

# Physical Activity at Work Contributes Little to Patient Care Workers' Weekly Totals

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**Objective:** To determine the number of minutes of moderate and vigorous physical activity at work in comparison to weekly total minutes in a pilot study of 50 hospital patient care workers. **Methods:** Workers wore accelerometers during work and nonwork hours for 7 days, and completed surveys at the end of the seventh day. **Results:** Although the participants reported on average 206 minutes of moderate activity at work, the accelerometers recorded on average 30 minutes of moderate activity at work. For the 7 days the accelerometers measured a total of 165 minutes of moderate activity. Self-reported fatigue and functional limitations were negatively correlated albeit weakly with measured minutes of vigorous activity outside of work. **Conclusions:** Physical activity at work on patient care units contributes a small fraction to these workers' weekly totals, and in turn meeting guidelines.

Higher rates of physical activity at moderate and vigorous intensity are protective for cardiovascular diseases.<sup>1-3</sup> Hence, the American College of Sports Medicine and the American Heart Association recommend that adults get 150 minutes of moderate or 60 minutes of vigorous activities per week.<sup>4</sup> Nevertheless, working in a physically demanding job has been associated with higher rates of ischemic heart disease, all-cause mortality, and long-term work absences.<sup>2,5-7</sup> This difference in health benefits for physical activity done at work and during leisure time may result from the different types of activities that exist at work; however, this difference is unclear.

The jobs associated with patient care workers in acute care hospitals fall into the category of physically demanding because responsibilities include frequent patient-handling tasks such as lifting and transferring patients, standing for long periods, and walking in the unit.<sup>7-12</sup> These physical demands of work have been associated with an increased risk of injuries and musculoskeletal disorders.<sup>2,13</sup> Determining the type of and workers' perception about physical activity at work is important for workplace interventions that follow the aims of the National Institute for Occupational Health Total Worker Health™ (TWH) program. The TWH program aims to integrate "occupational safety and health protection with health promotion to

prevent worker injury and illness and to advance health and well-being."<sup>14</sup> Nevertheless, the type of physical activity experienced by these workers at work and how it contributes to weekly totals of moderate- and vigorous-intensity activity are unclear. In addition, several factors, such as pain and fatigue, associated with the physical demands at work may increase barriers to obtaining leisure time physical activity outside of work.<sup>15,16</sup>

Therefore, the goal of this pilot study was to directly measure, using accelerometers, the amount of moderate and vigorous physical activity for 1 week at work and outside of work in a convenience sample of 50 patient care workers. Because these jobs were classified as demanding, we expected work to contribute considerably to the total minutes of moderate and vigorous activity for the week. In addition, we measured, via self-report, perceived levels of physical activity, fatigue, pain, and functional limitations to test associations between potential barriers and minutes of moderate and vigorous activity.

## METHODS

### Subjects and Study Design

Fifty participants were recruited via e-mail and poster advertisements sent to all workers in six patient care units in two large teaching hospitals in Boston. These units were part of the Be Well Work Well Study pilot intervention conducted by the Harvard School of Public Health Center for Work, Health, and Well-being, a TWH Center of Excellence.<sup>17</sup> The six units consisted of thoracic intensive care, orthopedic, burn and trauma, cardiac, and cardiac step-down type units. Participants provided written consent, and all protocols and forms were approved by the applicable institutional review board.

To measure physical activity, participants wore a GT3X Actigraph accelerometer on their waist for 7 consecutive days. The accelerometer was initialized and gathered "count" data in increments continuously. Participants wore the accelerometer at all times except when they were sleeping, taking a shower, or swimming. Participants kept a daily log documenting the beginning and end of work shifts and the time they wore the accelerometer. The accelerometers recorded data in 1-minute intervals, providing the number of counts for each minute. A count was defined as any activity with accelerations above the threshold of 0.016317 m/s<sup>2</sup>. The number of counts per minute has been highly correlated with energy expenditure.<sup>18</sup> After 7 days, the accelerometer was retrieved from the participant and its data were downloaded to a personal computer and the device turned off.

