INFANT CARRYING TECHNIQUES: WHICH IS A PREFERRED MOTHER-FRIENDLY METHOD?

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ABSTRACT

Infant carrying is still trendy among African mothers than in other climes, however, carrying techniques vary mostly along cultural divides. Using a pretest-posttest quasi-experimental design, the authors evaluated the effect of three types of infant carrying techniques on cardiopulmonary function, metabolic expenditure, fatigue demand and locomotion. Front wrap infant carrying technique led to a marginally higher cardiopulmonary demand. Hip sling technique resulted in greater metabolic expenditure and oxygen consumption with high rate of perceived exertion, while back wrap technique did not significantly decrease locomotion parameters. The authors recommend back wrap infant carrying technique based on its slightly lower effects on cardiopulmonary function, metabolic expenditure, fatigue demand and locomotion.

BACKGROUND

Infant carrying is a global but cross-culturally diverse practice (Schön, 2007). Irrespective of technique, infant carrying causes extreme strain and pain on the mother due to repetitive use of certain parts of the body (Montgomery, 2013). In addition, infant carrying has the potential for a higher stress/burden than lactation, as it drains maternal energy (Wall-Scheffler et al, 2007). Consequent to the advent of stroller, cots and collapsible carriers, infant carrying is becoming less common among mothers in developed countries, as well as among educated and elites women in developing countries (Schön, 2007). Nonetheless, infant carrying practices continue to thrive in most other societies owing to strong socio-cultural beliefs and religious inclinations (Schön, 2007; Moscardino, 2006).

Literature is replete on the advantages of infant carrying (Singh, 2009) which include promotion of infant's physical, emotional and mental development (Bryer, 2003), increase in psychosocial bonding between mother and infant (Schön, 2007), as well as regulation of infant's physical responses and vestibular system (Schön, 2007; Yuk et al, 2010). Furthermore, infant carrying serves as a communicating tool and also as a transitional womb (exterogestation) for infants to receive maternal warmth, having not learnt to control bodily function and movement (Schön, 2007; Laura, 2001; Yuk et al, 2010). While, the benefits of infant carrying to the child are well researched (Tiffany et al, 1996), however, studies on the effects of infant carrying on the mother are sparse.

There are numerous techniques of infant carrying, some of these have cultural antecedents, while the others are product of fashion and fads (Schön, 2007). Most commonly, mothers employ different variants of back-carrying, front-carrying and hip-carrying techniques (Schön, 2007; Yuk et al, 2010; Wu et al, 2016). Infant carrying on the back is commonly seen in Africa (Whiting, 1981), front carrying position are prevalent in Mayan society, as well as in western countries (Bernhard, 1996), while carrying infants with side sling is more common in East Africa (e.g. Kenya), and in the island of pacific and Indian ocean (Whiting, 1981). The side sling carrying position presents with more variants which may involve carrying an infant with sling close to the back, chest or hip. It is claimed that the side sling infant carrying in all its variations enhances freer movement for the mother or caregiver (Laura, 2001).

Despite the benefits of infant carrying for the mother and child, the different techniques come with heavy price for the mother (Wall-Scheffler et al, 2007). Front carrying position was reported to significantly alter the center of mass of the mother, similar to what obtains in pregnancy, and at the same time affect gait parameters and joint angles during standing (Lymbery and Gilleard, 2005; Singh, 2009). Changes in gait parameters and joint angles, combined with posture-related low-back and sacro-iliac joint pain, and stretch of the intra pelvic structures are sources of potential health concern for nursing women who are constantly carrying their infants (Sabino and Grauer 2008; Singh, 2009). Similarly, the effect of carrying an infant on hip was compared to carrying an asymmetric load. It was reported that carrying an infant on hip causes increase in side flexion of the trunk, forward trunk flexion with heavier loads (Singh, 2009), and contralateral hip abduction torque, with a decrease in ipsilateral hip torque with load in one side (Matsuo et al, 2008). As a result, posture and the biomechanical alignment of the mother's trunk is altered, which constitutes a potential risk factor for back pain. Understanding other health implications of infant carrying techniques on the mother, in addition to its advantages for the infant is a verdant area for research. In this study, the researchers evaluated the effect of three types of infant carrying techniques on cardiopulmonary function, metabolic expenditure, fatigue demand and locomotion.

