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PHYSICAL ACTIVITY OF DAILY LIVING AMONG ORTHOPAEDIC, VISUAL, AND INTELLECTUAL DISABLED PERSON

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ABSTRACT

The aim of the study was to compare different daily physical effort variables among orthopaedic, visual and intellectual disabilities. Seventy-five (75) persons with three types of disabilities i.e. Orthopaedic (OD), Visual (VD), and Mental (ID) who performed daily living physical activities were recruited as sample of the study. The mean age were 16.60, 14.40 and 14.60 years of OD, VD, and ID, respectively. Daily Living Physical Activities were recognized from the data by using 3-D accelerometers via smart/sports watch or any other portable instrument on wrist/hip/pocket and GPS information tracker via phone or any other portable instrument. Signal features was calculated for each second of the data collection. Frequency-domain features included the estimation of power of the frequency peak and signal power in different frequency bands. Speed was calculated from GPS location data. The feature selection proceeded by identifying for each activity, the feature having the best performance in discriminating the corresponding activity from other activities. The performance of each feature was evaluated by the area under the receiver operator characteristic (ROC). The signal features which was selected for activity classification were - walking speed, steps/day, cadence, distance covered/day, and activity m/d (I/O). Results of the study shows that there are significant differences exist among Physical, Intellectual and Visual disabled person in their step count per day. The present study indicated that orthopaedic disabled person more active as compare with visual and intellectual disabled person.
Keywords: *Physical activity, daily living, orthopaedic, visual, intellectual, accelerometer, GPS.*

1. INTRODUCTION

The physical activity of daily living is sum total of all structured and nonstructural activities such as walking, running, jumping, and other minor physical activities of daily life (Mohammad, 2017). According to National Health Survey - 1997, as much as 56% different disabled persons did not engage in any physical activity (leisure). The lack of physical activity can result in physical deterioration and impairment of multiple physiological systems such as reduced cardio respiratory fitness and impaired circulation to lower extremities (Ahsan, & Mohammad, 2018; Mohammad, 2017). To date, there is little information describing physical activity profiles of individuals with disabilities, thus limiting supportable health improvement guidelines. While many methods are available for assessing physical activity in able-bodied people (Mohammad, & Tareq, 2016; Singh, Raza, & Mohammad, 2011), they have limited utility for people with disabilities, especially for orthopedic, intellectual & visual disabled persons.

Accelerometer and Global Positioning System (GPS) devices are often used to evaluate the duration of gross physical activities such as mobility-related activities in different

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disabled or non-disabled persons (Ju, Roberts, & Zhang, 2013). The main purpose of this study was to investigate the activity pattern among the disabled persons. The study would combine a GPS device and an accelerometer to measure activity patterns among physical, visual, and intellectual challenged persons. Bench trials would show that activity scope, intensity, frequency, and duration can be quantified and outdoor travel and use of transportation can be derived. The instrumentation provides an objective means of capturing activity patterns of Physical, Visual, and Intellectual challenged persons, and enables further investigation on device effectiveness, exercise compliance, early problem detection and intervention.

2. METHODS AND MATERIALS

Seventy-five (75) persons with three types of disabilities i.e. Orthopaedic (OD), Visual (VD), and Mental (ID) performed daily living physical activities. Participants were recruited through the regional offices of the Disability and Community Centres of Health Services, Health Commissionaires, NGOs working with people with disabilities, educational institutes offering higher inclusive education, fitness and recreation centres. Their ages were OD= 16.60, VD=14.40 and ID= 14.60 years, Height were OD= 162.50, VD=162.30 and ID= 156.75 and weight were OD=55.38, VD=51.79 and ID =39.62 Kg, respectively. Daily Living Physical Activities were recognized from the data by using 3-D accelerometers via smart/sports watch or any other portable instrument on wrist/hip/pocket and GPS information tracker via phone or any other portable instrument. Signal features was calculated for each second of the data collection.

Frequency-domain features included the estimation of power of the frequency peak and signal power in different frequency bands. Speed was calculated from GPS location data. The feature selection proceeded by identifying for each activity, the feature having the best performance in discriminating the corresponding activity from other activities. The performance of each feature was evaluated by the area under the receiver operator characteristic (ROC). The signal features which was selected for activity classification are – (i) Walking speed, (ii) Steps/day, (iii) Cadence, (iv) Distance covered/day, and (v) Activity m/d (I/O).

