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RESEARCH ARTICLE

INFLUENCE OF SPATIO-TEMPORAL PARAMETERS ON GAIT SPEED IN SCHOOL CHILDREN.

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Abstract

This paper explores the influence of gait speed on various time-distance parameters. The approach consists of designing an experimental set up to gather running data at fast gait speeds. A total of number of twelve school children having mean and standard deviation (SD) of their age (yrs), body height (cms) and body weight (kgs) as 5.25 ± 0.13 , 122.33 ± 7.79 and 21.16 ± 2.82 respectively were selected for the study. The Spatio-temporal gait parameters were recorded during a complete gait cycle and were analyzed using appropriate motion analysis software. The statistical analysis was done using SPSSv17.0. The mean, standard deviation (SD) and correlation coefficient (r) was determined to find out any relationship between the selected Spatio-temporal parameters and gait speed. The results showed that stride length ($r=0.72$) is significantly correlated with gait speed. Therefore, while making an assessment of gait patterns in children for the management of neurological diseases, the impact of gait speed should be given due consideration.

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Introduction:-

Locomotion (walking and Running) is one of the most common in human movements. The motion of the body is a complicated process involving the coordination of neuromuscular and skeletal systems in order to have a smooth and efficient locomotion (Kyriazis, 2012). It is one of the most complex tasks that we learn, but once learned it becomes subconscious and automatic. The main purpose of walking/running is to transfer or move the body efficiently and comfortably across the ground (Winter, 1984). Walking and running is one of the basic activities seen in children helping them to develop their bones, nerves and muscles (Wang & Ji, 2012). Since the function and independence of a child depends upon the treatment of any abnormality in walking or running, it is of prime importance to timely assess any type of disorder if observed in walking or running with accuracy and objectivity (Kyriazis, 2002). "Gait" is the term used to describe the characteristics of body motion (Baharuddin, Salim & Hashim, 2009). It varies between the individuals and also varies from step to step within an individual. Gait consists of coordinated complex and cyclic movements of body parts through a dynamic interaction of the internal and external forces (Sacco & Amadio, 2000). The systematic study of human bipedal locomotion which is carried out both by visual observation and usage of various instruments is termed as gait analysis (Benson, Fixens, Macinell & Parsch, 2010).

The self-selected gait speed is increasingly being used as a major outcome source in the management of neuromuscular diseases by clinicians (Pirpis et al. 2003) and it is necessary to determine how different gait parameters change with gait speed (Vander Linden, 2002). In children the effect of both the gait speed and age must be taken into consideration when analyzing the gait patterns (Stansfield et al. 2001), in view of the completed researches the speed has been considered into account and the present study has been designed to investigate the influence of spatio-temporal parameters on gait speed in school children.

Methods:-

Subjects:-

Twelve normal children (with no known neurological, orthopedic or developmental problems) aged 5-6 years old school children were recruited for the study. The mean and standard deviation (SD) of their age (yrs), body height (cms) and body weight (kgs) were, 5.25 ± 0.13 , 122.33 ± 7.79 and 21.16 ± 2.82 respectively. Further, the subjects were selected in such a way that their anthropometrical measurements were of approximately same values to eliminate their extrenous effect on study.

Procedure

Spatio-temporal gait data was obtained using a cannon camcorder which was positioned perpendicular to sagittal plane on the left side of the subject at a distance of 8.5 meters from the mid of the calibrated running line/axis. The subjects ran on the provided calibrated running line/axis for about 10 meters at fast speeds. The subjects were given three trials and the best one was taken under consideration for analysis. The parameters assessed were, step length (SL) (mts), stride length (StL) (mts), cadence (Cd) (steps/mint.), gait cycle duration (GC_D) (sec.) and gait speed (GS) (mts/sec.).

After obtaining the required video data, the recorded videos were carefully viewed and the best performance clips were extracted for analysis which was done by appropriate motion analysis software.