MATERIALS AND METHODS

This this pretest-posttest quasi-experimental study was conducted at the Department of Physiotherapy, Obafemi Awolowo University Teaching Hospitals Complex (OAUTHC), Ile-Ife, Nigeria. Ile-Ife is a historic semi-urban town in South-west, Nigeria (Ile-Ife is referred to the as the cradle and ancestral place of the Yoruba race, one of the major ethnic tribes in Nigeria). Ile-Ife as a university city has a heterogeneous population of people from different parts of Nigeria. The city dwellers are predominantly civil servants, academics, students, traders and peasant farmers. The sample for this study were apparently healthy young women who were largely undergraduate students of the Obafemi Awolowo University, Ile-Ife, Nigeria, hospital workers and patients' relatives/caregivers respectively. Young women who had not been involved in infant carrying practices, who were within the weight bracket of 50-65 kg and were with no positive history of cardiopulmonary impairment or any obvious musculoskeletal and neurological impairment were purposively selected. General and Medical Questionnaire (GMQ) and Physical Activity Readiness Questionnaire (PARQ) were used to screen the participants' state of health and any contraindications to participating in moderate physical activity respectively (CSE, 1994; NASM, 1997). Both GMQ and PARQ were used to objectively ascertain that the consenting participants in this study were healthy individuals beyond self-reports. However, none of the participants who consented for the study had any past medical history or an existing or recent problem.

Based on a related study by Singh (2009) with 22 participants, a sample size of 25 participants was proposed for this single arm study. The estimated sample size for this study is comparable with a sample size of 26, proposed in a table of required sample sizes for hypothesis tests by Cohen (Kish 1965) where Cohen's d (i.e. effect size) and Power was 0.80 respectively.

Back wrap, front wrap and hip sling infant carrying techniques were investigated using a 10kg teddy bear (nicknamed as Cutie). (Cutie was used in this study in place of a 10Kg infant due to ethical reasons). The choice of 10 kg was based on average weight of a nine-month old baby (WHO, 2006). The nine month in a baby is the period of growth spurt (Humanussen, 1998), as well as the peak of infant carrying, and typically a child within the age 3 to 9 month is carried more by the mother (Hewlett et al. 1998). An infant carrier (Ergobabies 360, USA) was used to carry the teddy bear through a six-minute treadmill (Erapnonius Treadmill; Bonte Technology BV, Netherlands; Serial NR: ETB 04-433) walk speed of 1.1m/s in the different infant carrying techniques in random order. For example, three patterns of infant carrying order (A - back, front, side; B- front, side, back; and C- side, back, front) were implemented. As participants were recruited, they were assigned A, B or C infant carrying pattern consecutively so as not to give advantage to any particular method. A rest interval of 3 to 5 minutes was observed between each technique in order to allow cardiopulmonary recovery to its resting values. A G-Sensor was wrapped to the lower back of every consenting participant with a strap, as each one of them walked on a motorized treadmill, carrying Cutie in the three different positions. During the carrying test, the participant walked on a treadmill at 1.1 ms $^{-1}$ (Naughton (1978) sub-maximal exercise stress testing protocol) for six minutes at each load condition (Tread-6 minutes' walk). Prior the intervention, participants warmed up and familiarized with the treadmill unloaded (i.e. without carrying cutie) for three minutes. In order to reduce the possible co-founding effect of high body weight on a fixed load, as well as work survivor effect (Arrighi and Hertz-Picciotto, 1994; Tinubu et al, 2010).