### Data Processing of the Accelerometer Data Into Physical Activity

We parsed the accelerometer data into two sets of data: minutes associated with work (at work) and minutes associated with nonwork time (outside of work). For the parsed data, we assigned each minute to a different level of physical activity on the basis of definitions derived by Freedson and colleagues<sup>18</sup> from energy expenditure studies. The different levels included sedentary (0 to 100 counts per minute), light (101 to 1952 counts per minute), moderate (1953 to 5724 counts per minute), vigorous (5725 to 9498 counts per minute), and very vigorous ( $\geq 9498$  counts per minute). Because

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of the low number of minutes of very vigorous observed, we combined vigorous and very vigorous physical activity levels. Because most guidelines are based on sustained activity for a minimum of 10 minutes,<sup>4,19</sup> we also identified bouts of moderate and vigorous activities with duration of 10 minutes or more.<sup>20</sup>

We then calculated the total number of minutes of moderate and vigorous activity along with the total number of minutes of moderate and vigorous activity obtained in bouts of 10-minutes or more. We also calculated total minutes of sedentary and light activities for the at work set of data. We did not calculate these minutes for the outside of work data because they were heavily biased by the time not wearing accelerometers, mainly during sleep.

From these data we assessed whether an individual met weekly recommended guidelines for moderate and vigorous physical activity using three different sets of criteria. First, we used the strict recommendations from the American College of Sports Medicine and the American Heart Association of engaging in 30 minutes of moderate activity at least 5 days a week or 20 minutes of vigorous activity 3 days a week.<sup>4</sup> Second, we used the more recent guidelines from the United States Department of Health and Human Services of engaging in 150 minutes of moderate activity or 75 minutes of vigorous activity per week.<sup>19</sup> For both of these criteria, the minutes of moderate and vigorous should be obtained in bouts of 10 minutes or more. Third, we used a modified version of the US Department of Health and Human Services recommendations of 150 minutes of moderate or 75 minutes of vigorous activity obtained in any bout greater than 1 minute.<sup>3</sup>

### End of the 7-Day Survey

At the end of 7 days, each participant completed a survey that included measures of physical activity, pain, fatigue, and functional limitations covering the 7-day period.

The *physical activity* measure was the Behavioral Risk Factor Surveillance System (BRFSS) questionnaire of the Center for Disease Control and Prevention.<sup>21</sup> Participants provided the amount of minutes they spent doing moderate (1 item) and vigorous (1 item) activities for at least 10 minutes at a time while at work in the last 7 days, and while outside of work. Responses were summed to reflect weekly total minutes of moderate and vigorous physical activity.

The *fatigue measure* used a validated fatigue impact scale with eight items.<sup>22</sup> Each of the eight items had a response scale of one to five points (with increasing level from “never” to “very often”), which were summed for a total score ranging from 8 to 40.

The *pain measure* consisted of five items assessing pain severity for the past 7 days for the low back, neck and shoulder, wrist/forearm, knee, and ankle/feet. Responses were recorded on a five-point scale from none to extreme pain (one to five points).<sup>9</sup> The five responses were summed for a score ranging from 5 to 25.

The *functional limitations* measure questioned the participants about their ability to perform ten routine daily activities of living during the past 7 days.<sup>23</sup> Participants rated levels of difficulty in carrying out these ten tasks on a five-point scale (one to five points) from “no difficulty” in carrying out the task to “unable to do task without help.” Responses from these items were summed creating a score ranging from 10 to 50.

### Statistical Analyses

To evaluate the associations between directly measured physical activity and self-reported physical activity, fatigue, pain, and functional limitations, we used nonparametric Spearman correlations. Nonparametric Spearman correlations were chosen because of the ordinal ratings of the scales used in assessing fatigue, pain, and functional limitations; and the highly skewed distributions of these parameters in our small-sized sample. Correlation analyses explored associations between directly measured physical activity

(obtained in any bout > 1 minute) and self-reported physical activity, fatigue, pain, and functional limitations.

To ensure our correlations were not influenced by potential covariates, we ran logistic regressions on associations that had significant ( $P < 0.05$ ) correlations. Potential covariates included age, gender, job title (nurse/patient care assistant), and shift type (night, day/evening). For these logistic regressions, the dependent variables of directly measured physical activity and the independent variables (self-reported physical activity, fatigue, pain, and functional limitations) were dichotomized to high/low at the median values. A stepwise backward elimination was used to select the significant ( $P < 0.1$ ) covariates. Only gender and job title remained in the final models. All analyses were carried out in STATA 11 (StataCorp, College Station, TX).