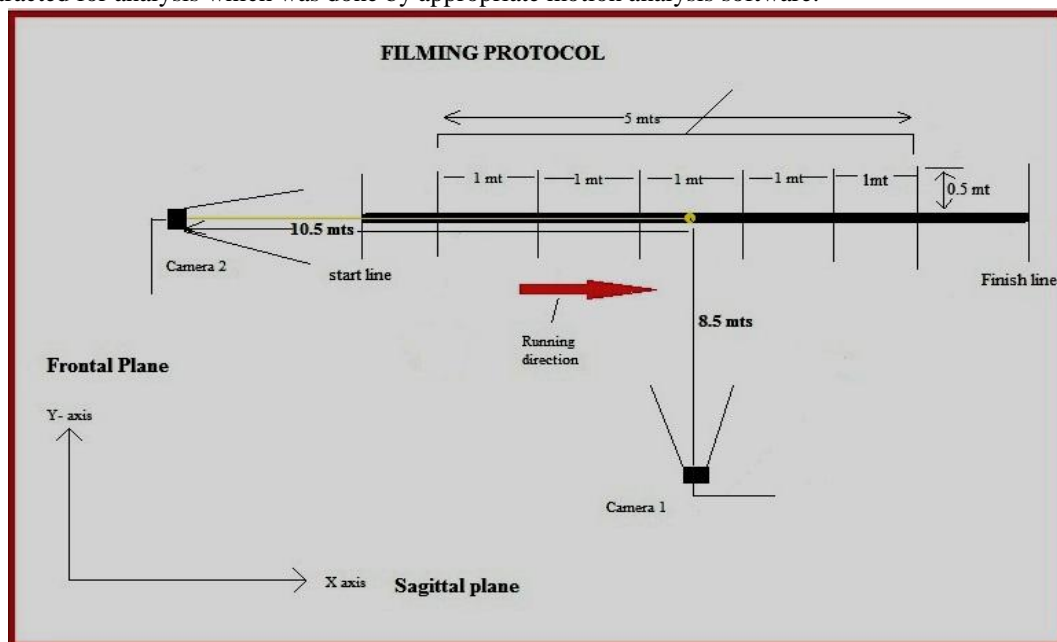
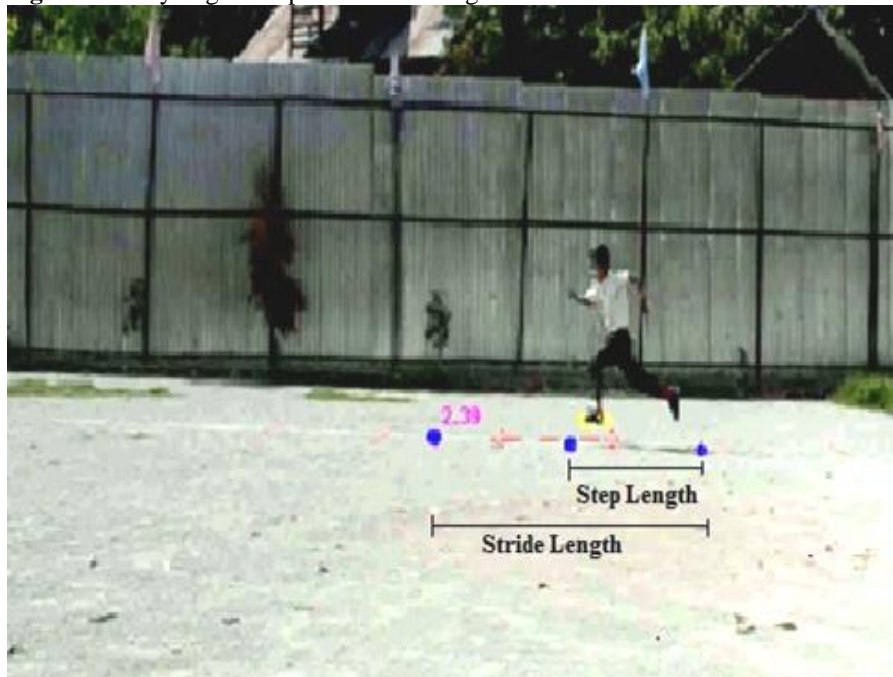


Table 1 Definitions of the assessed parameters

Parameter	Definition
Step length	Distance from heel centre of one limb to the heel centre of opposite limb.
Stride length	Distance between two consecutive heel centers of the same foot.
Cadence	Number of steps per unit time usually expressed in steps/mint.
Gait cycle duration	The period of time between the first contacts of two consecutive footfalls of the same foot.
Gait speed	Average horizontal speed of the body along the line of progression.

Figure 1 Analyzing of Step and Stride Length.**Figure 2** Analyzing of Cadence & Gait velocity.**Figure 3** Analyzing of Gait cycle duration.

Results:-

The main objective of the present study was to determine the relationship between children's Spatio-temporal gait parameters and gait speed during running.