Effects of the infant carrying techniques on cardiopulmonary functions was assessed in terms of Heart Rate (HR), Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP). Metabolic Equivalent (METS) was estimated from Saturated Oxygen Level (SPO_2) assessed using pulse oximeter (EC-500A; M/s, India), while Rate of Perceived Exertion (RPE)/fatigue was assessed using the Modified Borg scale (Borg, 2004). Locomotion was assessed in terms of walking speed, number of steps, cadence, stride length and step length. An automated blood pressure monitor (Omron, M2 compact, Singapore) and BTS G-Walk gait analyzer (make) were used to measure cardiopulmonary parameters and locomotory parameters. The motion and gait parameters during treadmill walk was analyzed using a locomotory analysis software (BTS G-Walk) (BTS SpA; Via della croce Rossa, 11 Padova (PD) 1-35129 Italy, SN: 0213-0378). The G-walk works with a G-sensor and a Bluetooth device and it is connected to a laptop computer (HP Pavilion G6 Notebook PC). Weight and height were also assessed using a weighing scale (Camry model; BR 9011) and a height meter (205HR Health O meter, USA) following standard procedures. Ethical approval for this study was obtained from the Ethics and Research Committee of OAUTHC. Informed consent of the participants were also obtained.

Data Analysis

Data was analyzed using descriptive of mean and standard deviations. Inferential statistics of repeated measure ANOVA was used to compare the effects of the different infant carrying techniques on cardiopulmonary and gait parameters. Alpha level was set at $p<0.05$. SPSS version 17.0 was used for data analysis.

Computation

Rate Pressure Product (mmHg/sec), Speed (mmin-1), Maximum Oxygen Consumption and Metabolic equivalent (METS) were computed as shown in Table 1.

RESULTS

The mean age, height, weight, and body mass index of the participants was 23.2 ± 2.81 years, 1.6±0.08m, 60.8±10.9kg, and 22.9± 4.33kg/m2 respectively. The general characteristics of the participants **is** presented in Table 2. Results of comparison of cardiopulmonary parameters of the participants at baseline (unloaded), and immediately after 3-5mins rest following the different infant carrying techniques (i.e. back, front and hip) are presented in Table 3. The results showed no significant differences in the cardiopulmonary variables during different carrying techniques compared with the baseline (unloaded) ($p>0.05$). Based on paired t-test results, the post-intervention values were higher than the baseline values for most of the outcome variables for unloaded walk, as well as during loaded walk in the different carrying techniques, the differences were only significant for HR and RPP measures ($p<0.05$).

Table 4 shows comparison of cardiopulmonary responses (i.e. mean change = change in pre and post 6MTW) and rate of perceived exertion across the different infant carrying techniques. Front wrap led to higher mean change in HR (18.0±13.9 vs. 15.7±14.3 (back wrap) and 16.9±11.0 (hip sling)); and SBP (5.80±7.88 vs. 3.72±8.93 (back wrap) vs. 5.20±9.33 (hip sling)). Hip sling led to higher mean change in SPO_2 (0.28±3.10 vs. 0.20±2.50 (back wrap) vs. 0.20±1.75 (front wrap)); but comparable METS mean change value with back wrap (2.39±0.13 vs. 2.38±0.18). However, these changes across the different techniques were not statistically significant ($p>0.05$).

There was significant difference in RPE scores across the techniques (F=13.052; p=0.001) with the hip infant carrying technique having higher RPE value (12.28±3.13). Comparisons of locomotory parameters is presented in Table 5. Stride length (1.03±0.14 vs. 0.95±0.12 vs. 0.97±0.12; p=0.050) and step length (0.51±0.07 vs. 0.47±0.06 vs. 0.49±0.06; p=0.049) were significantly different (p<0.05) across the various carrying techniques with higher values observed for back wrap technique. However, there were no significant differences in the other locomotion parameters (p>0.05). Superscripts ($^{a\ b\ c}$) were used to present LSD post-hoc test results. For a particular variable, mean values with different Superscripts are significantly different (p<0.05)

DISCUSSION

In this study, the researchers investigated the effects of front, back and hip sling infant carrying on cardiopulmonary and locomotory parameters. In order to control for possible underlying cardiovascular and musculoskeletal conditions that may cofound the findings of this study, PARQ and General and Medical Questionnaire were used to screen all participants. Furthermore, in view of reports that women walk with shorter stride length and greater stride frequency compared to men, and that the stride lengths of women decrease with increasing load while those of the men do not show significant change (Martin and Nelson, 1986), in this study we recruited young women without previous experience of infant carrying alone, as a way of ensuring homogeneity of sample, as well as, to rule out gender influence on cardiopulmonary and locomotory parameters.

