International Journal of ChemTech Research
CODEN(USA): IJCRGG, ISSN: 0974-4290, ISSN(Online):2455-9555
Vol.10 No.2, pp477-485,2017

Root Mean Square of Dominant Versus Non-Dominant Latissimus Dorsi Muscles during Unilateral Carrying

Amir N Wadee

Department of Basic Science for Physical Therapy, Faculty of Physical Therapy, Cairo University.

Abstract: **Background:** unilateral carrying causes many physical, physiological and biomechanical problems. **Purpose:** was for investigating the root mean square of dominant versus non-dominant Latissimus Dorsi muscles during unilateral carrying. **Subjects**: thirty normal students their ages ranged from 18 to 22 years. **Method**: Root Mean Square (RMS) of myoelectrical activity of Latissimus Dorsi muscles was measured during carrying unilateral shoulder bag with 10% of body weight (BW) on non dominant shoulder for 5 minutes. **Results:** Mann Whitney test revealed highly significant decrease of the RMS of EMG of non dominant side than of the dominant side with mean (5.20 $\pm$ 0.8 and 9.14 $\pm$ 2.43 mv) respectively (Z-value= -3.377 and P=0.001). **Conclusion:** unilateral carrying of 10% BW shoulder bag lead to asymmetrical increase in latissmus dorsi muscles activity.

Key word: unilateral bag carrying, myoelectrical activity, root mean square, Latissimus Dorsi muscles.

Introduction

Recently, the subjects' hand bags got to be distinctly heavier containing laptop, smart phones and an excessive number of different things because of the new innovation. The connection between load carriage and musculoskeletal pain in neck, back and shoulders had been well documented. Prevalence of back pain recorded to be as high as 30-51% in adolescent students and requiring 31% to look for therapeutic mediation. Reports of back problems were higher in juvenile females contrasted with youthful guys, which might be because of females having diminished abdominal strength [1,2,3]. Many individuals now convey their packs over one shoulder, commonly to be the non predominant, despite the fact that it is more hurtful than carrying over both shoulders [4]. It was accounted for that there is lateral deviation in the frontal plane (i.e. a spinal curve concave/ convex within the frontal plane) in response to a bag carried on one shoulder while revealing increased medial/lateral postural influence while conveying a hand held brief case [5,6,7].

Carrying of one-sided shoulder pack for delayed timeframes can negatively affect the human body. These impacts incorporate musculoskeletal misalignment, muscle spasms and postural asymmetry. These postural imbalances trigger a condition called vertebral subluxation [8]. Backpacks changed the liquid substance of the intervertebral discs, a hazard for discs herniation and osteoarthritis [9,10]. There were many past research had studied carrying loads and focused on worn backpack (conveying symmetrically loaded backpacks utilizing both straps). In any case, there is a relative deficiency of research concerning single strap sacks that are related with imperative asymmetric loading[11,12]. In spite of the fact that the larger part of reports demonstrates that loads carried by students are more noteworthy than as far as 10% of the body weight, numerous students and women convey packs containing more, which prompt to numerous physiological and biomechanical changes [13,14].

Sack's strap is single sided shoulder carriage (right shoulder to right hip) might prompt to various musculoskeletal compensations and postural asymmetries. Past reviews had found that the prevailing shoulder was lower than the non-dominant shoulder (this had been related with a hypermobility of the soft tissue and lengthening of the tendons and capsules of joints from more successive utilization of the predominant musculature. These asymmetries were experienced generally with no known relationship to race or sex. They likewise might be asymptomatic [15]. This asymmetry, however, could make an anomalous dissemination of weight through the lower limbs. Taking after conveying shoulder sacks for long time depression and rounded shoulder was found. In the event that a student wears a shoulder pack on the shoulder that is lower, this might assist asymmetries to stance, move the center of gravity outside of the base of support and modify weight bearing distribution through the lower limbs [16].

Past researches concentrated on the impact of bilateral carrying in children on balance, gait and activity of trapezious muscle. But, there were little reviews concerning the impact of carrying one-sided shoulder sacks on myoelectrical action of Latissimusi Dorsi muscles. Therefore additional research was required to further examine the relation between bag carrying styles and activity of the muscles which keep up posture and might be related with back pain. So, was there any difference in the root mean square of dominant versus non-dominant Latissimus Dorsi muscles during unilateral carrying?