3. RESULTS

Table 1: Descriptive statistics (mean of the age, weight, height) of the subjects

	Group		
	OD	**VD**	**ID**
Age (year)	16.60	14.40	14.60
Weight (Kg)	55.38	51.79	39.62
Height (cm)	162.50	162.30	156.75

OD= Orthopaedic Disabled, VD= Visual Disabled, ID = Intellectual Disabled

Table 2: Description of step/day among orthopaedic, visual, and intellectual disabled person

	Variables	**N**	**Mean**	**Std. Deviation**	**Std. Error**
Step/Day	**OD**	20	9402.5	2098.30	469.19
	VD	20	6891.1	2796.45	625.30
	ID	20	6213	1477.94	330.47
	Total	60	7502.2	2560.03	330.49

Table 3: Comparison of step/day among physical, visual, and intellectual disabled person

		Sum of Squares	df	Mean Square	F
Step/Day	**Between Groups**	112900000	2	56470000	11.75*
	Within Groups	273700000	57	4802470	
	Total	386700000	59		

***Significant at 0.05 level

The statistical analysis of data is presented in Table 3 which shows that there are significant differences exist among physical, intellectual and visual disabled person in their step/day as obtain $[f]_{cal}$ value is found greater than the tabulated $[f]_{tab}$ value (3.16) at 0.05 level of significance.

Table 4: Pair-wise comparison of step/day among orthopaedic, visual, and intellectual disabled person

Dependent Variable			Mean Difference	Std. Error	Sig.
Step/Day	**OD**	**VD**	2511.40*	692.99	0.00
	OD	**ID**	3189.50*	692.99	0.00
	VD	**ID**	678.10	692.99	0.33

*Significant differences

The Post-hoc test result revealed that there are significant difference exist between orthopaedic disabled person – visual disabled, orthopaedic disabled person- intellectual disabled person in their step count at per day.

Table 5: Description of cadence among orthopaedic, visual, and intellectual disabled person

	Variables	N	Mean	Std. Deviation	Std. Error
Cadence	**OD**	20	115.1	17.72	3.96
	VD	20	69	14.43	3.22
	ID	20	99.35	12.33	2.75
	Total	60	94.48	24.27	3.13

Table 6: Comparison of cadence among physical, visual, and intellectual disabled person

		Sum of Squares	df	Mean Square	F
Cadence	**Between Groups**	21962.63	2	10981.31	48.84*
	Within Groups	12814.35	57	224.81	
	Total	34776.98	59		

***Significant at 0.05 level

The statistical analysis of data is presented in Table 6 which indicates that there are significant differences exist among physical, intellectual and visual disabled person in their cadence as obtain $[f]_{cal}$ value is greater than the $[f]_{tab}$ value (3.16) at 0.05 level of significance.

Table 7: Pair-wise comparison of cadence among orthopaedic, visual, and intellectual disabled person

Dependent Variable			Mean Difference	Std. Error	Sig.
Cadence	OD	VD	46.10*	4.74	0.00
	OD	ID	15.75*	4.74	0.00
	VD	ID	-30.35*	4.74	0.00

*Significant differences

The post-hoc test result revealed that there is significant difference exist between orthopaedic disabled person - visual disabled, orthopaedic disabled person - intellectual disabled person and visual disabled person - intellectual disabled person in their cadence.

Table 8: Description of speed m/s among orthopaedic, visual, and intellectual disabled person

	Variables	N	Mean	Std. Deviation	Std. Error
Speed/m	OD	20	0.90	0.20	0.04
	VD	20	0.48	0.13	0.03
	ID	20	0.62	0.14	0.03
	Total	60	0.67	0.23	0.03

Table 9: Comparison of speed m/s among physical, visual, and intellectual disabled person

		Sum of Squares	df	Mean Square	F
Speed (m/s)	Between Groups	1.77	2	0.88	33.34*
	Within Groups	1.51	57	0.02	
	Total	3.29	59		

*****Significant at 0.05 level

Table 9 shows the statistical analysis of data and its indicates that there are significant differences exists among Physical, Intellectual and visual disabled person in their walking speed m/s as obtain $[f]_{cal}$ value greater than the $[f]_{tab}$ value (3.16) at 0.05 level of significance.