The finding from this study indicate that there were significant within-group but no across-group effects on cardiovascular and metabolic parameters. Since carrying infants on the back by mothers is comparable with carrying backpacks (Singh, 2009), therefore, it is adducible that the effects of carrying backpack on cardiopulmonary system and locomotion will be similar to carrying an infants on the back. Some studies (Wood and Orloff, 2007; Daniel et al, 2011; Chatterjee et al, 2012) reported that bearing external load on the back affects the trunk posture and motor control immediately and significantly. On the other hand, front carrying position can be compared loosely to pregnancy. Some studies have shown that load carrying, closer to the torso, compare to no load, had significant effect on HR, SBP, DBP, SPO_2, VO_2max, METS, RPP (Balogun, 1986; Abe et al, 2004).

Effects of load carrying on measures of oxygen consumption and energy demands during loaded weight carrying is reported in literature. Specifically, it has been suggested that metabolic demand during walking with load carriage increases linearly with the carrying weight compared to no load (Soule and Goldman, 1969; Keren et al, 1981; Gordon et al, 1983; Francis and Hoobler, 1986). But according to the result of this study, VO_2, SPO_2 and METS decreased during front infant carrying technique which could be as a result of the effect of load on chest wall, which in turn restricts chest expansion and reduces activities of the diaphragm (Daniel, 2012). A study by Saha et al (1964) reported that during submaximal task, VO_2max will continue to increase until exhaustion, which is same for METS. According to the findings of this present study, front wrap infant carrying technique led to lower METS and VO_2max value which could imply that the technique places significant toll on the metabolic system.

In addition, from this study, the authors found that the different infant carrying approaches led to fatigue which varied significantly across groups. Watson (2008) reports that carrying mannequin on hip or asymmetric load carrying is more strenuous and energy consuming than other carrying methods. Front infant carrying position has the next highest fatigue score followed by back infant carrying technique. Another result from this study indicates that the three modes of infant carrying technique have no significant effect on the locomotory parameters, except for stride length and left step length. Literature posit that stance phase of gait (foot on the ground) is not affected by loads of up to 50% of body weight, the duration of the swing phase (foot in the air) decreases with increased load i.e.; load more than 50% of body weight (Ghori and Luckwill, 1985; Martin and Nelson, 1986) and also increase in the percentage of double support (Harman et al, 1992). Therefore, from this study we found no significant alteration in most of the key locomotory parameters. Literature support that up to 50% of body weight used as load is needed to cause significant alteration in locomotion (Ghori and Luckwill, 1985; Martin and Nelson, 1986; Harman et al, 1992).

In addition, higher stride length and left step length observed in back wrap infant carrying technique in this study could be explained as an automatic balancing response to compensate for load bearing on the back. Also, increased step length in the front wrap infant carrying technique could be a balancing response to alteration in the body's centre of gravity occasioned by load carried in front thus causing more steps forward. Literature show that method of load placement will apparently alter locomotion and gait characteristics (Fiolkowski et al, 2006). Gait kinematics have been shown to deviate from normal when people carry load (Charteris, 1998; Vacheron et al, 1999) and that these differences increase as the load increases (Knapik et al, 1997; Quesada et al, 2000).