The results are presented in table below;

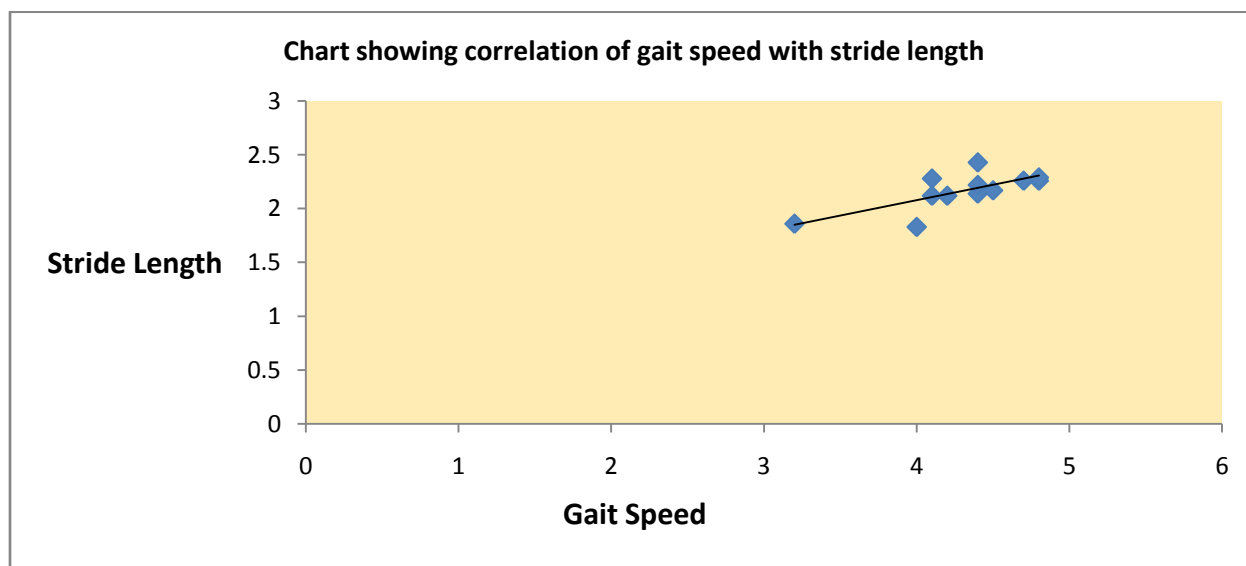
Table 1 Mean, SD & relationship between Spatio-temporal gait parameters and gait speed.

Variable	Unit	Mean	SD	Correlation (r)
Step Length (SL) ,	Meters	1.05	0.09	0.60
Stride Length (StL)	Meters	2.16	0.17	0.72*
Cadence (Cd)	Steps/mint	233.62	18.84	0.21
Gait Cycle Duration (GC _D)	Seconds	0.50	0.03	-0.17

*Significance level at 0.05

Tab $r_{0.05}(10) = 0.63$

A critical evaluation of table 1 shows that the stride length which was found significantly correlated with the gait speed ($r = 0.72$; $p < 0.05$) and no significant relationship exists between the step length, cadence, gait cycle duration and the gait speed,



Thus, the above statistical findings reveal that all the selected Spatio-temporal parameters except the stride length show insignificant relationship and hence are not significantly influenced by gait speed.

Discussion:-

A clear objective assessment of gait is of utmost need in quantifying the running gait parameters which will contribute to the determination of changes after therapeutic and orthotic interventions rather than a subjective assessment. In addition, interpretation and quantification of abnormal gait from the recorded normal gait parameters is also necessary (Krebs, Edelstein & Fisherman, 1980).

The results of the statistical analysis of data in present study showed significant relationship of gait speed to the stride length. No significant relationship existed between the gait speed and other selected Spatio-temporal parameters in gait cycle in specified age group. The findings of the present study are in consistent to the findings of (Rose-Jacobs, 1983) in which he found a significant difference in mean stride length due to speed of gait. Mean stride length was significantly longer ($P < 0.01$). For 5-year old group, significant correlations existed between stride lengths at all speeds. However in 3-year old children, significant correlation between stride length and gait speed

occurred only at free and fast speeds. At slow and free speeds, the older children were perhaps better able to control stride lengths despite the increased need for stability at slower gait speeds. At fast speed with less need for medial-lateral stability (Sutherland et al. 1978) and presumably less time spent in a unilateral support position, the 3-year old probably had less difficulty than at slower gait speeds.

Conclusion:-

The gait in children is influenced by a set of neurological and musculoskeletal adaptations that determine a pattern which evolves and optimizes as the individual matures. Results obtained from this study suggest that gait pattern of children may be affected by speed which emphasizes the complexity of gait development in children. To obtain more information about the influence of gait speed on gait factors, researches in future gait studies of school children should continue to control speed of gait as they test gait factors. Future gait studies should also involve more number of subjects and simultaneously motor development and gait development should be studied in combination so that treating of developmental disabilities by clinicians would become more logistic.

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