Design of the study: was pre-test post-test experimental design. The current study was ethically approved from the ethical committee of Faculty of Physical Therapy, Cairo University. This study was performed in the period from June to December 2016 in the electromyography (EMG) laboratory of the faculty.

Subjects, materials and methods:

Thirty normal volunteers selected from students of Faculty of Physical Therapy, Cairo University participated in this study. Their ages ranged from 18 to 22 years old and their body mass index ranged from 18.5% to 25% kg/m^2. They used the unilateral shoulder type of bags more than five minutes per day for five days a week; their bag weight was 10%of bodyweight.

Instrumentations:

A-Sand bags: different weights they were presented in different forms of 0.25, 0.5, 1 and 2 Kg each weight used was 10% BW.

B-Ordinary weight scale: for measuring body mass index is a value derived from the mass (weight) and height of an individual.

C- Unilateral shoulder bag: was carried over unilateral shoulder measured 15x11x5 inches and weighted 10% BW over the non dominant shoulder

D- Measurement instrumentation:

Electromyography (EMG): for measuring root mean square (RMS). Noraxon EMG MyoSystem apparatus: The EMG MyoSystem 1400A (Inc, Scottsdale, USA), AZ was used to record the EMG activity of participant Latissimusi Dorsi muscles. The surface electromyography (EMG) was an apparatus used to analyze muscular condition during rest or functional activities. Once the muscle electric signal had been captured, it was analyzed or processed by using the “root mean square” value (RMS) which had been widely utilized. In this form of processing, the EMG signal was submitted to mathematical treatments that were designed to quantify the intensity and the duration of several events of the EMG signal **Figure (1)** [20].

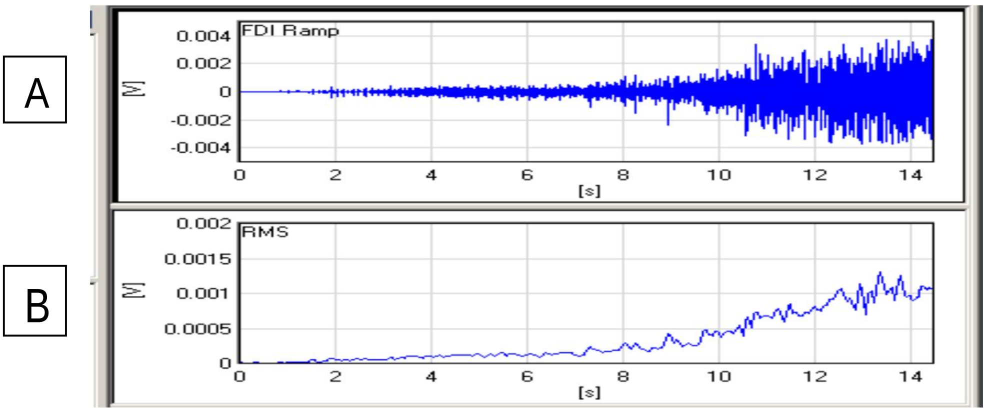

Figure (1) EMG signal processed by RMS: A) EMG signal and B) RMS

Procedures

The participant got relaxed in quite, air conditioned room for ten minutes before testing; the anthropometric data (Height, Weight) and age were registered. The body mass index for each one was calculated. The test procedures were explained to the participant. The weight of the unilateral shoulder bag (10% BW) was informed to the participant. All participants signed an informed consent form.

The skin of the back over the area of the muscle was cleaned by alcohol. The participant stood stride standing while carrying the unilateral shoulder bag on the non-dominant shoulder for five minutes. Two capture electrodes were placed in the direction of muscle fibers.

Electrodes placement: The scapula was palpated. Two active electrodes were placed (2cm apart) approximately 4 cm below the inferior tip of the scapula, half the distance between the spine and the lateral edge of torso. They were oriented in slightly oblique angle (25 degree), Surface EMG electrodes were placed over the muscle belly of the Latissimusi Dorsi muscles with a 2 cm inter-electrode distance. Electrode placement sites were shaved, abraded, and cleaned according to standard electromyographic procedures**.** Proper placement was verified by manual muscle testing **Figure (2)** [14,18].