Table 10: Pair-wise Comparison of walking speed m/s among orthopaedic, visual, and Intellectual disabled person

Dependent Variable			Mean Difference	Std. Error	Sig.
Speed (m/s)	OD	VD	0.41*	0.05	0.00
	OD	ID	0.27*	0.05	0.00
	VD	ID	-0.13*	0.05	0.01

*Significant differences

The post-hoc test result revealed that there are significant difference exists between orthopaedic Disabled person - Visual Disabled, Orthopaedic Disabled Person - Intellectual Disabled person and Visual Disabled person - Intellectual Disabled person in their walking speed (m/s).

Table 11: Description of distance covered m among orthopaedic, visual, and Intellectual disabled person

	Variables	N	Mean	Std. Deviation	Std. Error
Distance (m)	**OD**	20	4529.60	1051.86	315.64
	VD	20	3198.0	1457.36	325.87
	ID	20	3080.0	760.98	292.44
	Total	60	3602	1090.06	297.29

Table 12: Comparison of covered distance (m) among physical, visual, and intellectual disabled person

		Sum of Squares	df	Mean Square	F
Distance/d (m)	**Between Groups**	202200000	2	101100000	52.04*
	Within Groups	110700000	57	1942311.425	
	Total	312900000	59		

*****Significant at 0.05 level

The analysis of data Table 12 shows that there is significant differences exist among Physical, Intellectual and visual disabled person in their walking distance covered /day (m) as obtain $[f]_{cal}$ value greater than the $[f]_{tab}$ value (3.16) at 0.05 level of significance.

Table 13: Pair-wise comparison of distance covered (m) among orthopaedic, visual, and Intellectual disabled person

Dependent Variable			Mean Difference	Std. Error	Sig.
Distance/d (m)	**OD**	**VD**	1876.90*	440.71	0.00
	OD	**ID**	-2599.90*	440.71	0.00
	VD	**ID**	-4476.80*	440.71	0.00

*Significant differences

The post-hoc test result revealed that there are significant difference exists between orthopaedic Disabled person - visual disabled, orthopaedic disabled person - intellectual disabled person and visual disabled person - intellectual disabled person in their walking distance covered /day (m).

Table 14: Description of activity minute / day (indoor) in minutes among orthopaedic, visual, and Intellectual disabled person

	Variables	N	Mean	Std. Deviation	Std. Error
Activity/day	**OD**	20	289.45	71.85	16.06
	VD	20	184.95	30.68	6.86
	ID	20	257.95	56.33	12.59
	Total	60	244.12	70.25	9.07

Table 15: Comparison of activity minute / day (indoor) in minutes among physical, visual, and intellectual disabled person

		Sum of Squares	df	Mean Square	F
Activity/day (Indoor)	**Between Groups**	114943.33	2	57471.66	18.58*
	Within Groups	176290.85	57	3092.82	
	Total	291234.18	59		

*****Significant at 0.05 level

The statistical analysis of data is presented in the Table 15 which shows that there are significant differences exist among Physical, Intellectual and visual disabled person in their activity minute / day (indoor) in minutes as obtain $[f]_{cal}$ value greater than the $[f]_{tab}$ value (3.16) at 0.05 level of significance.

Table 16: Pair-wise comparison of activity minute/day (indoor) in minutes among orthopaedic, visual, and Intellectual disabled person

Dependent Variable			Mean Difference	Std. Error	Sig.
Activity/day (Indoor)	**OD**	**VD**	104.50*	17.58	0.00
	OD	**ID**	31.50	17.58	0.08
	VD	**ID**	73.00*	17.58	0.00

*Significant differences

The post-hoc test result revealed that there are significant difference exist between orthopaedic disabled person – visual disabled, and visual disabled person - intellectual disabled person in their activity minute / day (indoor) in minutes.

Table 17: Description of activity minute / day (outdoor) in minutes among orthopaedic, visual, and Intellectual disabled person

	Variables	N	Mean	Std. Deviation	Std. Error
Activity/day Outdoor	**OD**	20	47.1	8.83	1.97
	VD	20	186.8	39.20	8.76
	ID	20	65.6	33.83	7.56
	Total	60	99.83	69.22	8.93

Table 18: Comparison of activity minute/day (Out-door) in minutes among physical, visual, and intellectual disabled person

		Sum of Squares	df	Mean Square	F
Activity/day Outdoor	**Between Groups**	230318.53	2	115159.26	125.20*
	Within Groups	52427.80	57	919.78	
	Total	282746.33	59		

*****Significant at 0.05 level

Statistical analysis of data is documented in the Table 18 which indicates that there are significant differences exist among Physical, Intellectual and visual disabled person in their

activity minute/day (outdoor) in minutes as obtain $[f]_{cal}$ value greater than the $[f]_{tab}$ value (3.16) at 0.05 level of significance.