## RESULTS

We successfully collected accelerometer data on 48 of the 50 recruited participants (Table 1), covering 191 shifts ranging between 8 and 12 hours, including day, evening, and night shifts. Unsuccessful measures were due to initialization errors of the accelerometers. Self-reported compliance in wearing the accelerometer device at work

**TABLE 1.** Demographics and Self-Reported Levels of Activity, Pain, Limitation, and Fatigue for the 48 Participants With Successful Measurements

Individual Characteristics	N	%
Gender		
Female	41	85
Male	7	15
Job		
Nurse	39	81
PCA	9	19
	<b>Mean</b>	<b>SD</b>
Age, yrs	42	12
Questionnaire responses		
Numeric pain score (5–25)	9	3
Fatigue score (8–40)	15	6
Functional limitations for activities of daily living (10–50)	13	4
Self-reported physical activity at work		
Moderate activity, min/wk	206	207
Vigorous activity, min/wk	57	122
Self-reported physical activity outside of work		
Moderate activity, min/wk	190	161
Vigorous activity, min/wk	146	223
	<b>N</b>	<b>%</b>
Met guidelines for physical activity based on self-report		
Strict guidelines*	22	45
General guidelines†	36	73
Met guidelines for physical activity based on direct measure		
Strict guidelines*	4	8
General guidelines†	6	13
General with no 10-min bout requirement‡	27	56

\*Moderate activity for 30 minutes at least 5 days a week or vigorous activity for 20 minutes at least 3 days a week achieved in 10-minute bouts.

†Moderate activity for 150 minutes or vigorous activity for 75 minutes per week achieved in 10-minute bouts.

‡Moderate activity for 150 minutes or vigorous activity for 75 minutes per week. PCA, patient care assistant; SD, standard deviation.

was 100%. Self-reported compliance in wearing the accelerometers outside of work was 83%.

Minutes of self-reported moderate physical activity at work and outside of work were similar ( $P = 0.28$  paired  $t$  test), suggesting that work activities contribute as much as nonwork activities to total physical activity levels (Table 1). For self-reported minutes of vigorous activities, work contributes fewer minutes ( $P = 0.03$  paired  $t$  test), about one third the minutes reported outside of work.

### Directly Measured Physical Activity

In contrast to the self-reported minutes, the minutes of directly measured moderate and vigorous activity at work provided on average only 18% and 3% of the weekly minutes of moderate and vigorous activity, respectively (Table 2). Most minutes of moderate (82%) and vigorous (97%) activity were obtained outside of work. Almost 99% of time at work was classified as sedentary or light. On the basis of the minutes of moderate and vigorous activity obtained both at work and outside of work, 27 participants achieved the weekly amount recommended by the guidelines (Table 1).

The minutes of moderate and vigorous activity obtained in bouts of 10 minutes or more at work provided on average 4% and 0% of the total number of minutes of moderate and vigorous activity, respectively (Table 3). On the basis of the minutes of moderate and vigorous activity obtained in bouts of 10 minutes or more at work and outside of work, six participants achieved the weekly guidelines of 150 and 75 minutes of activity (Table 1). Only four participants achieved the weekly guideline of 30 minutes of moderate activity 5 days a week or 20 minutes of vigorous activity 3 days a week obtained in bouts of 10 minutes or more (Table 1).

### Correlation Analyses

There were no significant correlations between directly measured minutes and self-reported minutes of moderate and vigorous activity levels at work or outside of work (Table 4). Participants reported many more minutes of activity than were directly measured, with the largest overreporting occurring for physical activity at work. For example, participants reported on average 206 minutes of

moderate activity at work, whereas only 30 minutes on average were recorded.

In comparing activity levels at work and outside of work, three main significant correlations existed (Tables 4 and 5). Minutes of directly measured moderate and vigorous activity levels outside of work were negatively correlated with self-reported vigorous activity at work (Fig. 1). Directly measured moderate activity outside of work was negatively correlated with measured sedentary activity at work.

In terms of relationships between fatigue, pain, functional limitations, and directly measured physical activity, only

**TABLE 3.** Across Worker Mean (Standard Deviation) and Three Percentile Values for Minutes of Moderate and Vigorous Activity Obtained in Bouts of 10 Minutes or Longer for the 7-Day Measurement Period

	Mean (SD)	Percentiles		
		25th	50th	75th
At work, min				
Moderate	2.5 (6.4)	0.0	0.0	0.0
Vigorous	0.0 (0.0)	0.0	0.0	0.0
Both at work and outside of work, min				
Moderate	63 (83)	11	32	82
Vigorous	14 (39)	0.0	0.0	0.0

SD, standard deviation.

