The Association between Work-Related Physical Activity and Depression

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Abstract   Working long hours is often said to be associated with depression. Research has also shown that physical activity is a remedy for depression. If this is the case, work involving an adequate level of physical activity may reduce depression. This study therefore examines the association between work-related physical activity and depression. A cross-sectional quantitative research design was applied. Three groups of workers having varied physical activity levels were compared. Each group had 218 volunteer participants. Analysis of Variance and a linear contrasts test were used to present results. Data analysis shows that sedentary jobs have the highest level of depression (Mean = 26.03, SD = 10.24, 95%CI = 25.26-27.80). Partially sedentary jobs produce a depression level higher than SEDJOB but lower than PHYJOB (Mean = 15.867, SD = 7.49, 95%CI = 14.9, 16.9). Physical jobs produce the lowest level of depression (Mean = 11.119, SD = 6.26, 95%CI = 10.3, 12.0). The study thus finds a statistically significant negative association between work-related physical activity and depression at 1% significance level. Thus, depression decreases with increased work-related physical activity. It may therefore be necessary for organizations to implement systems that encourage workers to regularly engage in work-related physical activity. They may have to create recreation centers (e.g. Gyms) where workers can exercise after hours of work in sedentary conditions.

Keywords: *physical activity, work-related physical activity, sedentary behavior, depression*

1. Introduction

Physical activity is defined as "any bodily movement produced by skeletal muscles that requires energy expenditure" [1]. Engaging in physical activity is a popular recommendation for improving Health-Related Quality of Life (HRQoL) as adequate levels of physical activity reduce the risk of many diseases, particularly cardiovascular diseases, colon and breast cancer, diabetes and depression. Moreover, physical inactivity is known to be the fourth leading risk factor for worldwide mortality, causing about 3.2 million deaths globally [2].

A plethora of studies [3,4,5,6] have confirmed that physical activity is a good treatment for depression, which is a condition common among workaholics or individuals who work for hours on end without or with little rest [7,8]. Depression is nonetheless a psychological and emotional disorder that would counter individuals' happiness, HRQoL and productivity at work.

Though long hours of work is associated with depression [7], anecdotal evidence shows that some jobs require daily engagement in physical activity (PA). Many construction jobs, for instance, require engagement in physical activities such as walking, running and climbing. Therefore, in view of the empirical evidence that physical activity is a treatment for depression, Work-related Physical Activity (WPA) can counteract the adverse impact of hours of work on depression. Invariably, jobs rich in physical activity may result in less depression as compared to those largely associated with sedentary behavior or physical inactivity. No identifiable study has nevertheless been dedicated to assessing whether or not WPA is correlated to depression. To provide a basis for examining causation between WPA and depression in future research, this study ascertains whether or not WPA influences depression.

2. Methods

2.1. Study Design

This study adopts a cross-sectional quantitative research technique to address the research problem. Basically, the levels of depression for three groups of workers having varied physical activity levels were compared to see if depression reduces with increasing physical activity. The three groups compared are described as follows:

Group 1 –   the researcher refers to this group as *sedentary jobs* or SEDJOB. It is made up of individuals whose jobs require that at least 90% of working time is spent 'sitting or

reclining', which World Health Organization (WHO) recognizes as sedentary behavior.

Group 2 – this is called *partially sedentary jobs* or PSJOB in this study. It is composed of individuals whose jobs require that between 45 to 50 per cent of working time is spent 'sitting or reclining' and the remaining proportion of this time is spent in physical activity.

Group 3 – The researcher calls this group *physical jobs* or PHYJOB. It is constituted by individuals whose jobs require that at least 90% of working time is spent in some kind of physical activity.

The researcher employed Analysis of Variance to verify the presence of a necessary systematic difference in the physical activity of the three groups. Outcomes of this analysis are shown in the results section of this study.

2.2. Participants and Sample

This study's participants were volunteers working in various private and public sector organizations in Ho in the Volta Region of Ghana. In the process of selecting participants, the researcher took the list of all organizations in Ho from the Municipal Assembly. Each of the listed organizations was visited to identify, by means of a short interview, workers who were eligible to be included in any of the three groups. An individual could be in only one group.

In the interview, each participant was asked to describe his or her job in terms of how much it involved engagement in PA. Three general categories of responses provided the basis for forming the study groups. The three categories of responses are as follows:

Group 1(SEDJOB) – individuals revealed that their jobs requires sitting idle or by the computer for most of their working hours. They added that walking is the only physical activity they engage in at work, and walking about at work each day takes less than an hour.

