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Physical activity levels of persons with mental illness attending psychiatric rehabilitation programs

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Abstract

This study objectively measured physical activity levels in overweight and obese adults with severe mental illness and examined relationships among psychiatric symptoms, cognitive functioning and physical activity. A diverse sample (50% female, 50% African American) of overweight and obese adults (n=55) with mental illness were asked to wear accelerometers for 4 days. Study participants averaged 120 minutes/week of moderate to vigorous physical activity (MVPA); 35% had ≥ 150 minutes/week of MVPA. Only 4% accumulated ≥ 150 minutes/week of MVPA in bouts ≥ 10 minutes as per public health recommendations. Depressive symptoms, psychological distress and cognitive functioning were not associated with physical activity ($p > .05$). Although participants appeared to have substantial minutes of MVPA, increased physical activity bouts, or sessions, may be necessary for increased health and weight management benefits for persons with severe mental illness. Efforts are needed to increase physical activity sessions in this vulnerable population.

Keywords

Severe Mental Illness; Physical Activity; Exercise; Accelerometers; Obesity

1. Introduction

Obesity is at epidemic levels, and because of its association with cardiovascular disease, it is the second leading cause of preventable death in the United States (Flegal et al., 2002; Flegal et al., 2005). The prevalence of excess weight is even higher among adults with severe mental illness, and many of these adults have other chronic conditions such as diabetes, heart disease,

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hypertension, or pulmonary disease (Allison et al., 1999; Compton, Daumit, & Druss, 2006; Jones et al., 2004; Weil et al., 2002). Regular physical activity is one of the few health behaviors with demonstrated benefits for weight loss as well as related conditions such as hypertension, cardiovascular disease, and diabetes (American College Of Sports Medicine, 1998; US Department of Health and Human Services, 2000). Even independent of other risk factors, physical activity is associated with improved health status and decreased risk of premature mortality (Blair & Brodney, 1999; Haskell et al., 2007). Physical activity recommendations range from 150 minutes/week for general health benefits to 60 minutes/day for weight control (American College Of Sports Medicine, 1998; Haskell et al., 2007; Jakicic et al., 2001; Trumbo et al., 2002; US Department of Health and Human Services, 2000).

Physical activity levels in adults with severe mental illness are not well studied, although available evidence suggests this group is less active than the general population (Compton et al., 2006; Daumit et al., 2004). The lack of tailored physical activity programs may be one reason for these low activity rates. Psychological symptoms and low cognitive functioning may also pose a barrier to regular physical activity. A previous study found that adults with intellectual disabilities had higher levels of physical inactivity compared to the general population estimates of physical activity (Robertson et al., 2000). Additionally, persons with mental illness report that negative affective states (e.g., sadness, depression) as well as mental illness symptoms are barriers to their participation in physical activity (McDevitt et al., 2006; Ussher et al., 2007). There have been few attempts to use objective measures of physical activity to determine if these psychological factors are barriers to regular physical activity levels.

One of the challenges in studying physical activity in persons with chronic mental illness is assessing physical activity. Accurate measurement of physical activity is difficult in the general population, and may be particularly challenging in persons with severe mental illness. Physical activity questionnaires are simple to administer, but are subject to self-report bias. Studies examining the use of physical activity questionnaires in adults with mental illness showed only modest correlation with objective, accelerometer-based, measures of physical activity (Faulkner, Cohn, & Remington, 2006; Soundy et al., 2007). An accelerometer is a small, unobtrusive, device the size of a pager, that records movement, or accelerations, and provides a corresponding activity count used in determining physical activity levels. Their use in clinical trials and population-based studies has increased substantially in the last decade. This technology is considered one of the most significant advances in activity measurement (Trost, McIver, & Pate, 2005; Ward et al., 2005). Although there is increased participant burden using accelerometers compare to self-report questionnaires, the resulting data allow for objective estimates of time spent in sustained physical activity.

The first objective of this study was to determine the extent to which adults with severe mental illness in a psychiatric rehabilitation center met the Surgeon General's physical activity recommendation of 30 minutes of moderate to vigorous physical activity on most if not all days of the week (US Department of Health and Human Services, 2000). The second objective was to examine if physical activity levels were associated with mental health symptoms or cognitive functioning.