**TABLE 4.** Spearman Correlation Coefficients (and  $P$  Values) Between Direct Measures\* and Self-Reported Minutes of Physical Activity

Parameter	Self-Reported At Work		Self-Reported Outside of Work	
	Moderate	Vigorous	Moderate	Vigorous
Directly measured at work				
Sedentary	0.22 (0.17)	0.09 (0.57)	-0.06 (0.73)	-0.08 (0.77)
Light	0.17 (0.29)	0.22 (0.18)	0.08 (0.65)	-0.17 (0.30)
Moderate	0.26 (0.12)	0.03 (0.85)	0.04 (0.83)	-0.14 (0.40)
Vigorous	0.00 (0.99)	0.08 (0.65)	0.14 (0.42)	0.25 (0.13)
Directly measured outside of work				
Moderate	-0.24 (0.14)	-0.37 (0.02)	-0.14 (0.40)	0.19 (0.26)
Vigorous	0.06 (0.72)	-0.36 (0.03)	-0.12 (0.47)	0.06 (0.74)

\*These are total minutes obtained in bouts of 1 minute or longer. Italicized values indicate significant correlations ( $P < 0.05$ ).

**TABLE 5.** Spearman Correlation Coefficients (and  $P$  Values) of Directly Measured Physical Activity\* at and Outside of Work

	At Work	Sedentary	Light	Moderate	Vigorous
Outside of work					
Moderate	-0.59 (0.00)	-0.08 (0.61)	0.06 (0.70)	-0.06 (0.67)	
Vigorous	-0.12 (0.40)	-0.21 (0.16)	-0.03 (0.82)	-0.09 (0.57)	

\*These are total minutes obtained in bouts of 1 minute or longer. Italicized values indicate significant correlations ( $P < 0.05$ ).

**TABLE 2.** Across Worker Mean (Standard Deviation) and Three Percentile Values for Minutes and Percentage of Total Minutes at Work for the Levels of Physical Activity for the 7-Day Measurement Period

	Mean (SD)	Percentiles		
		25th	50th	75th
At work, min				
Sedentary	1308 (485)	939	1322	1597
Light	1084 (386)	852	1123	1384
Moderate	30 (32)	8	17	42
Vigorous*	0.4 (1.5)	0.0	0.0	0.0
At work, % of total min at work				
Sedentary	54 (12)	45	52	58
Light	45 (11)	41	47	53
Moderate	1 (1)	0	1	2
Vigorous	0 (0)	0	0	0
Both at work and outside of work, min				
Moderate	165 (95)	86	159	224
Vigorous	18 (44)	0	1	11

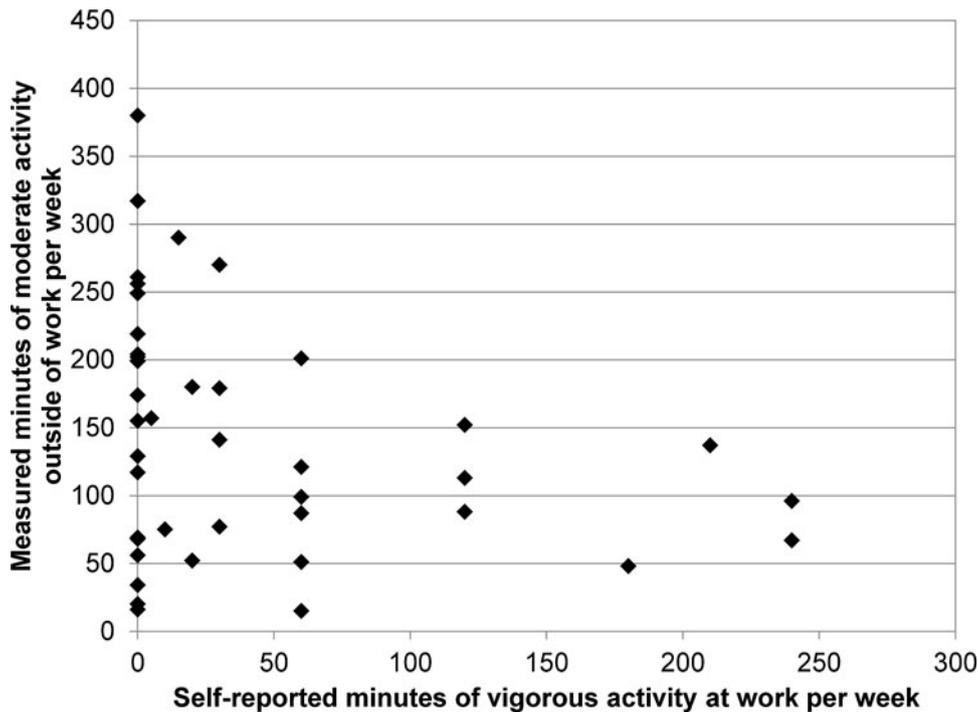
\*Decimal places were added to demonstrate across subject averages. SD, standard deviation.

directly measured minutes of vigorous activity were negatively correlated with fatigue and functional limitations (Table 6 and Fig. 2).