Table 19: Pair-wise comparison of activity minute / day (indoor) in minutes among orthopaedic, visual, and intellectual disabled person

Dependent Variable			Mean Difference	Std. Error	Sig.
Activity/day Outdoor	**OD**	**VD**	139.70*	9.59	0.00
	OD	**ID**	18.50	9.59	0.06
	VD	**ID**	121.20*	9.59	0.00

*Significant differences

The post-hoc test result revealed that there is significant difference exist between orthopaedic disabled person – visual disabled, and visual disabled person - intellectual disabled person in their activity minute / day (outdoor) in minutes.

4. DISCUSSION

The main aim of the study was to compare different daily physical effort variables among orthopaedic, visual and intellectual disabilities. Results of the study show that there are significant differences exist among Physical, Intellectual and Visual disabled person in their step count per day. The present study indicated that orthopaedic disabled person more active as compare with visual and intellectual disabled person. Despite that orthopaedic disabled persons were comes under the moderate daily activity in comparison with normal population (Tudor-Locke, & Bassett, 2004). The participants were on average 9402 step/day orthopaedic disabled, 6891 step/day visual disabled, intellectual and 6213 step/day intellectual disabled person. This study contraindicates with previous studies, the basic recommendation (embodied in most public health guidelines world-wide) of 60 minutes of MVPA is associated with 10,000-14,000 free-living steps/day in preschool children (≅4-6 years of age), 13,000 to 15,000 steps/day in male schoolchildren, 11,000 to 12,000 steps/day in primary/elementary school children, and 10,000-11,700 steps/day for adolescents. This variation of step/day count between disabled and normal population is the major problem is disability of the children. This is indicating that visual disability is a biggest hurdle of physical activity of the children. (Tudor-Locke, & Bassett, 2004; Schmidt et al. 2009) recommended that step/day <5000 sedentary life style, 5000-7499 physically inactive, 7500-9999 moderate active, >10000 physically active and > 12500 very active. However, the US, P. C. S. N, 2016 has set daily step goals as part of its President's Active Lifestyle Award 12,000 steps per day for youth aged 8–17 years, and 8500 steps per day for adults. As per the previous studies (Tudor-Locke, & Bassett, 2004) we can conclude that physically disable children come under the category of moderate active and intellectual and visually disabled person comes under the category of physically in active.

Cadence is the action of steps taken per unit time (i.e., steps/minute) and it can be used to infer intensity of eternal ambulation (Khan, Hussain, & Mohammad, 2013; Tudor-Locke et al., 2005; Marshall et al., 2009). Result shows that there are significant differences exist among Physical, Intellectual and visual disabled person in their cadence. The study determined step taking by orthopaedic disabled person 115.1 step/minutes > 99.35 step/minutes taken by intellectual disable person > 69 step/minutes by visual disable person. Visually disabled person reported extremely slow pace of walking. Walking speed of cadence was slowed by about 10% in vision disability and raised their foot higher when stepping over obstacles (Hayhoe et al., 2009). Visually challenged person spent proportionately more time to fixating the obstacles and fixated longer while guiding foot placement near an obstacle.

W.H.O- recommendation of at least on an average 6677 step per day. The average counts per minute (cpm) (intensity) are 1,040 ± 431 and the children and adolescents spent 92 ± 46 min per day at moderate-to-vigorous intensity.

From the previous research in intellectual disability, raw data have hardly been reported. Only Phillips and Holland (2011) reported steps per day: in their small paediatric subgroup (12–15 years; n = 7), boys took 7,181 ± 179 steps per day, which is comparable higher to the current results (99.35 step/m). Counts per minute (cpm) were more often reported: many studies in youth with intellectual disability showed average cpm between 300 and 450 cpm (Einarsson et al., 2015, 2016).