Group 2 (PSJOB) – participants in this group agreed that about half of their working time requires participation in field work while the remaining half of this time involves sitting idle or by the computer. The field work they engage in daily involves much of climbing, walking, running, riding of bicycle, and/or other activities that increase the energy expenditure of their body.

Group 3 (PHYJOB) – participants in this group agreed that they engage in field work for most of their working hours, with less than an hour spent each day sitting idle or by the computer. The field work they engage in involves much of climbing, walking, running, riding of bicycle, and/or other activities that increase the energy expenditure of their body.

The researcher afterward used an informed consent form to identify willful participants in each organization. The number of participants reached for each group is as follows: Group 1 – 285; Group 2 – 241; and Group 3 – 260. A number of studies [16,17] contend that group comparison using ANOVA yields the best result when all groups have the same number of participants. Based on [16] therefore, 47 and 20 participants were randomly taken out of groups

1 and 3 respectively, resulting in all groups having the same number of participants (number = 231).

2.3. Instrumentation

The Beck Depression Inventory – II (BDI-II) was used to measure depression. BDI-II is a 21-item self-report rating inventory that is used to measure symptoms and characteristic attitudes of depression for the last two weeks [9]. It is associated with a 4-point scale that ranges from 0 (i.e. symptom not present) to 3 (i.e. symptom strongly present).The resulting summary scores thus range from 0 to 63, with 21 indicating depression at its lowest level. In this study, the BDI-II was employed because it provides evidence of current depression and it has been used at both clinical and non-clinical levels [10]. More importantly, it is largely validated [11].

Physical activity, on the other hand, was measured using the second version of WHO's Global Physical Activity Questionnaire (GPAQ-2). The GPAQ-2 is the most recently validated version of the GPAQ and is much oriented for measuring physical activity relating to work. It also includes items that capture physical activity in days and hours, making it robust and comprehensive. Its first six items (i.e. Q1-Q6) measure work-related physical activity whereas the next nine items (i.e. Q7-Q15) measure physical activity relating to leisure and recreation. The sixteenth item (Q16) measures sedentary behavior. The GPAQ-2 has five questions that are associated with two levels of response, namely "Yes" and "No". Based on [1], "Yes" and "No" were associated with the codes 1 and 2 respectively in this study. Since this study focuses on WPA, only the first six items of the GPAQ-2 were considered in data analysis. Based on [1], WPA was computed using the following formula:

$WPA = (P2*P3*8) + (P5*P6*4)$, where the constants 8 and 4 represent the Metabolic Equivalents (METs) of vigorous and moderate WPA respectively, and P2, P3, P5 and P6 are respectively the second, third, fifth and sixth question on the GPAQ-2.

In addition, P2 and P3 measure vigorous WPA in days/week and hours/day respectively, while P5 and P6 measure moderate WPA in days/week and hours/day respectively. With respect to the above equation, the unit of measurement of PA is minutes per week. The GPAQ-2 specifies that the minimum recommended PA level is 600 minutes per week. For only WPA however, this value would be less than 600. Before WPA was computed using the above formula, the researcher identified based on the recommendation of [1] the proportion of individuals who did not engage in WPA and those who engaged in moderate and vigorous WPA based on responses to question 1 (P1) and 4 (P4).

2.4. Ethical Statement and Data Gathering

Prior to data collection, the management of each organization from which participants were drawn endorsed the study. Each participant also signed an informed consent form, which clearly spelt out the benefits and potential risks to which every respondent was exposed.

Table 1. Study Response Rate

Group	NQD	NQR	NDQ	NQA	RR
1	231	224	6	218	97%
2	231	226	5	221	98%
3	231	228	6	222	99%
Total	693	678	17	661	98%

Key: NQD – number of questionnaires distributed; NQR – number of questionnaires returned; NDQ – number of discarded questionnaire; NQA – number of questionnaires analyzed; RR – response rate.

Data was collected in about twelve (12) weeks through hand delivery of the self-reported questionnaire. The response rate achieved in data collection is shown in Table 1. For each group, almost equal numbers of males and females responded (Group 1: males = 111; females = 107; Group 2: males = 115, females = 106; Group 3: males = 117, females = 105), and the age distribution of the three groups is approximately the same (Group 1: mean = 24.6, SD = 12.2; Group 2: mean = 25.1, SD = 11.7; Group 3: mean = 24.9, SD = 13.4).