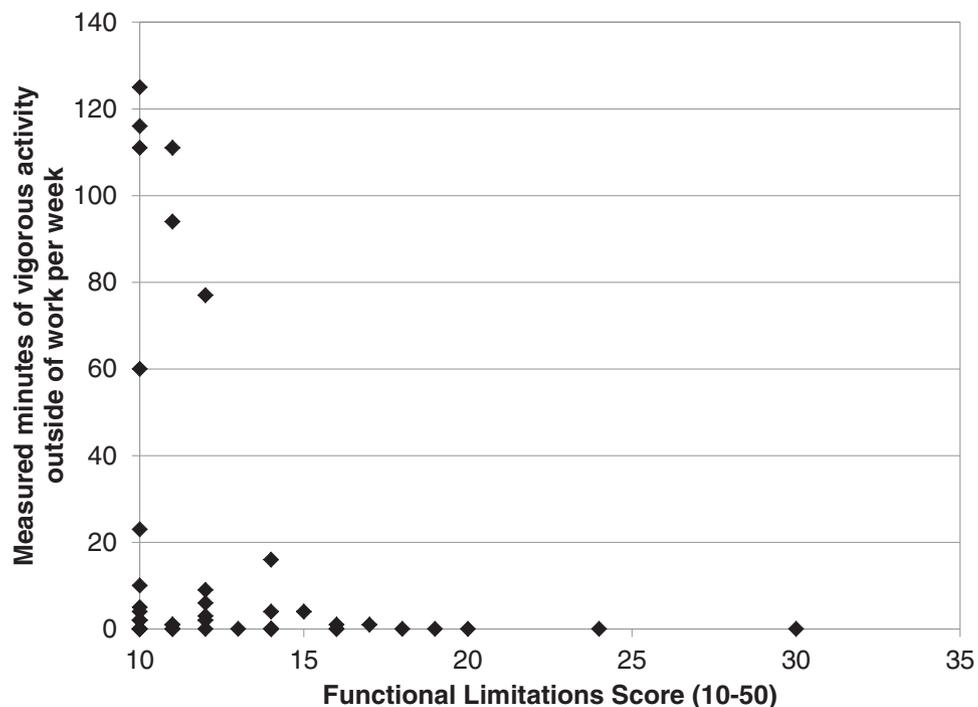
All the significant associations identified by the correlation analyses remained significant in logistic regressions after adjusting for gender and job title.

### DISCUSSION

The goal of this pilot study was to measure physical activity at work for patient care workers in acute care hospitals and document at work contributions to weekly totals for moderate and vigorous physical activity. Contrary to our expectation, directly measured physical activity at work contributed little to the weekly minutes of moderate



**FIGURE 1.** Directly measured minutes of moderate activity outside of work versus self-reported levels of vigorous activity at work.



**FIGURE 2.** Directly measured minutes of vigorous activity outside of work versus self-reported levels of functional limitations.

**TABLE 6.** Spearman Correlation Coefficients (and *P* Values) Between Directly Measured Minutes of Physical Activity\* and Self-Reported Fatigue, Pain, and Limitations

Parameter	Fatigue	Pain	Functional Limitations
At work			
Sedentary	-0.07 (0.67)	-0.01 (0.96)	-0.09 (0.61)
Light	-0.07 (0.66)	-0.18 (0.27)	-0.06 (0.70)
Moderate	-0.04 (0.81)	-0.11 (0.52)	-0.21 (0.20)
Vigorous	0.01 (0.93)	0.11 (0.53)	-0.05 (0.78)
Outside of work			
Moderate	-0.07 (0.68)	-0.21 (0.20)	-0.08 (0.62)
Vigorous	<i>-0.35 (0.03)</i>	-0.16 (0.35)	<i>-0.43 (0.01)</i>

\*These are total minutes obtained in bouts of 1 minute or longer.  
Italicized values indicate significant correlations ( $P < 0.05$ ).

activity and almost nothing to vigorous; however, the workers' self-reported levels suggest work contributes a considerable amount of minutes to their weekly totals.