2. Methods

2.1. Recruitment

Participants were undergoing screening for enrollment in a diet and physical activity intervention study at two psychiatric rehabilitation centers, one in Baltimore City (urban) and one in Baltimore County (suburban). Eligible participants were at least 18 years of age with a body mass index of at least 25 kg/m^2 and no medical contraindications for weight loss or

participation in moderate intensity physical activity. Body mass index (BMI) was based on National Institutes of Health cutoff points calculated from standardized measurement of height and weight (National Heart Lung, and Blood Institute, 1998). All procedures were approved by the Johns Hopkins University Institutional Review Board and written informed consent was obtained.

2.2 Measures

Trained staff measured weight with a digital scale to the nearest 0.1 lb and height with a stadiometer to the nearest 0.1 cm. The primary psychiatric diagnosis/disorder was obtained from chart review. Participants completed the Symptom Checklist-90 (SCL-90) providing a measure of psychological distress with the global severity index (Derogatis, Lipman, & Covi, 1973). Interviewers assessed depressive symptoms with the Center for Epidemiologic Studies Depression Scale (CES-D), and cognitive function with the Repeatable Battery for the Assessment of Neuropsychological Status (Gold et al., 1999; Radloff, 1977).

The Surgeon General's guidelines for moderate to vigorous intensity physical activity (MVPA) are often operationalized in two different ways. The simplest approach is to track the accumulation of at least 30 minutes/day of moderate to vigorous physical activity for 5 out of 7 days, or ≥150 minutes/week of MVPA. Another common approach uses the same volume of physical activity (≥150 minutes/week MVPA) but indicate that physical activity needs to be performed in sessions lasting at least 10 minutes in duration. The latter is a more comprehensive operationalization of the actual recommendation.

Physical activity was assessed with the RT3 (Stayhealthy, Inc), a triaxial accelerometer. The RT3 captures movement, or acceleration, from vertical, horizontal, and anterior-posterior planes resulting in vector magnitude for each minute of monitoring. The vector magnitude is summarized into activity counts that are used to determine the intensity of activity performed during that time period. The RT3 has been shown to be a reliable and valid physical activity measure (Powell, Jones, & Rowlands, 2003; Rowlands et al., 2004). Previous work showed that activity counts from the RT3 had strong correlation with steady state oxygen consumption during treadmill walking at different speeds (r=.79) and during non-regulated physical activity, r=.89 (Rowlands et al., 2004).

Participants received both written and verbal directions for wearing the accelerometers. They were asked to wear the accelerometer during waking hours on their right hip for 4 days, including 1 weekend day. Due to the scheduling of data collection appointments, participants often had the accelerometer for 1 week and were asked to wear the device the entire time. Accelerometers were re-administered to those participants who did not have at least 10 hours of wear time per day across 3 weekdays and 1 weekend day.

On all days with at least 10 hours of accelerometer wear time, total number of minutes with activity counts above the previously established cut-point for moderate physical activity (i.e., 1316 counts/min) were summed to provide daily minutes of MVPA (Rowlands et al., 2004). Moderate to vigorous physical activity performed in bouts of at least 10 minutes (bout MVPA) were also identified. Estimated average minutes/week of MVPA was calculated as the weighted average of average daily MVPA associated with both weekends and weekdays (estimated MVPA=(mean $MVPA_{weekday}$*5 + mean $MVPA_{weekend}$*2)). The aforementioned steps in processing the accelerometer data were performed uses SAS 9.1 (Cary, NC) and details are available from the primary author.

2.3 Participants

The 66 participants across the two psychiatric rehabilitation programs were diverse with respect to race and sex (48% African American, 52% female) and ranged in age from 20 to 67 years old (M=44 years). Participants were either overweight (27%) or obese (73%). The primary psychiatric condition was determined by chart review with 58% of the participants identified as schizophrenia or schizoaffective disorder, 23% bipolar disorder, and 18% major depression. CES-D scores ranged from 1 to 49 and the average CES-D score (M=22.2, SD=12.0) indicated substantial depressive symptoms. Participants were taking a mean of 2.4 (SD=1.3) psychotropic medications with 87% using antipsychotics; 71% atypical and 22% typical antipsychotics. There were 38% of the participants who had a history of alcohol or substance abuse. The average SCL-90 global severity index was 0.97 (SD=.75) indicating that severity of psychological symptoms were higher in this sample than in the general population (Gold et al., 1999) with scores ranging from .01 to 2.99. RBANS scores ranged from 44 to 111 and the average RBANS scores (M=64.3, SD=14.1) indicated a cognitive impairment. We had sufficient accelerometer data on 55 participants and the analyses were limited to these participants.