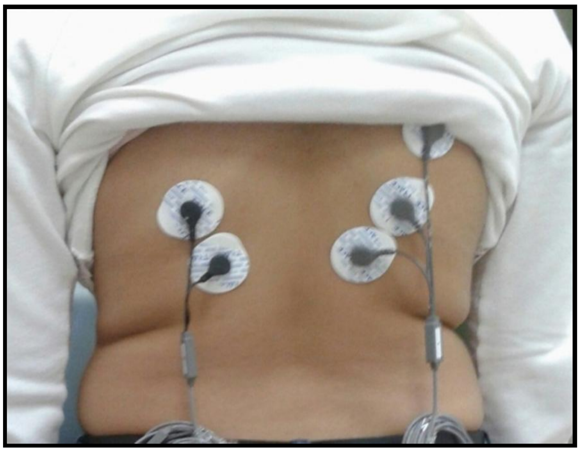

Figure (2). Electrodes placement on Dominant and non-Dominant Latissmus Dorsi muscles

Each participant was examined under two conditions:

A-First condition for determination of maximum voluntary contraction (MVC): While carrying no bag (for measuring the reference value), the starting position of the subjects is sitting on a bench, then placing both fists either side of their body. All participants were asked to lift themselves off bench whilst extending their legs out in front of the body to measure the reference isometric voluntary contractions. All contractions were held for 5 seconds **Figure (3)** [21].

Figure (3) : MVC contraction of latissmus Dorsi muscles

B-Second condition: After taking a rest period ten minutes, subject carry10% of the body weight was carried into the unilateral shoulder bag determined by using sand bags of different weights. All subjects were asked to comfortably stride stand and carry the bag on the non-dominant shoulder for five minutes **Figure (4)**[21].

Figure (4): Standing carrying 10% BW

Results:

I. RMS of EMG for MVC of non-dominant and dominant Latissimus Dorsi muscles: Each subject performed maximum voluntary contraction for (non dominant and dominant) LatissimusiDorsi muscles with RMS value ranged from 3.60 to 27.30 mv and 20.6 to 38.20 mv with mean ± SD 16.99 ± 5.87mv and 30.06 ± 4.09 mv respectively as shown in table (1) and figure (5).

Table (1): RMS of EMG for MVC of non-dominant and dominant Latissimus Dorsi muscles:

	N	Minimum	Maximum	Mean	SD
RMS of MVC non dominant (mv)	30	3.60	27.30	16.99	5.87
RMS of MVC dominant(mv)	30	20.6	38.20	30.06	4.09

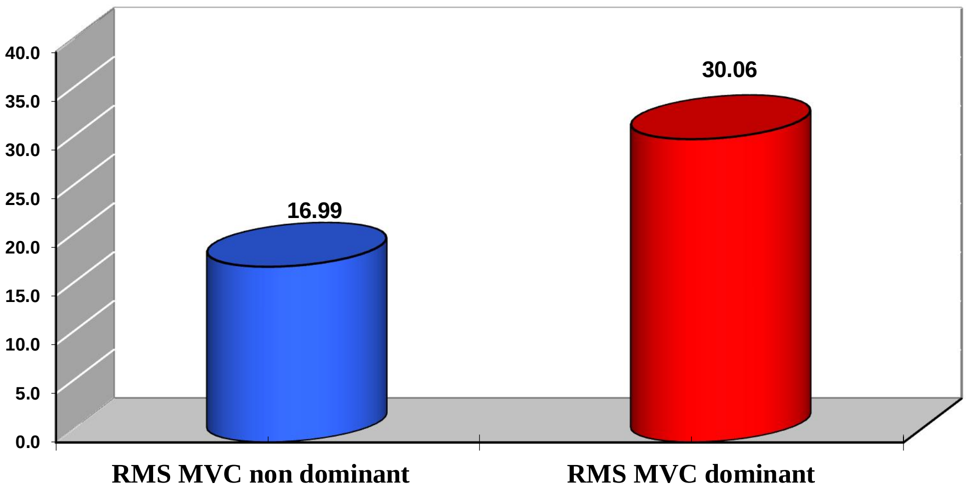

Figure (5):RMS of EMG for MVC of non-dominant and dominant Latissimus Dorsi muscles

II. Percent change of RMS of EMG activities from MVC: There was a statistical difference in the mean values of percent change of RMS of EMG activities after carrying 10% of body weight when comparing the non-dominant side with the dominant side (10.79 and 19.92) with percent change (64.54 % and 66.35 %) respectively as shown in table(2) and figure (6).