On the basis of these data, increasing physical activity could be an excellent health promotion goal for these workers as part of a TWH program; however, the workers report that they get plenty of moderate and vigorous activity at work, potentially creating the illusion that they are getting enough activity. At best, by using only bouts of activity greater than 1 minute, half of this sample was meeting the recommended weekly amounts of moderate and vigorous activity on the basis of data from the accelerometers. Incorporating feedback to workers about their actual minutes may enhance motivation for meeting recommended amount of physical activity.

Several associations between the directly measured and self-reported perceptions about work may be barriers for health promotion approaches, aiming to increase leisure time physical activity. For example, one barrier could be fatigue, which had a negative correlation with minutes of vigorous activity outside of work. The development of key messages toward improving the health of these workers via physical activity needs to be sensitive to these barriers and incorporate these ideas into the specific health promotion activities. One such approach might integrate the improvement of working conditions with the promotion of workers' health.

At work, the participants overreported minutes of moderate activity by nearly sevenfold compared to the directly measured minutes of moderate activity; whereas, outside of work, the self-reported minutes of moderate activity were only 40% larger than those measured directly. Increased physical demands of a task can lead to increased overreporting the duration of a task.<sup>24</sup> In addition, walking in a patient care unit is probably not sustained for 1 minute necessary to be categorized as moderate level by the accelerometer; however, the worker's perception may be that it lasted longer than 1 minute. Furthermore, the BRFSS survey questions may not be well suited for determining physical activity at work as many of the verbal cues in the questionnaire focus on leisure time activities, which do not translate to activities at work. Other self-reported instruments for physical activity at work do exist<sup>25-27</sup>; however, these questionnaires have been validated in their capability of capturing sedentary nature of work, making it difficult to determine minutes of moderate and vigorous activity that are measured from either an accelerometer or the BRFSS survey.

This large difference between self-reported activity at work and directly measured activity may indicate that, for this population, the health paradox of physical activity during leisure time and at work may be an artifact of self-reported data. Holtermann et al<sup>7</sup> rejected the hypothesis that occupational and leisure time physical activities have similar health effects and proposed the idea of the

health paradox for the two types of activities. On the basis of our self-reported data, the patient care workers would be classified into Holtermann et al's high physical activity at work; however, on the basis of the direct measures, many of the patient care workers would not be classified into a high physical activity at work leading to a misclassification error. Self-reported physical activity at work may be capturing many other cognitive and psychosocial demands often associated with ill-health effects, which could explain the health paradox and the need for work environment interventions integrated with approaches to increase leisure time physical activity.

The moderate activities we did observe at work generally lasted less than the recommended 10-minute bouts for leisure time activities. At work it is difficult to sustain moderate activities for more than 10 minutes; however, all guidelines for physical activity have the requirement that moderate and vigorous activities need to be sustained for 10 minutes. Recently, there is evidence that moderate and vigorous activity obtained in bouts of 10 minutes or less "may favorably influence cardio-metabolic risk,"<sup>23</sup> and therefore we would expect the moderate activity we did observe at work to contribute to improved health.

We need to consider conclusions within the limitations of this pilot study. First, the accelerometers that we used are limited to capturing specific types of physical activities. They may not capture activities associated with lifting; these activities may be of short duration and hence the total counts for a minute may not be high enough to be considered a more intense activity. Second, these results are limited to patient care unit workers in only two acute care hospitals—other workers in other environments may have different activity patterns. Third, the small number of participating workers may not be representative of all workers; however, we did have large variability across these workers. Observed trends could be driven by a few outliers, but the removal of a single outlier did not change our major observations and associations remained significant when we dichotomized the variables. Fourth, although 100% compliant in wearing the accelerometers at work, the participants were less compliant during nonworking hours, indicating we may be missing minutes of leisure time moderate and vigorous activity. Algorithms do exist to estimate moderate and vigorous activity for participants with missing accelerometer data by extrapolating their activity when wearing the accelerometer<sup>20</sup>; however, the participants in this study with missing data had almost no moderate and vigorous data when they did wear the accelerometer outside of work.

## CONCLUSIONS

Physical activity at work among patient care unit workers in acute care hospitals contributes little to meeting recommended minutes of moderate and vigorous activity per week within this convenience sample. These data indicate that challenges exist in promoting improved physical activity within acute care hospital workers and that integrated TWH approaches that both reduce the barriers at work and promote physical activity outside of work are needed.

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