An- Najah National University
Faculty of Graduate Studies

The Influence of Backpacks on Students backs A Cross-Sectional Study of Schools in Tulkarm District

By
Alaa` Osaid khalil AL-Qato

Supervisor
Dr. Khalil Issa
Co-Supervisor
Prof. Gassan Abu-Hijleh

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This thesis was defended successfully on 26/1/2012and approved by:

Defense Committee members	**Signature**
1. Dr. Khalil Issa / Supervisor	
2. Prof. Ghassan Abu-Hijleh / Co-Supervisor	
3. Dr.Ayman Hussein / Internal Examiner	
4. Dr. Alaa`Azmi / External Examiner	

Dedication

I *dedicate my efforts in this study to my father Osaid (may Allah, almighty, bless his soul) and my beloved mother Mariam, brothers, sisters and all my family members for their continuous encouragement throughout the course of my research.*

Alaa` Osaid AL-Qato

Acknowledgment

I*t is not possible to credit everyone who has contributed to the success of this research. However, I would like to give particular Recognition to those who helped and guided me through this study.*

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Thanks are also due to the Palestinian Ministry of Education, Directorate of Education and School Headmasters and students at Tulkarm district for their help in sample collection. Thanks are also due to Dr. Jihad Abdallah for his kind help and assistance in statistical analysis.

I shall never be able to express adequately my acknowledgment to all my supportive friends, who were very cooperative and helpful. Sincere thanks, appreciation, and love go to all my family members, especially to my mother, for their patience, encouragement, and endless support during my graduate study.

الإقرار

أنا الموقعة أدناه مقدمه الرسالة التي تحمل عنوان:

The Influence of Backpacks on students Backs: A Cross-Sectional Study of schools in Tulkarm District.

تأثير الحقائب المدرسية على ظهور الطلاب - دراسة مقطعية لمدارس محافظة طولكرم

اقر بان ما اشتملت عليه هذه الرسالة إنما هو نتاج جهدي الخاص ، باستثناء مـــا تمـــت الإشارة إليه حيثما ورد، وان هذه الرسالة ككل من أو جزء منها لم يقدم من قبل لنيل أية درجـــة أو بحث علمي أو بحثي لدى أية مؤسسة تعليمية أو بحثية أخرى .

Declaration

The work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

Student's name: **اسم الطالبة:**

Signature: **التوقيع:**

Date: **التاريخ:**

List of Abbreviations

DP: Dorsal Pain
L.B.P: Low Back Pain
C.C.A: Cranio Cervical Angel
C.V: Cranio Vertebral
H.O.N: Head on Neck
C.V.A: Cranio-vertebral Angle
T.F.L: Turn Forward lean
L.A: lordosis Angle
M.R.I: Magnetic Resonance Imaging
C.G: Center of Gravity
A.O.T.A: American Occupational Therapy Association
A.P.T.A: American Physical Therapy Association
A.C.A: American Chiropractic Association
S.I.L: Stander Institution of Israel
A.A.P: American Academy of Pediatrics
H.O.N.T: Head on Neck or Trunk
M.S.D: Musculoskeletal Disorder
A.I.S : Adolescent Idiopathic Scoliosis
C.O.P: Center of Pressure
B.W: Body weight
M.O.H: Ministry of Health
M.O.E.D: Ministry of Education

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Abstract

There is an ongoing concern regarding the weight of children's schoolbags and the negative consequences of such heavy loads on the musculoskeletal pain and developing spine.

This study investigated the weight of school bag (ratio) and musculoskeletal symptoms related to school bag carriage on primary and secondary schools in Tulkarm district. The purpose of the present study was to determine the relationship between musculoskeletal pain and/or fatigue and school bag carriage in Tulkarm schools. A cross sectional study, using random sampling method was conducted during spring 2009. 800 students (males and females) grades 3-9 correctly filled out a questionnaire with closed-ended questions. Each student's weight and full backpack weight were measured. The results revealed that the mean full schoolbag weight was 5.267 kg; the mean percentage of full school bag to body weight was 12.3%. Also, 73% of the students had a loaded bag weight ≥ 10% of body weight, For pain related to carrying schoolbag; 47.8% of students had shoulder pain, 21.6% had lower back pain, and 18.2% had neck pain .