2.5. Statistical Analysis

Data was analyzed using SPSS 21. Descriptive statistics were used to summarize the data. Normal distribution of the data was also tested and verified for the main dependent variables (i.e. Depression). Data associated with depression, the dependent variable, was normally distributed on the basis of satisfying $p > 0.05$ criterion recommended in the literature [e.g. 1,16,17] in terms of Shapiro-Wilk test (Statistic = 2.329, p = .601). Moreover, the z-score computed for each value of the dependent variable is within the generally recommended range of -3 to 3. In data analysis, the linear contrasts test was conducted to ascertain whether or not there is a "dose-response" relationship between WPA and depression and to correct the condition of the three groups having unequal variances. Results of the study are presented in the next section.

3. Results

Table 2 shows the number of participants who agreed to have engaged in vigorous and moderate WPA and those who indicated they did not. It can be seen from this table that the number of participants who engaged in vigorous WPA is lowest for SEDJOB (frequency = 4) and highest for PHYJOB (frequency = 117). On the other hand, the number of participants who did not engage in vigorous WPA is largest for SEDJOB (frequency = 214) and smallest for PHYJOB (frequency = 101). The evidence is similar for engagement in moderate WPA and suggests that the number of participants engaging in vigorous and moderate WPA is not the same for the three categories. This evidence is corroborated by results of the Pearson's Chi-square test of association shown in Table 3.

Table 2. Number of Participants who engaged and did not engage in Vigorous and Moderate WPA

Group	Engagement in vigorous WPA		Total	Engagement in moderate WPA		Total	Overall total
	Yes	No		Yes	No		
SEDJOB	4	214	218	9	209	218	654
PSJOB	89	129	218	104	114	218	654
PHYJOB	117	101	218	167	51	218	654
Total	210	444	654	280	374	654	1962

Table 3. Chi-Square Tests of Association

Variable	Chi-square	df	p-value	Eta		Eta squared
				Group Dependent	WPA Dependent	
Engagement in vigorous WPA	1151.351	90	.000	0.918	0.510	0.260
Engagement in moderate WPA	1652.452	90	.000	0.923	0.621	0.386

Table 4. Descriptive Statistics showing WPA Level of the three Groups

	N	Mean	Std. Deviation	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
SEDJOB	218	25.182	20.052	19.990	30.374
PSJOB	218	426.667	142.297	356.364	496.969
PHYJOB	218	2752.675	628.994	2541.495	2963.855
Total	654	1068.175	558.200	951.959	1184.390

Table 5. One-Way ANOVA [Testing for a Difference in WPA Level across the three Groups]

	Sum of Squares	df	Mean Square	F	p-value
Between Groups	1001825993.527	2	500912996.763	509.522	.000
Within Groups	678341698.346	690	983103.911		
Total	1680167691.873	692			

NOTE: Levene's Test [Statistic = 535.75, df1 = 2; df2 = 690; p = .000]
Welch [Statistic = 385.21, df1 = 2; df2 = 308.31; p = .000]
Brown-Forsythe [Statistic = 509.52, df1 = 2; df2 = 280.67, p = .000].

Table 6. Contrasts Tests [Testing for a Difference in WPA Level across the three Groups]

Note	Contrast	Value of Contrast	Std. Error	t	df	p-val.
Assume equal variances	1	3.6820	.30582	12.040	651	.000
Does not assume equal variances	1	3.6820	.35088	10.494	330.929	.000

ANOVA-related statistics: Combined [df = 2; F = 113.551, p = 0.000], Linear Term [(Contrast – df = 1; F = 226.038; p = 0.000), (Deviation – df = 1; F = 1.063; p = 0.303)].

Table 7. Tamhane Multiple Comparison Test [Testing for a Difference in WPA Level across the three Groups]

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	p-value	95% Confidence Interval	
					Lower Bound	Upper Bound
SEDJOB	PSJOB	-401.485*	35.778	.000	-487.532	-315.437
	PHYJOB	-2727.494*	107.212	.000	-2985.364	-2469.623
PSJOB	SEDJOB	401.485*	35.778	.000	315.437	487.532
	PHYJOB	-2326.009*	112.963	.000	-2597.356	-2054.662
PHYJOB	SEDJOB	2727.494*	107.212	.000	2469.623	2985.364
	PSJOB	2326.009*	112.963	.000	2054.662	2597.356

*. The mean difference is significant at the 0.05 level.