2.4 Analyses

Spearman rank-order correlations are often used to examine associations of a number of variables with physical activity data due to the skewed distribution of the data. In this study we calculated spearman correlations of selected characteristics (age, BMI, CES-D, SCL-90 and RBANS) with both MVPA and bout MVPA. In addition we examined activity levels across dichotomized groups. Specifically, a median split was calculated for age. Cut-points based on clinical literature were used to create dichotomous variables for depressive symptoms, psychological distress, and cognitive functioning. We used an established cut-point for depressive symptoms (CES-D <16) were higher CES-D scores indicate higher levels of depressive symptoms (Radloff, 1977; Weissman, Sholomskas et al., 1977). Similarly, higher SCL-90 scores indicate higher severity of psychological symptoms and previous reports identified .91 as an appropriate cut-point between community populations and clinical samples (Holi, Marttunen, & Aalberg, 2003). However, for the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS), higher scores indicate higher cognitive functioning and we used <70 as a clinical cut-point based on literature suggesting that 70 was a conservative cut-point to distinguish clinical subgroups (Derogatis, 1994). We also created dichotomous variables using median splits for depressive symptoms, psychological distress, and cognitive functioning. Sensitivity analyses were performed using these median splits. Analyses were conducted using SPSS for Windows, version 13.0 (Chicago, IL) and *p* values are presented for two tailed t-tests when comparing means and global chi-square test comparing cross-tabular frequencies.

3. Results

We defined compliance with the accelerometer as wearing the device for at least 4 days with at least 10 hours of accelerometer data per day. Only 25 participants were compliant on the first distribution of accelerometers; however 16 participants agreed to wear the accelerometer again resulting in 54 compliant participants (82%). Compliers did not differ from non-compliers based on sex, race, age, BMI, diagnosis/disorder, or psychiatric symptoms. One participant had two weekdays and one weekend day with at least 10 hours/day of wear time. Although she was not considered “compliant” her data was used for these analyses and sensitivity calculations indicate that her inclusion did not have a significant impact on the results. As such, the sample size for these analyses was N=55.

Average weekly physical activity levels indicated that the sample was active (M=120 minutes/ week of MVPA), albeit lower than recommended levels. However, the average minutes/week of MVPA that occurred in bouts ≥10 minutes was only 25 minutes/week (Table 1). Across subgroups the number of minutes/week of bout MVPA was at least a 65% lower than the minutes/week of MVPA. Similarly, 35% of the sample met physical activity guidelines (≥ 150 minutes/week of MVPA), but only 4% accumulated ≥150 minutes/week of bout MVPA.

Men were more physically active than women. Men had more weekly minutes of MVPA (p=.005) and a greater frequency of accumulating ≥150 weekly minutes of MVPA (p=.008); however, sex differences did not reach statistical significance (p=0.059) when examining MVPA performed in sessions of at least 10 minutes (Table 1). Younger adults (< 45 years old) had more minutes/week of MVPA (p=.020) and a greater frequency of accumulating at least 150 weekly minutes of MVPA compared with those 45 years of age and older (p=.024). Age group differences were not statistically significant when examining bout MVPA. No differences were found between African-Americans and Non-African Americans or between overweight and obese participants in physical activity levels or in meeting recommended guidelines.

Spearman rank-order correlation showed a moderate correlations between physical activity levels and age (ρ= −.46 to − .37), but no other characteristics (Table 2). Additional analyses are reported below, but data are not shown. There was a numerical, but non-significant difference in the weekly minutes of MVPA comparing the higher functioning RBANS subgroup (M=149.6 minutes/week; 40% ≥150 minutes/ week of MVPA) and the lower functioning RBANS group (M=102.9 minutes/week; 29% ≥150 minutes/week of MVPA). Physical activity did not differ across levels of depressive symptoms (CES-D) or severity of psychological distress (SCL-90). Similar results were found during sensitivity analyses that used dichotomous variables created by median splits rather than clinical cut-points on the CES-D, SCL-90 and RBANS measures.