Table (2): Percent change of RMS of EMG activities from MVC after carrying 10% of body weight in both non dominant and dominant Latissimus Dorsi muscles

Characteristics	Non dominant	Dominant
10% of body weight		
Mean difference (mv)	10.79	19.92
Percent change (mv)	64.54 %	66.35%

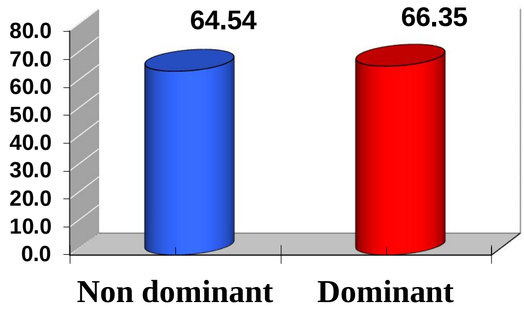

Figure (6): Percent change of RMS of EMG activities from MVC after carrying 10% of body weight in both non dominant and dominant Latissimus Dorsi muscles

III. RMS of EMG activities between non dominant and dominant LatissimusDorsi: The mean value of carrying 10% of body weight in non-dominant side was 5.20 ± 0.80 mv while it was 9.14 ± 2.43mv in dominant side.Mann Whitney test revealed that there was a statistical significant increase in the mean values of RMS of EMG activities between dominant and non-dominant after carrying 10% of body weight (Z= -3.377; p= 0.001) Table(3) and Figure (7).

Table (3): Mean values of RMS of EMG activities after carrying in both non dominant and dominant LatissimusDorsi

Characteristics	Non dominant(n= 30)	Dominant (n= 30)	Z value	P value
10% of body weight	5.20 ± 0.80mv	9.14 ± 2.43mv	-3.377	0.001**

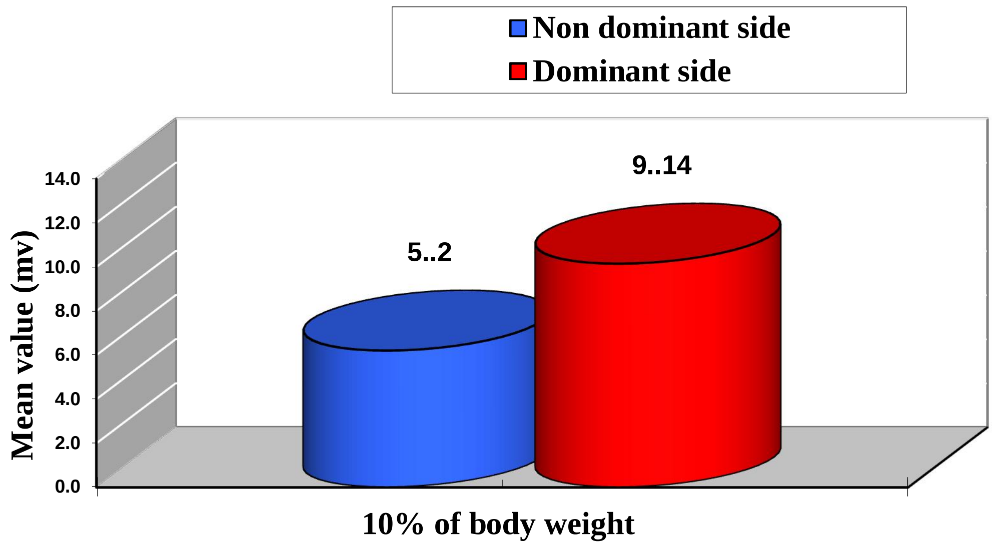

Figure (7):Mean values of RMS of EMG activities after carrying in both non dominant and dominant Latissimus Dorsi muscles

Discussion:

The consequences of this study demonstrated that there was a significant decrease in the mean values of RMS of EMG activities of non- dominant Latissimus Dorsi muscles subsequent to carrying 10% of body weight when contrasted with the dominant side with mean 5.20 and 9.14 mv respectively (Z value was= - 3.377; P=0.001).

This outcome was supported by comparable a review on ten adult males walking for eight minutes conveying 7.2 kg. one-sided shoulder golf sack, the researcher observed that all subjects utilized a higher percentage of muscular exertion in the examined muscles (right and left Trapizuse and Latissimus Dorsi) so as to maintain posture. Since the right shoulder (dominant side) was taking the greater part of the load, the left Trapezius and left Latissimus Dorsi required increasing exertion, trying to counter act the asymmetrical load of the spine [18].