Table 8. Descriptive Statistics showing Depression Level of the three Groups

Group	N	Mean	Std. Deviation	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
SEDJOB	218	26.028	10.238	25.260	27.795
PSJOB	218	15.867	7.487	14.867	16.866
PHYJOB	218	11.119	6.255	10.284	11.954
TOTAL	654	17.67133	10.671	15.852	17.491

Table 9. One-Way ANOVA [Testing for a Difference in Depression across the three Groups]

	Sum of Squares	df	Mean Square	F	p-val.
Between Groups	15668.443	2	7834.222	86.905	.000
Within Groups	58685.876	651	90.147		
Total	74354.320	653			

NOTE: Levene's Test [Statistic = 64.70, df1 = 2; df2 = 651; p = .000]
Welch [Statistic = 80.17, df1 = 2; df2 = 408.55, p = .000]
Brown-Forsythe [Statistic = 86.91, df1 = 2; df2 = 448.50].

Table 10. Contrasts Test [Testing for a Difference in Depression Level across the three Groups]

Note	Contrast	Value of Contrast	Std. Error	t	df	p-val.
Assume equal variances	1	-3530.463	244.094	-14.464	690	.000
Does not assume equal variances	1	-3530.463	129.006	-27.367	403.441	.000

ANOVA-related statistics: Combined [df = 2; F = 509.522, p = 0.000], Linear Term [(Contrast – df = 1; F = 873.997; p = 0.000), (Deviation – df = 1; F = 145.047; p = 0.000)].

Table 11. Tamhane Multiple Comparison Test [Testing for a Difference in Depression across the three Groups]

(I) Group		Mean Difference (I-J)	Std. Error	p-val.	95% Confidence Interval	
					Lower Bound	Upper Bound
SEDJOB	PSJOB	7.16055*	1.030	0.000	4.689	9.632
	PHYJOB	11.90826*	0.992	0.000	9.528	14.289
PSJOB	SEDJOB	-7.16055*	1.030	0.000	-9.632	-4.689
	PHYJOB	4.74771*	0.661	0.000	3.164	6.332
PHYJOB	SEDJOB	-11.90826*	0.992	0.000	-14.289	-9.528
	PSJOB	-4.74771*	0.661	0.000	-6.332	-3.164

*The mean difference is significant at 5% significance level.

With respect to "engagement in vigorous WPA" in Table 3, the Chi-square test is significant at 1% significance level [Chi-square (χ2) = 1151.351; df = 90; p = .000]. This result suggests that there is a positive relationship between group membership and engagement in vigorous WPA. Similarly, engagement in vigorous WPA increases from SEDJOB through PSJOB to PHYJOB. The Chi-square test is also significant at 1% significance level with respect to "engagement in moderate WPA" [Chi-square (χ2) = 1652.452; df = 90; p = .000]. Thus, engagement in moderate WPA increases from SEDJOB through PSJOB to PHYJOB. The respective Eta statistics corresponding to "engagement in vigorous WPA" and "engagement in moderate WPA" are 0.51 and 0.62. Since these statistics are greater than 0.5, the relationship between group membership and engagement in vigorous and moderate WPA is strong.

In Table 4, SEDJOB has the lowest level of WPA (Mean = 25.18, SD = 20.052, 95%CI = 19.99-30.37). PSJOB has a WPA level higher than SEDJOB but lower than PHYJOB (Mean = 426.67, SD = 142.297, 95%CI = 356.36-496.97). PHYJOB produces the highest level of WPA (Mean = 2752.68, SD = 628.99, 95%CI = 2541.50-2963.86). In Table 5, the ANOVA test is significant at 1% significance level [F (2, 690) = 509.52, p = .000]. This result implies that there was a difference in the WPA of the three groups. At the bottom of Table 5, Levene's test is significant at 5% significance level (Statistic = 535.75, p = .000). Hence, it is assumed that the three groups have unequal variances.