4. Discussion

This is one of the first reports of objectively-measured physical activity among an ethnically diverse group of overweight and obese persons with Mental Illness (MI). The rehabilitation center participants accumulated on average, 120 minutes/week of MVPA, and 35% accumulated at least 150 minutes/week. These estimates are similar to accelerometer-based physical activity estimates of 25 individuals with schizophrenia. They accumulated on average 90-100 weekly minutes of MVPA, and 26% met physical activity guidelines of at least 150 minutes/week (Faulkner et al., 2006). The MVPA estimates from this paper contribute to the evidence that many adults with mental illness engage in some regular physical activity, but a majority fall short of meeting physical activity guidelines.

The Surgeon General and the American College of Sports Medicine suggest that activity be performed in bouts of at least 10 minutes in length for a total of 30 minutes/days, most days of the week (American College Of Sports Medicine, 1998; US Department of Health and Human Services, 2000). The sample was, on average, fairly active but few participated in sufficiently long bouts of activity to meet recommendations. Strikingly, only 4% of participants accumulated at least 150 minutes/week of MVPA performed in bouts of at least 10 minutes. The results from this study are similar to prevalence rates (3.2%-3.8% meeting recommendations) from a recent accelerometer-based national estimate (Troiano et al., 2008). We believe these results suggest the sample engaged in sporadic, rather than sustained, physical activity.

The operationalization of the "bout" dimension of the public health recommendation resulted in dramatically lower physical activity estimates. The average bout of MVPA (25 minutes/week) was 79% lower than the average minutes of MVPA (120 minutes/week). Similar disparities between MVPA and bout MVPA were also found in the Weight Loss Maintenance Trial (WLM), a large, multi-center weight loss trial (Svetkey, 2008). In the WLM trial, RT3 accelerometeres were used for baseline physical activity estimates on over 1300 overweight and obese adults entering a weight loss study. The average mins/week of bout MVPA was 64% lower than the average mins/week of MVPA in the WLM trial (Jerome et al., 2009). Undoubtedly, the participants in these studies are obtaining some health benefit from their moderate intensity physical activity, although this amount appears insufficient to achieve a healthy weight.

The physical activity recommendations for weight loss and weight maintenance are 60 minutes/day or more if needed (Trumbo et al., 2002) which is greater than the volume needed for general health (approximately 30 minutes/day). It is challenging to meet the weight loss and weight maintenance recommendations of 60 minutes each day or 420 minutes a week without intentionally participating in sessions of physical activity. Further research is needed to determine the general health benefits and the weight management benefits adults with mental illness would realize if bouts of physical activity were layered onto their current, sporadic physical activity levels.

Based on accelerometer data, we cannot determine if the paucity of physical activity performed in sessions of at least 10 minutes is due to brief transportation-related physical activity (e.g., walking a few blocks to the bus stop) or the absence of any planned continuous physical activity (e.g., exercise classes). The results are likely influenced by both scenarios. Other studies indicated that adults with mental illness report more minutes walking than minutes of MVPA (Dubbert et al., 2006; Faulkner et al., 2006). The participants in this study frequented public transportation. Perhaps a brisk walk to the bus stop by the participants was captured as MVPA by the accelerometer.

Psychological and affective factors may act as barriers to exercise for these adults (McDevitt et al., 2006; Ussher et al., 2007). In this study, those with lower cognitive functioning assessed by the RBANS appeared to have lower physical activity levels than those with higher cognitive functioning, but this difference was not significant. We found no evidence that depressive symptoms or severity of psychological symptoms were associated with activity levels. These findings are not definitive as the current study was a small pilot and may have been under powered to address this question.

Men were more active than women and that the younger participants were more active than the older participants. Similar sex and age difference have been found in population-based surveys of physical activity (Troiano et al., 2008; US Department of Health and Human Services, 2000). However the low levels of activity for women and older participants in this study may be due to the standard cut-points for the RT3 accelerometer. The cut-point used to interpret accelerometer output was standardized on a group of men (Rowlands et al., 2004). Thus, it may be appropriate for women and older adults to use a different accelerometer cut-point. Although two previous studies had used the RT3 accelerometer with adults with mental illness, there has not been a corresponding validation of the cut-points for different subgroups. Further validation of the RT3 intensity cut-points is need among different groups such as women and older adults.

One limitation of the study is the lack of self-reported description of physical activity. In addition there are limitations associated with accelerometer measurement as they do not capture swimming and do not provide an accurate representation of bicycling. We derived the primary

psychiatric diagnosis/disorder from chart review, and there is inherent error associated with this method. However, all participants had a severe metal illness by virtue of their attendance at the psychiatric rehabilitation center. Future studies could examine physical activity variation associated with actual DSM diagnoses.