This might be expected to the Dorsi neutralize the forward bending of the shoulder, while responding to the golf sacks arbitrary swaying during walk cycle [18]. So the first hypothesis which expressed that no impact of carrying one-sided shoulder sack containing 10% of body weight on RMS of EMG action of Latissimus Dorsi muscle in normal females was rejected.

In addition, a single strap carrying was observed to be less steady and showed an impressive influence as the subject walked. This increased sway might be made up for by increment in action on Trapizius and Ltissimus Dorsi trying to maintain posture. Physiological differentiation occurred within the Latissimus Dorsi during conveying a golf pack with one-sided shoulder strap. The single strap setup made unequal conveying exertion over the spinal musculature, brought about by either the immediate weight of the pack forcing muscles to build their effort or counteraction of the inverse side to the load, which might have been required to maintain posture [22]; This concurred with the current results of percent change in muscle activity of non- dominant not as much as dominant side (64.54% and 66.35%) respectively after carrying.

Likewise the recent outcomes were supported by specialists who revealed lateral deviation in the frontal plane (a spinal curve concave/ convex within the frontal plane) in response to a pack carried on one shoulder [22]. Also, the current outcomes were agreed with a review which informed that unilateral loading modes created asymmetrical deviations far from the load which brought about significant greater postural deviations and adjustments than symmetrical loading. The shoulder and handheld packs delivered postural deviations in all planes which might bring about unfavorable stress and strain on spinal structures and at last prompt to pain and progressive postural scoliosis. Conveying the load on the right shoulder fundamentally increased the thoracic lateral curvature in the frontal plane and diminished the thoracic kyphosis in the sagittal plane [11,17,23].

Moreover the aftereffects of the current review uncovered that there was significant decrease in the RMS of EMG of non- dominant side contrasting and predominant during carrying. Others concurred with these outcomes as they revealed that there were contrasts in the postural reactions to the distinctive types of asymmetrical loads. A general incline forward was seen combined with a lateral shift to the left side far from the load placed on the right hip. The degree of this side bending motion was not as extensive in the cross-body stacked condition [23].

In the same-side loaded condition height of the stacked shoulder was seen, accompanied by a corresponding counter-balancing lowering of the non-loaded shoulder. Adjustments of the spinal curvature inferable from improper posture could be restoratively named as functional scoliosis. This is temporary as the spinal column continues its right arrangement and correcting the poor posture by removing the load. The lasting impacts of poor posture were not known, but rather such changes of the spine might be in charge of the postural discomfort, musculoskeletal pain in the shoulders and back pain related with substantial load carriage [19].

Notwithstanding that it was reasoned that single strapped sacks influence posture by brought about expanded cranial thoracic spine pivot, increased shoulder rise, expanded pelvic tilt, increased trunk lateral flexion, because of weight bearing on one side of the spine and increased lumbar flexion and lordosis of the spine. Additionally, studies reported that these postural changes will probably brought about an increase in muscle activity of the back muscles in charge of keeping up posture trying to keep up the area of centre of mass over the base of support during the walking. This increased muscle action had been connected with increased back pain and injury [24]. This clarifies the current outcomes in increased the RMS of EMG of non- dominant side after carrying with mean (5.20 mv). Others agreed with these outcomes as they reported increasing in contralateral muscle activity with asymmetrical sack carriage contrasted with symmetrical pack carriage, so the first and second hypotheses were rejected. Likewise, a review supported the utilization of 10% of body weight for safe use of back pack for 531 students in northern California, they found that more youthful students are more at hazard because of moderately lower body weight while females additionally conveyed heavier back pack than male [25].

Additionally, in a review applied on twenty four students (twelve males and twelve females) in Grand Valley University, found that there was a significant interaction impact found between conveyed weight and individual muscle activity for both the ipsilateral and contralateral paraspinal muscles. The review likewise announced that numerous different muscles work in trunk stability including internal obliques, transverses abdominus, and the multifidus. These muscles might fire more in response to the load in order to improve stability of the trunk; accordingly lessening the activity requests of the erector spinae and Latissimusi Dorsi muscles [26].