Overall, compared with other infant carrying techniques, front infant carrying position evoked higher cardiopulmonary response, as well as lower measures of metabolic equivalent and oxygen consumption, however, the differences across the different techniques were not statistically significant. Back infant carrying position led to higher stride length and left step. Stride length and step length are major determinants of gait economy (Whitcome et al., 2017). Compared with the other infant carrying methods, back infant carrying techniques does not impede or regress ambulation. From this study, hip sling infant carrying position resulted in higher cadence. Ardestani *et al*., (2016) submits that cadence and stride length have significant impact on lower extremity joint moments. The authors posit that cadence and stride length are individual's speed-regulating parameters, and as such may influence walking speed. Also from this study, front infant carrying position led to higher number of steps, while hip sling infant carrying position resulted in significantly higher level of fatigue. The front infant carrying position may alter the body's centre of gravity by shifting it forward. As a result, during walking, the body may be reflexly set in a non-significant anteropulsion movement. Thus, higher numbers of steps are recorded, even as the body pushes or falls forward while walking because of the displacement of center of gravity that is caused by the weight of the baby. Infant carrying is a form of exterogestation, just like in pregnancy, there is an alteration that swing the centre of gravity of the body, shifts the postural balance and increases the risk of falls (Cakmak *et al*., 2016). Thus, increase in the number of steps with front infant carrying position may be a mechanism for fall prevention and protection for the mother.

In sum, front wrap infant carrying technique evoked a marginally higher cardiopulmonary demand. Hip sling technique led to greater metabolic expenditure and oxygen consumption with high rate of perceived exertion, while back wrap technique did not significantly reduce locomotion. To our knowledge, this is the first study to explore and provide empirical support for mother-friendly infant carrying techniques. The outcome of this study provides scientific evidence to advance mother-friendly infant carrying practices and promote quality of life of mothers. However, a potential limitation of this study is that a fixed load was used. It is hypothesized that a lower or higher load may yield a different outcome, thus future studies are needed to verify this postulation. Furthermore, purposive sampling was used to recruit participants in a bid to ensure homogeneity of samples, but can be prone to researcher bias and at the same time limit the generalizability of findings. In addition, lack of control arm, which is typical of single arm studies and the small sample size are part of the limitations of this study. The authors recommend that qualitative inquiry into the determinants of the preference of women on infant carrying techniques be carried out.

CONCLUSION

Back wrap infant carrying technique has slightly lower effects on cardiopulmonary function, metabolic expenditure, fatigue demand and locomotion. This finding has policy implication towards promoting back wrap infant carrying techniques among health workers based on its comparative mother-specific advantages over front wrap and hip sling techniques.

Conflict of Interest - None declared

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Table 1: Computations of some of the outcomes used in the study

SN	Outcome	Computation	Reference
1	Rate Pressure Product (mmHg/sec)	Systolic Blood Pressure (mmHg) * Heart Rate (bpm)	Fredarick (1978)
2	Speed ($mmin^{-1}$)	Distance/time	Naughton (1978)
3	Maximum Oxygen Consumption	VO2max (ml $O_2kg^{-1}min^{-1}$) = speed ($mmin^{-1}$)*0.1m/O_2/Kg + 3.5m/O_2/Kg/min	Dlugosz et al., (2013)
4	METS (Metabolic equivalent)	VO_2max (ml O_2kg^{-1} min^{-1})/3.5	Gunn et al., (2002)

Table 2: General characteristics of the participants (N=25)

Variable	Mean (range)	n	%
Socio-demographics			
Age (years)	23.2(20.0-32.0)		
Occupation			
Student		16	64
Employed		6	24
Unemployed		3	12
Single		25	100
Anthropometrics			
Height (m)	1.6(1.51-1.85)		
Weight (Kg)	60.8(50.0-87.0)		
BMI (Kg/m^2)	22.9(15.1-34.0)		
Personal History			
Smoking			
Yes		25	100
Alcohol			
Yes		25	100
Allergies			
Yes		25	100
Hospitalization/Operation			
Yes		18	72
No		7	28
Existing/Current Health Problem			
Yes		0	0
No		25	100

Table 3: Comparison of participants' cardiopulmonary parameters within and across baseline (unloaded) and the different infant carrying techniques (N=25)