We found high compliance with the accelerometer protocol, however, not without a few challenges. As noted, we re-administered accelerometers to a number of participants. One individual had an accelerometer for 2 weeks, but did not accumulate 4 days of data with at least 10 hours/day of wear time. It could be that the individual forgot to put on the accelerometer until late in the day or took it off mid-day. It is also possible that mental illness symptoms precluded sufficient waking hours to accumulate 10 hours/day of wear time. The mobility and daily functioning level of participants with MI may be a real barrier to accelerometer compliance. More information is needed on the daily functioning of participants to allow for better interpretation of accelerometer data. Accelerometer data could be coupled with information about functional limitations, typical number of waking hours or the frequency someone travels out of their house. This may lead to a more comprehensive profile of the participant's daily activity. Continued improvements are needed in optimizing accelerometer protocols and examining how other indicators of general mobility and daily functioning can assist in interpreting accelerometer output both in the general population and specifically for persons with severe mental illness.

6. Conclusion

This was one of the first studies with a diverse group of overweight and obese adults with mental illness to examine meeting physical activity recommendations taking into consideration that the activity sessions should be at least 10 minutes in duration. By analyzing accelerometer data that captures bouts, we were able to make a more accurate determination if the participants were meeting public health guidelines for physical activity. The current study provides conflicting evidence regarding the physical activity levels of adults with mental illness in that overall moderate intensity activity levels may be higher than expected but are not being performed in bouts of at least 10 minutes. Previously reported physical activity estimates that do not take bouts into consideration may be over-reporting compliance with physical activity guidelines among this population. The challenge in increasing physical activity levels for persons with mental illness will be to determine the most effective way to augment current activity to optimize health outcomes such as weight loss, weight loss maintenance, and the primary prevention of conditions such as cardiovascular disease. This may include the introduction of more structured activity programs targeting increased fitness.

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Table 1

Physical Activity Levels of Persons with Mental Illness by Selected Characteristics

	Moderate to Vigorous Physical Activity				Meeting Physical Activity Guidelines			
	minutes/wk		minutes/wk in bouts ≥ 10 minutes		≥ 150 minutes/wk		≥ 150 minutes/wk in bouts ≥ 10 minutes	
	M(SD)	*p*	M(SD)	*p*	(%)	*p*	(%)	*p*
Total (N=55)	120.3(13.1)		24.9(5.6)		35		4	
Sex		0.005		0.059		0.008		0.142
Female (n=28)	84.9(76.7)		14.6(28.6)		18		0	
Males (n=27)	156.9(103.8)		35.6(49.5)		52		7	
Race		0.205		0.446		0.260		0.937
African American (n=26)	102.6 (107.4)		20.4 (37.9)		27		4	
Non-African American (n=29)	136.1 (93.4)		29.0 (44.3)		41		3	
Age in years		.020		.271		.024		.128
< 45 years (n=29)	148.9(103.1)		30.8(38.6)		48		8	
≥ 45 years (n=26)	88.3(80.6)		18.4(43.9)		19		0	
Body Mass Index (kg/m^2)		.521		.614		.915		.40
Overweight (n=14)	134.8(85.5)		20.0(25.7)		36		0	
Obese (n=41)	115.3(101.4)		26.6(45.5)		34		5	

Table 2

Spearmen Rank-Order Correlation of Physical Activity Levels and Selected Characteristics among Persons with Mental Illness

	Age (years)	Body Mass Index (kg/m^2)	SCL-90 score	RBANS score	CES-D score
	ρ (p)	*ρ (p)*	*ρ (p)*	*ρ (p)*	*ρ (p)*
Moderate to Vigorous Physical Activity					
minutes/wk	−.46(<.001)	.24(.084)	.04(.766)	.14(.340)	.029(.839
minutes/wk in bouts ≥ 10 minutes	−.37(.006)	−.90(.515)	.03(.849)	.07(.611)	.02(.901)
Depressive Symptoms					
CES-D score	−.10(.515)	.13(.341)	.79(<.001)	.04(.796)	
Cognitive Function					
RBANS score	.11(.445)	−.15(.292)	.09(.534)		
Severity of Psychological Symptoms					
SCL-90 score	−.05(.719)	.09(.519)			