This agreed by a study had performed on Sixty-five college volunteers, every member wore a one-sided strap be shoulder pack by two diverse ways (left shoulder to left hip and right shoulder to left hip and the other way around) on the predominant and non- dominant shoulder while standing on a Postural Scale Analyzer to measure lower limb weight distribution and they found that it was conceivable to wear a single strap shoulder sack in a certain way to diminish postural asymmetry in standing. Right hand prevailing people who wore a shoulder sack draped over their left shoulder showed all the more evenly distributed weight through their lower limbs regardless of which one displayed increased weight bearing at first. Outcomes proposed that it might be advantageous for students who utilize a one-sided strap shoulder pack to carry it draped across their non-predominant shoulder keeping in mind the end goal to adjust weight bearing through their lower limbs [27,28].

On the other hand, others disagreed with the current outcomes as their research was connected on a sample of twelve females college student walked on a treadmill for five minutes at 1.1 m/s during five conditions; control, 1 strapped rucksack, 2 strapped rucksack, ipsilateral shoulder strap and contralateral shoulder strap, each containing 10% bodyweight. Electromyography for the trapezius, erector spinae and Latissimus Dorsi was recorded for each condition. For the Latissimus Dorsi There were no significant differences in muscle activity amongst left and right Latissimus Dorsi muscles during any of the bag conditions. This distinction might be because of progress in test number (twelve females walking on a treadmill yet the current example was thirty static standing females), additionally the past study might have some artifact because of measuring three muscles respectively and walking [29].

Likewise, in a review applied on thirty seven solider, for testing the biomechanical impact of the heaviness of equipment on trunk muscles utilizing electromyography for evaluation for Latissimus Dorsi, Pectoralis Major and Trapizius muscles. For the Latissimus Dorsi muscle As the weight of equipment was progressively increased over the right shoulder, muscular activity of the Latissimus Dorsi demonstrated a significant increase just when the rifle was added, with most extreme activity happening when the rifle was conveyed in front of the body (right side, weapon in front versus control, $p < 0.001$). Activity on the right side was fundamentally higher than on the left (weapon in front, WI, $p < 0.001$). At the point when the rifle was conveyed thrown over the right shoulder, muscular activity in the respective Latissimus Dorsi muscle diminished altogether (right side, weapon on shoulder versus weapon in front, $p = 0.014$)[29].

This outcome contrasts with the current review as the increased activity was in the ipsilateral side (right shoulder) of carrying equipment's however in the current study; the increased activity was in the contralateral side. This distinction might come about because of progress in the shape and weight of the conveyed objects. Likewise, might be because of progress of sex and the method for conveying as in the past research was for the male fighters conveyed more than one object in a same time in various courses, yet in the current study the subjects convey just one-sided shoulder bag on non dominant side [29].

References:

1. Schulze C., Lindner T., Schulz k., Finze S., Kundt G., Mittelmeier W. and Bader R.: The Influence in Air force Soldiers through Wearing Certain Types of Army-Issue Footwear on Muscle Activity in the Lower Extremities, Open Orthop. J, Vol. 5, 219–223, 2011.