Variable	Unloaded (x ± SD)	Infant carrying techniques Back (x ± SD)	Front (x ±SD)	Hip (x ± SD)	F-ratio	P-value
HR[a]	81.0 ± 10.6	80.7 ± 8.78	81.9 ± 10.4	80.3 ± 10.5	0.117	0.950
HR[b]	96.4 ± 17.1	96.4 ± 16.5	100 ± 13.9	98.9 ± 12.7	0.350	0.789
t(p)	3.83(0.001)	4.20(0.001)	5.21(0.001)	5.64(0.001)		
SBP[a]	115.0 ± 9.94	113.5 ± 11.7	113.1 ± 11.4	112.6 ± 9.81	0.241	0.868
SBP[b]	120.2 ± 9.43	117.3 ± 8.88	119.0 ± 10.3	118.0 ± 9.92	0.469	0.704
t(p)	1.90 (0.064)	1.29 (0.202)	1.92 (0.061)	1.94 (0.059)		
DBP[a]	71.2 ± 8.99	72.5 ±7.98	71.7 ± 8.72	73.1 ± 11.1	0.195	0.900
DBP[b]	74.4 ± 9.38	70.8 ± 6.96	73.0 ± 13.6	71.5 ± 10.5	0.594	0.620
t(p)	0.55 (0.583)	0.80 (0.426)	0.40 (0.689)	0.52 (0.603)		
SPO_2[a]	97.6 ± 1.50	97.7 ± 1.34	98.0 ± 1.29	97.2 ± 2.33	0.777	0.510
SPO_2[b]	98.3 ± 1.62	97.8 ± 1.98	97.8 ± 1.52	97.5 ± 2.57	0.649	0.585
t(p)	1.59 (0.119)	0.21 (0.835)	0.50 (0.618)	0.43 (0.667)		
VO_2max	8.17 ± 0.61	8.37 ± 0.47	8.08 ± 0.42	8.32 ± 0.62	1.503	0.219
METS	2.33 ± 0.17	2.39 ± 0.13	2.31 ± 0.12	2.38 ± 0.18	1.503	0.219
RPP[a]	9364.4 ±1731.4	9153.0 ± 1234.8	8929.8 ± 2249.0	9038.9 ± 1405.0	0.299	0.826
RPP[b]	11621.0 ± 2426.1	11358.0 ± 2379.0	11900 ± 1982.8	11682.0 ± 2002.8	0.255	0.858
t(p)	3.79 (0.001)	4.11 (0.001)	4.95 (0.001)	5.40 (0.001)		

Key: Superscript [a,b] - indicates pre and post six minute treadmill walk in the different infant carrying techniques respectively.
HR – Heart Rate; SBP – Systolic Blood Pressure; DBP – Diastolic Blood Pressure; SPO_2 – Saturated Oxygen level; VO_2max – Maximum oxygen consumption; METS – Metabolic Equivalents; RPP – Rate Pressure Product.
Unloaded – Free six minute treadmill walk without carrying load

Table 4: Comparison of cardiopulmonary response (mean change) and rate of perceived exertion across different infant carrying technique and unloaded (N=25)

Variable	Unloaded ($x \pm SD$)	Back ($x \pm SD$)	Front ($x \pm SD$)	Hip ($x \pm SD$)	F-ratio	P-value
		Infant carrying techniques				
HR	15.4 ± 14.9	15.7 ± 14.3	18.0 ± 13.9	16.9 ± 11.0	0.357	0.784
SBP	5.20 ± 9.57	3.72 ± 8.93	5.80 ± 7.88	5.20 ± 9.33	0.245	0.865
DBP	3.16 ± 6.10	-1.68 ± 5.37	1.36 ± 10.38	-1.56 ± 11.7	1.787	0.155
SPO	0.68 ± 2.51	0.20 ± 2.50	-0.20 ± 1.75	0.28 ± 3.10	0.515	0.673
VO_2max	8.17 ± 0.61	8.37 ± 0.47	8.08 ± 0.42	8.32 ± 0.62	1.503	0.219
METS	2.33 ± 0.17	2.39 ± 0.13	2.31 ± 0.12	2.38 ± 0.18	1.503	0.219
RPP	2256.2 ± 2255.1	2205.4 ± 1752.9	2970.3 ± 2869.7	2643.4 ± 1599.0	0.680	0.566
RPE	7.88 ± 2.07	10.20 ± 2.63^{a}	11.80 ± 3.03^{b}	12.28 ± 3.13^{c}	13.052	0.001*