The analysis of data shows that there are significant differences exist among Physical, Intellectual and visual disabled person in their walking speed m/s. The participants were divided into three different categories orthopaedic, visual and intellectual disabled persons. Intellectual and visual disabled persons with self-selected speed lower than 0.80 m/s and orthopaedics disabled persons greater than 0.80 m/s speed. Perry et al. (1995) conclude that 0.80 m/s and Armand, Decoulon, and Bonnefoy-Mazure (2016) conclude 0.88 m/s were the mean value for classify the value for classifying the peoples. The study determined walking speed m/s by orthopaedic disabled person 0.90m/s > intellectual disabled person 0.62 m/s > visual disabled person 0.48 m/s. this is indicate that visually disabled person walking speed lesser and Orthopaedic disabled person reported higher walking speed among all three categories of disabled population. The walking speed generally analyzed for clinical purpose. Slow walking speed is associated with different diverse health outcome i.e. physical, visual and intellectual disability. Normal walking speed of the adult who are healthy with range 0.90 m/s to 130.0 m/s (Hageman, & Blanke, 1986, Langlois, Keyl, & Guralnik, 1997, Krishnamurthy, & Verghese, 2006; Mohammad, 2016), whereas walking speed range of 0.60 to 0.70 m/s are comes under the risk factor which is associated with poor health outcome (Montero-Odasso et al., 2005). In reference with previous studies indicate that intellectual and visual disabled persons associated with poor health outcome.

This division has been used in a previous study that evaluated walking performance in different environments in subject's post-stroke (Taylor et al, 2006). Perry et al. (1995) concluded that 0.8 m/s was the mean value for classifying people with disability as community walkers. This division has been used in a previous study that evaluated walking performance in different environments in subject post-stroke (Taylor et al., 2006). Perry et al. (1995) concluded that 0.8 m/s was the mean value for classifying people with stroke.

If adopted, such a steps/day scale should continue to reinforce the importance and added value of taking at least an age-appropriate portion of daily steps (e.g., 10,000 -12000 steps per day) at minimally moderate intensity, and if at all possible, at vigorous intensity, congruent with public health guidelines world-wide. Of course, non-ambulatory moderate and vigorous intensity activities (e.g., swimming, bicycling) are also valuable. Recommendations are based on a limited number of relevant studies and must therefore be considered preliminary.

The analysis of the study shows that there are significant differences exist among Physical, Intellectual and visual disabled person in their walking distance covered /day (m) and daily life style activity (indoor and outdoor). Intellectual disabled person covered greater distance per day and activity (indoor) minute per day as compare with orthopaedics and visual disabled persons. Whereas orthopaedics disabled person activity (outdoor) minute per day minimum as compare with visual and intellectual disabled person. The level of intellectual disable person was another potential factor influencing the volume of physical activity (Hilgenkamp, Wijck, & Evenhui, 2012; Phillips, & Holland, 2011). This is in contradiction to previous studies, which showed that that physical activity levels seem to decrease with increasing severity of intellectual disability in adults and elderly (Hilgenkamp et al., 2012; Phillips, & Holland, 2011).

McGarty et al. (2017) examine in their review of five different studies and meta-analysis of two studies that current interventions are insignificantly increasing physical activity levels. Therefore, research on effective intervention components for this specific population is needed. One of the other components of physical effort might be motor skill. These studies indicate that participant with low motor development less physically active and those are having high motor development high amount physically active. Unfortunately, high amount of distance covered by intellectual disable person as compare with others disability indicate that intellectual disable person having high motor component. Based on previous study Hocking, McNeil, and Campbell (2016) suggested in their reviews that task-specific training may be useful, but that the overall quality of evidence is low. More research is needed to study if and how motor development can be increased in person with disability.

5. CONCLUSION

Within the limits and limitation of the study and obtained results it was found that there are significant differences exist among Physical, Intellectual and Visual disabled person in their step count per day, walking speed m/s and walking distance covered/day (m) and daily life style activity (indoor and outdoor).

On the basis of results, it can be concluded that orthopaedic disabled person more active as compare with visual and intellectual disabled person. It can be also concluded that physically disable children come under the category of moderate active and intellectual and visually disabled person comes under the category of physically in active. Further, visually disabled person reported extremely slow pace of walking. Intellectual disabled person covered greater distance per day and activity (indoor) minute per day as compare with orthopaedics and visual disabled persons. Whereas, orthopaedics disabled person activity (outdoor) minute per day minimum as compare with visual and intellectual disabled person.

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