However, with regard to the grade, time to arrive to school, ratio of the bag weight to body weight, and right-left swaying, it was showed that they had significant relationships with occurrence of musculoskeletal pain, while residence, transport, and carry method had no significant relationship ($P > 0.10$) with occurrence of pain. Also; gender, grade, time to arrive to school, ratio of bag weight to body weight, carry method and right-left swaying were significantly associated ($P < 0.05$) with occurrence of fatigue, while residence and transport had no significant relationships ($P > 0.10$) with occurrence of fatigue . Carrying a backpack weighing >10% of body weight appeared to be too heavy to maintain posture for students.

It is recommended that a school bag should be limited to no more than 5-10% of a student's body weight and work towards affording e-book for each student should be taken seriously. There is always a need for further research in this area and more in-depth studies to identify risk factors for bodily pains in school children.

CHPTER ONE

INTRODUCTION

CHPTER ONE
INTRODUCTION

It was and still is of great concern the relation between back pain and school bags. In this study, we are also concentrating on the issue of children health through their developmental years in regards of holding school bags on their backs and causing what is called (backpack syndrome). We assume that the parents and teachers are not so much aware of the risks of such a problem. We are trying through this study to come to a conclusion that aids alleviation of this bag burden and prevent the progression of its implications upon school children.

In order to better understand abnormalities or health problems related to spine in children we need to be aware of some basic spinal anatomy.

1.1 Anatomy of vertebral column

The back is an intricate structure of bones, muscles, and other tissues that form the posterior part of the trunk from the neck to the pelvis. The centerpiece is the spinal column, which not only supports the upper body's weight but houses and protects the spinal cord — the delicate nervous system structure that carries signals to control the body's movements and convey its sensations. Stacked on top of one another are more than 30 bones — the vertebrae — that form the spinal column, also known as "The Spine". Each of these bones contains a roundish hole that, when stacked in register with all the others, creates a channel that surrounds the spinal cord (72).

The bones or vertebrae that make up the spinal column are not stacked directly on top of each other. There are spaces between them that are maintained by round, spongy pads of cartilage called ***intervertebral*** disks. These disks and the spaces between the bones that they fill, give the back flexibility. The disks act much like shock absorbers throughout the spinal column to cushion the bones as the body moves. Bands of tissues called ***ligaments and tendons*** hold the vertebrae in place and attach the muscles of the back to the spinal column. Small nerves called ***roots*** enter and emerge from the spinal cord through spaces between the vertebrae [3.73].

The spine has three major components [1]***:***

- The spinal column (i.e., bones and discs).
- Neural elements (i.e., the spinal cord and nerve roots).
- Supporting structures (e.g., muscles and ligaments).

❖ Spinal column.

The spinal column is part of the axial skeleton, in adults it consists of 26 bones; considering the sacrum and coccyx each as one bone (Figure1:1).

The primary functions of the spinal column include [2]*:*

- Providing a column of support, bearing the weight of head, neck, and trunk.
- Ultimately transferring the weight to the appendicular skeleton of the lower limbs and protecting the spinal cord.

- Helping to maintain an upright body position, as in sitting or standing.
- Providing flexibility of motions.

The spinal column is divided into cervical, thoracic, lumber, sacral and coccygeal regions [(2)]:

- Seven cervical vertebrae constitute the neck and extend inferiorly to the trunk.
- Twelve thoracic vertebrae from superior portion of the back; each articulates with one or more pairs of ribs.
- Five lumber vertebrae form the inferior portion of the back;
- The fifth articulate with sacrum, which in turn articulates with the coccyx. The cervical, thoracic, and lumber regions consist of individual vertebrae.

During development, the sacrum originates as a group of five vertebrae and the coccyx begins as three to five very small vertebrae. In general, the vertebrae of the sacrum are completely fused by age 25-30 year. Ossification of the distal coccygeal vertebrae is not complete before puberty, and thereafter fusion occurs at a variable pace [(2)].

