Effects of weight carriage on gait parameters in healthy young individuals using GAITRite® SystemMedica

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Abstract

Individuals utilize backpacks every day, commonly persisted their shoulders to free the upper extremities for different exercises and to sort it more agreeable while conveying loads. From a biomechanical viewpoint, asymmetrical posture while wearing a backpack induces changes in walking pattern and parameters of gait.

Objective:

To find out the changes in gait parameters due to weight carriage

Method:

Thirty females participated in this study through convenient sampling technique from university students. Data was collected from students of university in Lahore. Participants were instructed to walk twice on GAITRite mat one without carrying backpack and second with carrying backpack of 3kg over single shoulder.

Result:

The mean age, height and weight of participants were 21.37±1.18 years, 1.62±.043 meters and 45.56±5.04 kg respectively. To evaluate the gait parameters GAITRite® system has been used. A backpack weighted 3kg was carried when participant walked on the mat of the GAITRite® system. There was increase in velocity .Mean velocity increased from 105.79±10.85 to 109.13±10.89 (p =.001) over wearing backpack.

Conclusion:

The study concluded that wearing backpack over one shoulder showed significant changes velocity parameter of gait (p value .001). The other parameters double limb support left (p=.489) and right (p=.348), stance (p = .288), single limb support left (p=.565) and right (p=.493) showed no significant differences.

Key Words: Gait, GAITRite system, Backpack, velocity, single limb support, double limb support.

INTRODUCTION:

Human walk is a biomechanical procedure including a perplexing interchange amid solid and inertial powers that outcomes in the smooth movement of the body through space while limiting the use of vitality[1]. The human musculoskeletal framework has been thoroughly inspected for a considerable length of time, and human walk has been tentatively broke down with a relatively approach power[2]. Essential requirements for walk investigation are the appraisal of spatial temporal step parameters and the examination of developments inside consequent walk cycles. This parameterization of walk requires the discovery of resulting foot contacts. Not exclusively is foot contact location vital for the assurance of basic spatiotemporal walk qualities (e.g. step length or walk term), additionally the investigation of kinematic or physiologic signs amid consequent walk cycles fundamentally relies upon the location of beginning and end of walk cycles[3]. To find the diagnosis of pathological gait and in finding clinical conclusions, the gait parameters temporal and spatial are important.[4]

Individuals utilize backpacks every day, commonly persisted their shoulders to leave the upper appendages free for different exercises and to make it more agreeable while conveying loads.[5, 6]. it is accounted for that measure of load conveyed increments consecutively as youngsters move to higher evaluations.[7] Excessively overwhelming backpack and lacking conveying techniques may appropriate the weight improperly causing back agony muscle weakness, and expanded pressure in various body parts, which may lead to inappropriate stance and spinal deformity [8]. The three primary damage systems referred to as being related with utilization of the backpacks, lifting, or removing the rucksacks. Other damage components were stumbling over the knapsack, venturing into the backpack, or getting hit with a knapsack by someone else. Nonetheless, how the kid was hit by someone else was not distinguished in the report. Strangely, of the intense wounds detailed, the most widely recognized damage areas were the head/confront (22%), the hand (14%), the wrist/elbow (13%), the shoulder (12%), the foot/lower leg (12%), and the back (11%)[9, 10].

From a biomechanical viewpoint, asymmetrical posture while wearing a backpack induces changes in walking pattern. In any case, as individuals constantly convey rucksacks, they have a tendency to disregard possible issues and unfavorable impacts that may possibly be related with backpacks weight and position of placement. A few investigations have detailed adjustment in the kinematic and dynamic parts of step related with use of backpacks, as confirmed by the progressions in spatiotemporal parameters. Those progressions included reduced velocity, rhythm, step length, single support, and expanded double limb support time and walk term.[11]. Be that as it may, as far as anyone is concerned, the lion's share of studies has researched the impact of backpack on the stride spatiotemporal parameters among youthful grown-ups[8].

Among the population who wear the backpacks youth make the noteworthy percentage of it.[8] However, the recommendations of safe weight of backpack which should be carried are limited to school age children.[12]. Therefore, we presume that evaluating the impact of carrying a backpack on young grown-ups' changeability of gait patterns may provide deeper understanding of how physical loads shake gait features under usually situations. By and by, the suggestions of harmless loads depend on offspring of school age. In this manner, we expect that surveying the impact of conveying a rucksack on youthful grown-ups' fluctuation of step examples may give further comprehension of how physical burdens influence stride attributes under routinely circumstances[8] .The elementary gait parameters most regularly used are velocity, step length, and step frequency[13, 14].

A few investigations have been centered on walk adaptation to the outside load in such biomechanical conditions as conveying an extra weight. These investigations likewise reported changes in the fundamental spatiotemporal walk measures because of moment over-burden of the engine framework. For instance, LaFlandra and collaborators (2003) demonstrated that the backpack containing heap of 40% of body weight fundamentally influenced treadmill velocity in youthful sound subjects communicated as the diminishing of walk length with attending increment of walk.[8, 15]

Method:

Table 1: statistics of Age, Height and Weight

	Age	Height	Weight
Mean	21.37	1.6260	45.5667
Std. Error of Mean	.344	.00792	.92187
Std. Deviation	1.884	.04336	5.04930
Minimum	18	1.55	38.00
Maximum	24	1.75	60.00

This table shows the mean age recorded 21.37 ± 1.88 (SE. 0.344). height as 1.6260 ± .04336 (SE. .00792) and mean weight as 45.5667 ± 5.04930 (SE. .92187).

