiatric	28 (8.0)	
Respiratory	12 (3.4)	
Gastrointestinal	3 (0.9)	
Cancer	12 (3.4)	
Other	10 (2.8)	
Unexpected interpretation	5 (1.4)	
No condition named ^e	195 (55.6)	
Behavioral Outcomes		
Intentions to obtain physical activity (n=346, M, SD) ^f	2.8 (0.8)	
Minutes of physical activity in prior week (M, SD)	48.0 (44.7)	

M=Mean, SD=standard deviation. Some totals may not sum to 100% due to rounding.

^aN=351 unless otherwise indicated.^bIncludes Asian and American Indian/Native American. No Pacific Islanders, Native Hawaiians, or Alaska Natives agreed to participate.^cParticipants could identify up to three diseases, so percentages total more than 100 percent.^dDisease codes are unavailable for the full sample because only the subsample was coded.

^e Eleven of the 195 no condition named codes represent individuals who reported “none” or “n/a.”

^f Higher scores indicate higher intentions, as assessed by the average of 3 items, Cronbach’s $\alpha = .91$. Response options were [1] Do not agree to [4] Agree a lot. There were 5 missing data points for intentions.

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Table 2.Frequency of Disease Codes by Demographics (N=351)^a

Disease Code	n (%)	Sex (N=350)		p	Education		p	White		p
		Men	Women		High School/ GED	Some college		Racial/ ethnic minority	Non-Hisp White	
		n=144	n=206		n=175	n=176		n=177	n=174	
		n (%)	n (%)		n (%)	n (%)		n (%)	n (%)	
Cardiovascular	223 (63.5)	95 (66.0)	128 (62.1)	.46	95 (54.3)	128 (72.7)	<.001	102 (57.6)	121 (69.5)	.02
Metabolic	231 (65.8)	99 (68.8)	132 (64.1)	.36	107 (61.1)	124 (70.5)	.07	107 (60.5)	124 (71.3)	.03
Musculoskeletal	37 (10.5)	14 (9.7)	23 (11.2)	.67	19 (10.9)	18 (10.2)	.85	20 (11.3)	17 (9.8)	.64
Fatigue	7 (2.0)	4 (2.8)	3 (1.5)	.45 ^b	5 (2.9)	2 (1.1)	.28 ^b	4 (2.3)	3 (1.7)	1.0 ^b
Psychiatric	28 (8.0)	9 (6.3)	19 (9.2)	.31	13 (7.4)	15 (8.5)	.71	15 (8.5)	13 (7.5)	.73
Respiratory	12 (3.4)	8 (5.6)	4 (1.9)	.08 ^b	3 (1.7)	9 (5.1)	.08	4 (2.3)	8 (4.6)	.23
Gastrointestinal	3 (0.9)	1 (0.7)	2 (1.0)	1.0 ^b	1 (0.6)	2 (1.1)	1.0 ^b	2 (1.1)	2 (0.6)	1.0 ^b
Cancer	12 (3.4)	5 (3.5)	7 (3.4)	1.0 ^b	6 (3.4)	6 (3.4)	.99	3 (1.7)	9 (5.2)	0.7
Other	10 (2.8)	5 (3.5)	5 (2.4)	.75 ^b	4 (2.3)	6 (3.4)	.75 ^b	5 (2.8)	5 (2.9)	1.0 ^b
Unexpected interpretation	5 (1.4)	1 (0.7)	4 (1.9)	.65 ^b	2 (1.1)	3 (1.7)	1.0 ^b	5 (2.8)	0 (0.0)	0.6 ^b
No condition named	195 (55.6)	79 (52.1)	119 (57.8)	.29	114 (65.1)	81 (46.0)	<.001	104 (58.8)	91 (52.3)	.22

Boldface indicates statistical significance (p<0.05).

GED=Graduate Equivalency Diploma

^aN=351 unless otherwise noted.^bFisher's exact test used for expected cell counts <5. Otherwise chi-squared tests were used

Table 3.

Physical activity intentions and behavior by presence or absence of disease code among participants

Disease Code	n (%)	Intentions					
		T- or U-value ^a	df	p	Code Present Mean (SD) or Median ^b	Code Absent Mean (SD) or Median ^b	Mean difference (95% CI)
Cardiovascular	223 (63.5)	3.3 ^c	214.9	.001	2.9 (0.7)	2.6 (0.9)	0.3 (0.1–0.5)
Metabolic	231 (65.8)	2.6 ^c	191.4	.01	2.9 (0.7)	2.6 (0.9)	0.3 (0.1–0.4)
Musculoskeletal	37 (10.5)	5169.5	N/A	.33	3.0	3.0	N/A
Fatigue	7 (2.0)	1127.0	N/A	.82	3.0	3.0	N/A
Psychiatric	28 (8.0)	4193.5	N/A	.62	3.0	3.0	N/A
Respiratory	12 (3.4)	1717.0	N/A	.39	3.0	3.0	N/A
Gastrointestinal	3 (0.9)	278.5	N/A	.16	3.3	3.0	N/A
Cancer	12 (3.4)	1514.0	N/A	.14	3.0	3.0	N/A
Other	10 (2.8)	1489.0	N/A	.53	3.0	3.0	N/A
Unexpected interpretation	5 (1.4)	831.5	N/A	.92	3.0	3.0	N/A
No condition named	195 (55.6)	2.8	344	.006	2.7 (0.8)	2.9 (0.7)	−0.2 (−0.4–(−0.1)
Behavior							
Cardiovascular	223 (63.5)	3.5 ^c	300.7	.001	54.0 (46.2)	37.6 (39.4)	16.4 (7.2–25.6)
Metabolic	231 (65.8)	2.9	349	.005	52.9 (45.1)	38.7 (42.4)	14.2 (4.6–23.8)
Musculoskeletal	37 (10.5)	5310.5	N/A	.39	40.0	40.0	N/A
Fatigue	7 (2.0)	993.0	N/A	.42	40.0	40.0	N/A
Psychiatric	28 (8.0)	3646.5	N/A	.08	50.0	40.0	N/A
Respiratory	12 (3.4)	1875.5	N/A	.64	52.5	40.0	N/A
Gastrointestinal	3 (0.9)	373.5	N/A	.39	0.0	40.0	N/A
Cancer	12 (3.4)	1922.0	N/A	.74	20.0	40.0	N/A
Other	10 (2.8)	1209.0	N/A	.11	75.0	40.0	N/A
Unexpected interpretation	5 (1.4)	632.5	N/A	.29	0.0	40.0	N/A
No condition named	195 (55.6)	3.2	349	.001	41.2 (3.0)	56.8 (3.7)	−15.2 (−24.6–5.9)

Boldface indicates statistical significance (p<0.01).

N/A=information not applicable for the column.

df=degrees of freedom. SD=standard deviation. CI=confidence interval.

^aMann-Whitney U tests were used for all analyses except those for the Cardiovascular, Metabolic, and No condition named codes. For those codes, t-tests were used.^bMedians reported instead of means for all analyses except those for the Cardiovascular, Metabolic, and No condition named codes. For those codes, means and standard deviations are reported.^cEqual variances not assumed due to a statistically significant Levene's test for equality of variances