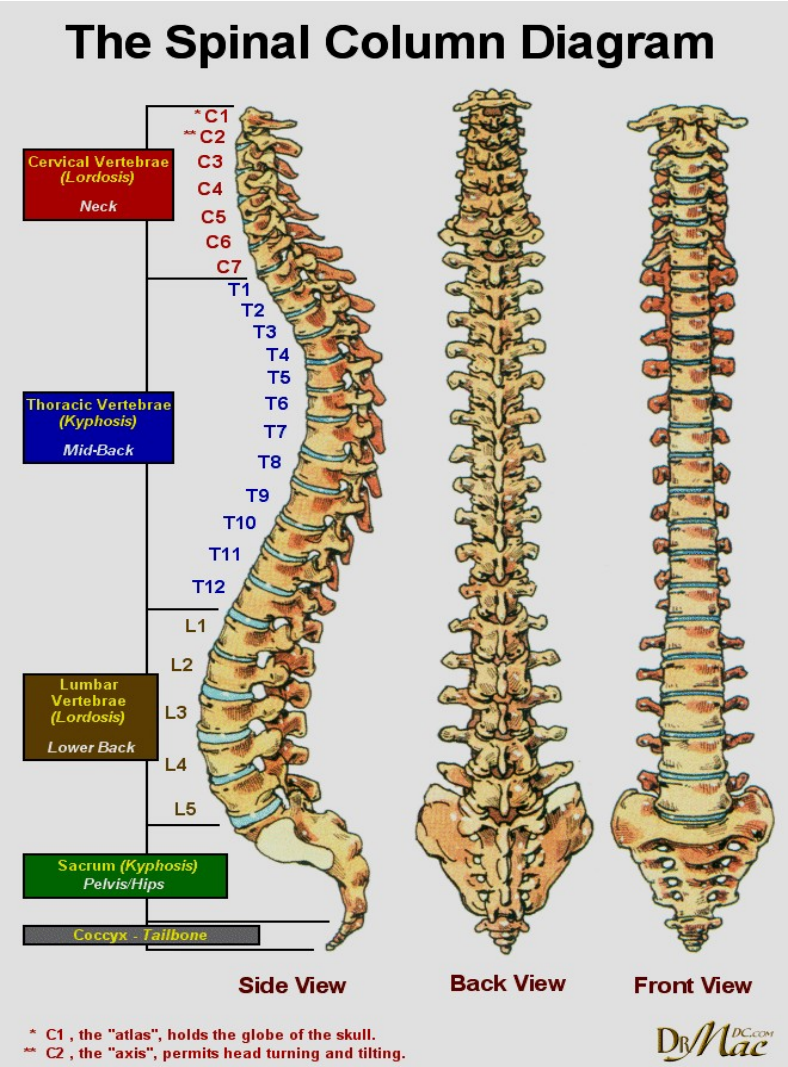

Figure (1:1): The spinal column diagram

❖ Spinal curvatures

The spinal column is neither straight nor rigid. A lateral view shows four spinal curves (Figure 1:2): the cervical, the thoracic, the lumber, and the sacral. In the fetus, there is only a single anteriorly concave curve. At approximately third postnatal month, when the infant begins to hold its head erect, the cervical curve develops. Later, when the child stands and walks, the lumber curve develops. The cervical and lumbar ones are anteriorly convex. Because they are modifications of the fetal position, they

are called *secondary curves*. The other two curves, the thoracic and the sacral are anteriorly concave. Since they retain the anterior concavity of the fetus, they are referred to as *primary curves* [1] the cervical curve develops as the infant learns to balance the head upright. The lumber curve develops with the ability to stand. Both compensations become accentuated as toddlers learn to walk and run. All four curves are fully developed by the age of 10 years [2].