Superscripts ($^{a\ b\ c}$) based on post-hoc ranked test results, for a particular variable, mean values with different. Superscripts are significantly different ($p<0.05$). * indicate particular variable that is significantly ($p<0.05$) different.

Table 5: Comparison of locomotion parameters across baseline (unloaded) and the different infant carrying technique (N=25)

		Infant carrying techniques				
Variable	Unloaded (x ± SD)	Back (x ± SD)	Front (x ±SD)	Hip (x ± SD)	F-ratio	P-value
Walking Speed	46.7 ± 6.08	48.7 ± 4.67	45.8 ± 4.23	48.3 ± 6.26	1.503	0.219
Number of Step	371.2 ± 196.6	410.4 ± 183.4	471.0 ± 174.8	396.8 ± 197.7	1.113	0.349
Cadence	50.0 ± 4.63	47.43 ± 3.37	48.7 ± 4.17	49.76 ± 5.01	1.810	0.150
Stride length	0.94 ± 0.14^{a}	1.03 ± 0.14^{b}	0.95 ± 0.12^{a}	0.97 ± 0.12^{c}	2.536	0.050*
Step Length (Lt)	0.46 ± 0.07^{a}	0.51 ± 0.07^{b}	0.47 ± 0.06^{a}	0.49 ± 0.06^{c}	2.712	0.049*
Step Length (Rt)	0.48 ± 0.07	0.52 ± 0.08	0.47 ± 0.06	0.48 ± 0.06	2.308	0.081
Stride/height (%)	524.2 ± 1615.2	603.7 ±1875.9	527.2 ± 1622.6	531.7 ± 1608.3	0.013	0.998
Gait Cycle duration	1.21±0.11	1.27±0.09	1.24±0.10	1.20±0.11	2.116	0.103
Step Duration (Lt)	0.60±0.06	0.63±0.05	0.62±0.05	0.61±0.06	1.094	0.356
Step Duration (Rt)	0.60±0.06	0.64±0.04	0.62±0.05	0.60±0.06	2.215	0.091
Stance Duration	64.31±6.53	65.28±6.56	62.36±5.29	63.60±5.64	1.034	0.381
Stance Duration (Lt)	64.47±6.44	65.41±6.86	62.45±5.58	62.98±7.81	1.018	0.388
Stance Duration (Rt)	64.15±6.74	65.19±6.40	62.11±4.87	63.45±5.42	1.193	0.317
Swing Duration	46.96±6.55	33.14±6.58	36.00±5.30	34.74±5.66	0.884	0.452
Swing Duration (Lt)	34.65±7.80	33.03±6.86	36.49±6.45	34.57±6.09	1.069	0.366
Swing Duration (Rt)	34.16±6.72	33.29±6.43	34.97±7.91	34.03±6.20	0.253	0.859
Support Duration (D)	14.99±6.26	16.06±6.55	12.83±5.77	14.44±5.64	1.226	0.305
Support Duration (S)	34.00±6.53	33.14±6.58	36.00±5.30	34.74±5.66	1.006	0.394

Key: Lt-Left, Rt- Right, D- Double, S- Support

Superscripts ($^{a\ b\ c}$) based on LSD Post-hoc test results, for a particular variable, mean values with different superscripts are significantly (p<0.05) different. Mean values with the same superscripts are significantly (p>0.05) not different. * indicate particular variable that is significantly (p<0.05) different.