2. Moore M., White G. and Moore D.: Association of relative backpack weight with reported pain, pain sites, medical utilization, and lost school time in children and adolescents. J School Health; 77: 232–239; 1746-1561, 2007.
3. Ibrahim A.: Incidence of back pain in Egyptian school girls: Effect of schoolbag weight and carrying way. World ApplSci J; 17:1526–1534, 2012.
4. Feingold A. and Jacobs K.: The effect of education on backpack wearing and posture in a middle school population. Work; 18: 287-294, 2002.
5. ClarysJ.: Electromyography in sports and occupational setting update of its limits and possibilities. J Ergonomics; 43 (10):1750-1762, 2000.
6. An D., Yoon J., Yoo W. and Kim K.: Comparisons of the gait parameters of young Korean women carrying a single strap bag. Nurs Health Sci; 12:87–93, 2010.
7. Criswell E.: Cram's introduction to Surface Electromyography. Jones and Bartlett publishers. ed 2nd; Pp341-344, 2011.
8. Fong D., Hong Y. and Li J.: The effect of load carriage and schoolbag design on lateral trunk posture during stairs descent in children. International Symposium on Biomechanics in Sports: 149-151, 2004.
9. Jones G. and Macfarlane G.: Epidemiology of low back pain in children and adolescents. Arch Dis Child; 90: 312–316, 2005.
10. Korovessis P., Koureas G. and Papazisis Z.: Correlation between Backpack Weight and Way of Carrying, Sagittal and Frontal Spinal Cur-vatures, Athletic Activity, and Dorsal and Low Back Pain in Schoolchild-ren and Adolescents. Journal of Spinal Disorders and Techniques; 17 (1), 33-40, 2004.
11. Mackenzie W., Sampath J., Kruse R. and Sheir-Neiss G.: Backpacks in children. Clinical orthopedics and related research; 409:78-48, 2003.
12. Mosaad D.: Influence of school bag carriage on gait and posture, Faculty of Physical Therapy, Cairo University, doctoral degree thesis, 2009.
13. Skoffer B.: Low back pain in 15- to 16-year-old children in relation to school furniture and carrying of the school bag. Spine; 32:713–717, 2007.
14. Warren J., Bettany-Saltikov J. and Van-Schaik P.: 3-D Measurement of Posture and Back shape Using a Low Cost, Portable System, A Reliability Study. In: Tanguy, A., Peuchot, B. eds. Research into Spinal Deformities 3 IOS Press, Amsterdam; 100-104, 2002.
15. Zultowoski I. andAruinZ.: Carrying loads and postural sway in standing: the effect of load placement and magnitude. Ios press; 30:359-36, 2008.
16. Merletti R., Botter A., Troiano A., Merlo E. and Minetto M.: Technology and instrumentation for detection and conditioning of the surface electromyographic signal: State of the art. Clinical Biomechanics; 24:122-34, 2009.
17. Konrad P: The ABC of EMG. A Practical Introduction to Kinesiological Electromyography,(version 1.0). Noraxon Inc., US, Pp 11- 24, April 2005.
18. Ikeda E., Cooper L., Gulick P. and Nguyen P.: The metabolic cost of carrying a single- versus double-strap golf bag. J Strength Cond Res; 22(3): 974-977, 2002.
19. Haselgrove C., Strakel L., Smith A., O Sulliivan P., Perry M. and Solan N.: Perceived school bag load. Duration of carriage and method of transport to school are associated with spinal pain in adolescent: an observational study .Australian Journal of physiotherapy, 54(3):193-200, 2008.
20. Forjuoh B., Samuel N., Bryan L., Schuchmann N. and John A.: Percentage of Body Weight Carried by Students in Their School Backpacks American. Journal of Physical Medicine & Rehabilitation April 2003; Vol. 82 - Issue 4: pp 261-266.
21. Elbably H : Influence of backpacks on myoelectrical activity of upper fibers of trapizius in school students during walking(master degree); faculty of physical therapy, Cairo university, 2011.
22. Connolly B., Cook B., Hunter S., Laughter M., Mills A., Nordtvedt N. and Bush A.: Effects of backpack carriage on gait parameters in children. PediatrPhysTher; 20(4):347-55, 2008.
23. Basmajian J. and De-Luca C.: Muscles alive: Their functions revealed by electromyography. In: Zhou P, Rymer W. Factors governing the form of the relation between muscle force and the EMG: Astimulation study. Journal of Neurophysiology; 92: 2878-86, 2004.
24. Arnsdorff M.: Mounting Research on Backpack Use I.C.P.A. Newsletter ; 22(3): 974-977, 2002.
25. Freiwald J., Baumgart C. and Kondrad P.: Introduction to electromyography. Sport - Rehabilitation Balingen: Spitta-Verl; 24:122-34, 2007.

26. Hong Y. and Brueggemann G.: Changes in gait patterns in 10-year-old boys with increasing loads when walking on a treadmill. Gait and Postur; 11: 254 – 259, 2000.
27. Kamen G. and Gabriel D.: Essentials of Electromoyograhy. Champaign, IL: Human Kinetics publishers. Kawakarni, Y., Abe, T.Muscle fiber pennation angles are greater in hypertrophied than in normal muscles. Journal of Applied physiology, 74, 2740-2744, 2010.
28. Kim M., Yib C., Kwonb O., Chob S. and Yooc W.: Changes in neck muscle electromyography and forward head posture of children when carrying schoolbags. Ergonomics; 51 (6): 890–901, 2008.
29. Krebs D., Goldvasser D., Lockert J. and Portney L.: Is base of support greater in unsteady gait? Phys Ther.;82(2):138-47, 2002 Feb.

*****