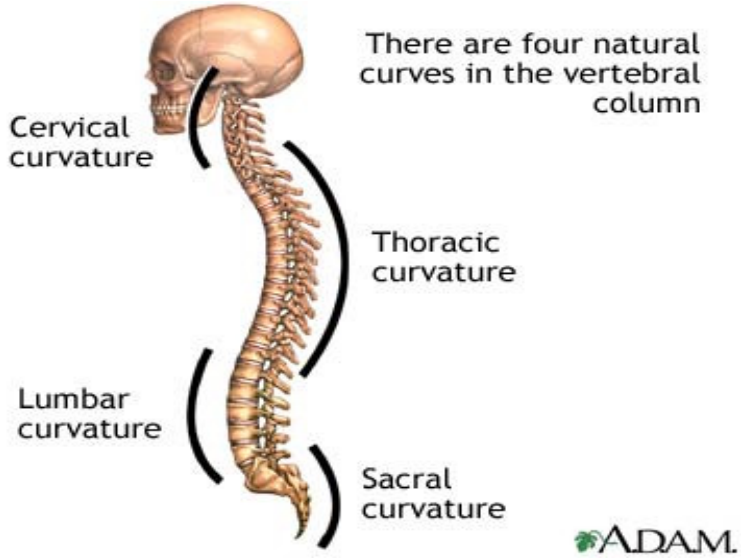

Figure (1:2): Normal curves of the spine

Several abnormal distortions of spinal curvatures (Figure 1-3) may appear during childhood and adolescence. ***Hyper kyphosis*** is an exaggerated thoracic curvature, ***Hyper lordosis*** is an exaggerated lumber curvature and ***scoliosis*** is an abnormal lateral curvature [2]. When we stand, the weight of our body must be transmitted through the spinal column to the hips and ultimately to the lower limbs. Yet most of our body weight lies anterior to the spinal column.

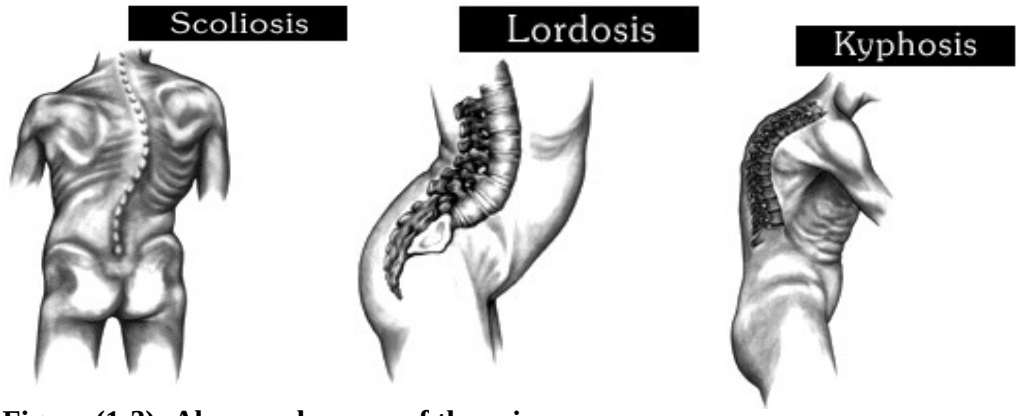

Figure (1:3): Abnormal curves of the spine

❖ Muscles and ligaments of the Spinal column

The spinal column (Figure1:4) is covered by superficial back muscles, such as Trapezius and latissimus Dorsi, and deep layer ones such as Semispinalis, longus Capitis, oblique and rectus muscles, all of which function together to move the spine [(2)]. These muscles also provide support for the spine, allowing us to comfortably carry out our everyday activities. Back muscles can be grouped into three main categories. ***First,*** the extensor muscles allow us to stand up straight. ***Secondly,*** the flexor muscles allow us to bend forward. ***Finally***, the oblique muscles enable us to rotate from side to side and keep everything stable and aligned.

Ligaments and tendons are fibrous bands of connective tissue that attach to bones. Ligaments connect two or more bones together and also help to stabilize joints. Tendons attach muscle to bone. They vary in size and are somewhat elastic. The system of ligaments in the vertebral column, combined with the tendons and muscles, provides a natural type of brace to help protect the spine from injury. Ligaments keep a joint stable during rest and movement. Further, ligaments help to prevent injury from hyper-

extension and flexion movements and if the muscles and ligaments are stretched or strained it can cause pain.