The data was collected from 30 healthy females. The participants were enrolled in this study after their taking consent. The system which was used to record the parameters of gate was the GAITRite® System version 4.7.7. Fractures, pain, orthopedic problems, congenital deformities of the foot or ankle, scoliosis or kyphosis, back ache and neurological or musculoskeletal troubles together with, however not confined to, cerebral palsy, myelodysplasia, or arthritis were included in exclusion criteria. To rule out Postural Deformities observation of posture with naked eye was performed on subjects.

Each subject was well instructed about the procedure before walking on the mat of GAITRite system .In first walk subjects were asked to walk on mat of GAITRite system without any load .In the second walk attempt a bag with weight of 3kg was stranded on one shoulder either left or right depending on how it is being carried in daily routine by subject and asked to walk on mat of GAITRite system. Each subject was asked to walk from a distance of 2 meters from the mat .Subjects were asked to maintain their normal pattern of gait during walk on the mat with or without load.

Results:

There was increase in the velocity on wearing the backpack on single shoulder, contrasted with velocity when no backpack was worn over either left or right shoulder. Related sample t test shows that there is statistically marked difference between the velocity of with and without load (p=.001). Mean, standard deviation, standard error and p value are mentioned in **TABLE 2**

The stance parameter of gait had no significant difference when subjects worn the backpack over 1 shoulder in comparison when walked without carrying the backpack. Related sample t test shows that there is statistically marked difference between the stance of with and without load. Mean stance, standard deviation, standard error and p value are described in **TABLE 2**

There were no significant changes in left double limb support (p=.489) and right double limb support right (p.348) before and after wearing backpack over 1 shoulder confirmed by paired sample t test . The left and right double limb means, standard deviation, standard error ad p value are described in **TABLE 2**

According to paired sample t test there were no significant changes found for both left single limb support (p=.565) and right double limb support (p=.493) leg mean values with and without weight carriage. In the following **TABLE 2** are mentioned mean single limb support values, standard deviation and standard error and p value.

TABLE 2: Paired sample statistics of Gait Parameters with and without Weight Carriage

	Without weight carriage	With weight carriage	Without-With weight carriage	P value
Velocity cm				.001
Mean	109.133	105.790	3.3433	
Std. Deviation	10.8901	10.8565	5.2046.	
Std. Error Mean	1.9882	1.9821	.9502	
Stance % GC				.288
Mean	61.500	61.365	.1350	
Std. Deviation	1.4253	1.5300	.9753	
Std. Error Mean	.1840	.1975	.1259	
Double Limb Support Left % GC				.489
Mean	23.0900	22.9167	.1733	
Std. Deviation	2.5009	2.7908	1.35543	
Std. Error Mean	.45661	.50954	.24747	
Double Limb Support Right % GC				.348
Mean	22.9833	22.6900	.29333	
Std. Deviation	2.4291	2.7818	1.6846	
Std. Error Mean	.44350	.50790	.30756	
Single Limb Support Left % GC				.565
Mean	38.3467	38.443	-.09667	
Std. Deviation	1.3710	1.53548	.91066	
Std. Error Mean	.25032	.28034	.11626	
Single Limb Support Right % GC				.493
Mean	38.6800	38.836	-.15667	
Std. Deviation	1.5957	1.53656	1.23587	
Std. Error Mean	.29135	.28054	.22564	

Discussion:

The main study aim was to find out the variability in gait parameters when wearing load over one shoulder. The main focus of this study was on velocity, single support time, double support time and stance. The results have been compared with results of previous studies which were conducted on changes in gait parameters. There were no significant changes in most of the parameters except few parameters among velocity is of the prime importance. There were changes in velocity. The study was in contrast to Barbara H. Connolly[9] study which assessed no significant changes in velocity under load wearing conditions over 1 or 2 shoulders. The walking speed was maintained constant for all conditions In Kinoshita's study[16].

The results of double limb support were similar to Barbara H. Connolly[9] study. The results for double limb support were conflicted with to Barbara H. Connolly[9] and Chow et al[17] who reported when weighted backpacks were worn double support time was significantly increased. However, KU Smith [18] study concerning the temporal parameters of gait for single and double support periods showed no significant differences with an increase in load. The study conducted by D. H. K. Chow et al[17] reported results of decrease in velocity ,single support time Significant increases in the double support time were seen with increasing backpack load conflicting with our findings which is increased velocity and no significant changes in single support and double support time. on carrying a backpack (on one or two shoulders) the subjects walked with increased stance and double stance than when walking without a backpack according to the study of Cottalorda, J., et al [19]. The outcomes of velocity were not consisted with the study of Singh et al[15] who provided reduced mean velocity for loaded conditions.

Conclusion:

This study concluded that wearing load over one shoulder has caused significant change in the gait parameter of velocity. The other parameters stance, double limb support and single limb support showed no significant change.

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