Table 6 shows results of a linear contrasts test. Beneath this table are ANOVA-related statistics of the contrasts test. Of interest is the "Contrast", which is statistically significant at 1% significance level (F = 226.038; p = 0.000). Moreover, results in this table with respect to "Assume equal variances" show that the three groups significantly differ in terms of WPA at 1% significance level (t = 12.04, df = 651, p = .000). Evidently, there is a "dose-response" relationship between WPA and group membership. In Table 7, the Tamhane Multiple Comparison test shows that the WPA score of PHYJOB is significantly larger than those of the other two groups at 1% significance level. The WPA score of PSJOB is also significantly larger than that of SEDJOB at 1% significance level. So the three groups compared had varied levels of WPA, and this provided a basis for comparing their depression levels as a way of examining the association between WPA and depression.

In Table 8, sedentary jobs have the highest level of depression (Mean = 26.03, SD = 10.24, 95%CI = 25.26-27.80). Partially sedentary jobs produce a depression level higher than SEDJOB but lower than PHYJOB (Mean = 15.867, SD = 7.49, 95%CI = 14.9, 16.9). Physical jobs produce the lowest level of depression (Mean = 11.119, SD = 6.26, 95%CI = 10.3, 12.0). In Table 9, the ANOVA test is significant at 1% significance level [F (2, 651) = 86.91, p = .000]. As a result, there is a significant difference in the depression of the three groups.

At the bottom of Table 9, Levene's test is significant at 5% significance level (Statistic = 64.70, p = .000). It is thus assumed that the three groups had unequal variances. Below Table 10 are ANOVA-related statistics of the linear contrasts test. The "Contrast" category is statistically

significant at 1% significance level (F = 873.997; p = 0.000). Moreover, results in Table 10 with respect to "Assume equal variances" show that the three groups significantly differ in terms of depression at 1% significance level (t = 12.04, df = 651, p = .000). It is therefore confirmed that there is a "dose-response" relationship between depression and group membership. In Table 11, the Tamhane Multiple Comparison test shows that mean score for the PHYJOB group is significantly larger than those of the other two groups at 1% significance level. The mean score of PSJOB is also significantly larger than that of SEDJOB at 1% significance level. So depression decreases across the three groups from SEDJOB through PSJOB to PHYJOB. The analysis thus confirms that depression decreases with increased WPA.

4. Discussion

Data analysis shows that depression reduces as work-related physical activity increases. For this reason, participants in the first group, SEDJOB, had the largest depression score and were as well depressed. The two other groups that more frequently engaged in work-related physical activity had lower depression scores and were not depressed. This result is supported by several studies [3,4,5,6] conducted in western countries and signifies that engaging in physical activity reduces the level of depression.

The result reached in this study implies that working for long hours does not necessarily lead to depression. Moreover, works involving less physical activity and much of sedentary behavior would often result in depression, while those involving much more physical activity are likely to be associated with less depression. Nonetheless, working beyond a certain limit of time would not necessarily remedy depression owing to fatigue, occupational stress and strain [7]. The maximum working time that supports the reducing impact of work-related physical activity on depression is however an important topic that future research and academic debate should embrace.

Based on some studies [13,14], the positive effect of physical inactivity or sedentary behavior on depression could be worse depending on the sector in which an individual works. The services sector is characterized by more sedentary jobs (e.g. jobs requiring long hours of sitting, reclining, etc.). As seen in the data analysis therefore, depression is likely to be higher among people working in service-oriented companies. Employers and companies in this and similar sectors can change this anomaly by introducing a corporate policy that encourages individuals to engage in physical activity, at least on daily basis. A practical step that could be taken in the light of this policy is creating a suitable recreation center (e.g. Gym) where workers can exercise after hours of inactivity on their jobs.

This study suggests that individuals nurturing sedentary jobs are more vulnerable to depression, especially if employers do not provide appropriate interventions (such as the one mentioned above) to work-related sedentary behavior. Needless to say, many previous studies [3,8,15] have recommended non-work related physical activity as a

way to reduce depression. Hence, workers have no choice than to resort to this option if employers are not ready to provide corporate systems that support work-related physical activity.

5. Conclusion

It is concluded that depression decreases as WPA increases. Physical jobs are therefore less likely to lead to depression. Unfortunately, many individuals would have the sole option of working in sectors that encourage sedentary behavior. As a consequence, it is incumbent on employers or companies to introduce policies and systems that support engagement in work-related physical activity.

While employers are less likely to provide such systems possibly due to the need to optimize operational cost and focus on core business activities, individual employees may have to get used to engaging in regular physical activity outside the work environment. Individuals could also regularly engage in physical activity at work, provided this step does not conflict with their jobs. For instance, a few minutes of aerobics during lunch time is acceptable and would be helpful.

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