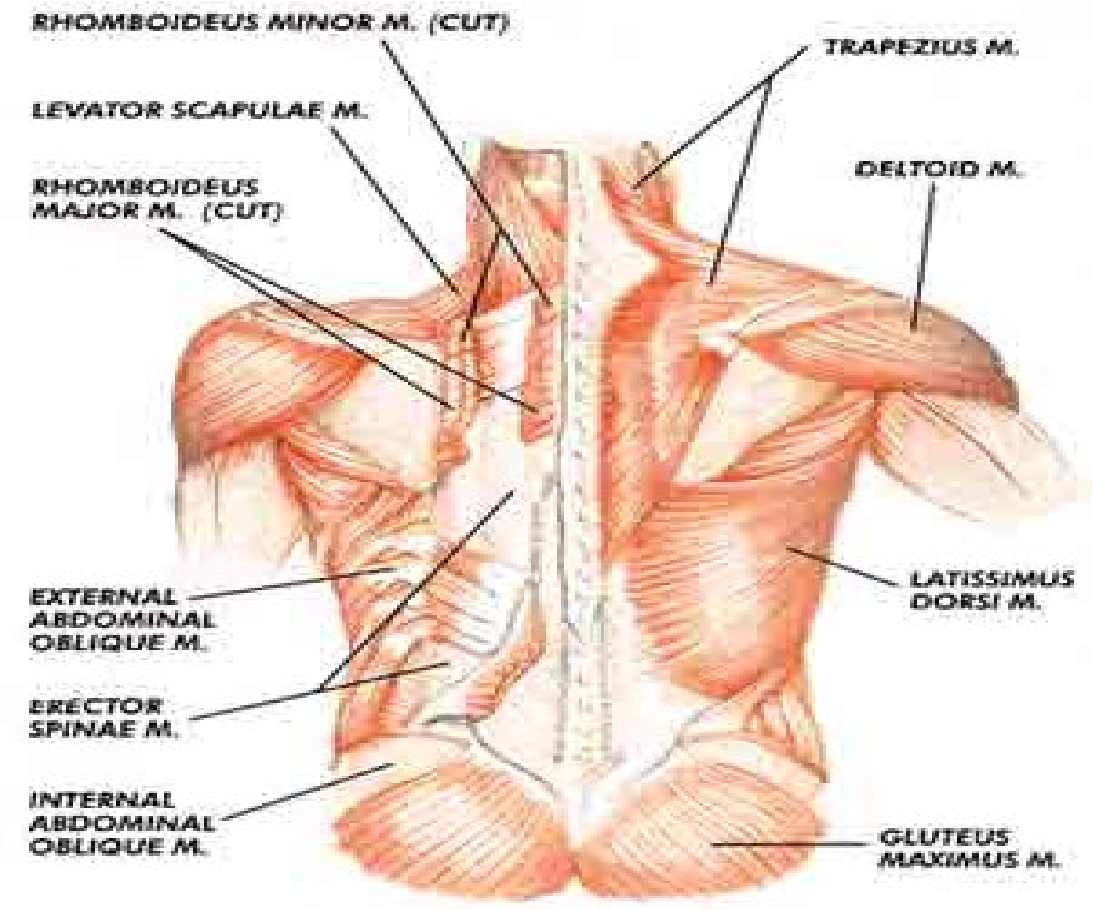

Figure (1:4): The Muscles of the vertebral column

- Spinal cord

The spinal cord is a cylindrical structure that is slightly flattened anteriorly and posteriorly, Figure (1:5). It begins as a continuation of medulla oblongata, the inferior part of the brain stem, and extends from the foramen magnum of the occipital bone to the upper level of the second lumbar vertebra. The length of an adult spinal cord ranges from 42 to 45 cm [(1)].

The spinal cord has two main functions: it controls many reflex activities of the body and it transmits information back and forth from the nerves of the peripheral nervous system to the brain [3].

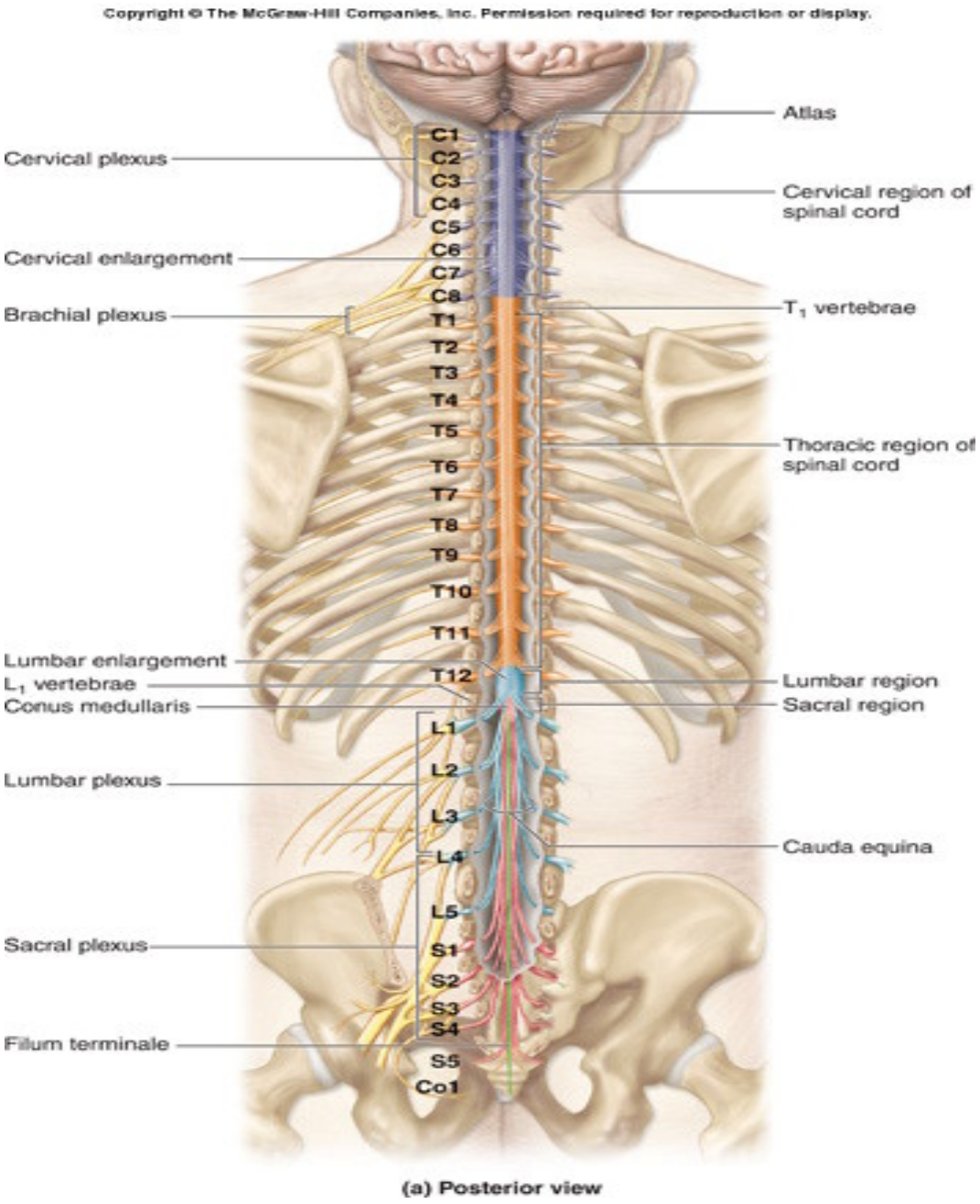

Figure (1:5): spinal cord

Spinal nerves figure (1:6) are classified as mixed nerves; they contain both afferent (sensory) and efferent (motor) fibers. There are 31 pairs of spinal nerves, each identified by its association with adjacent vertebra [(2)].

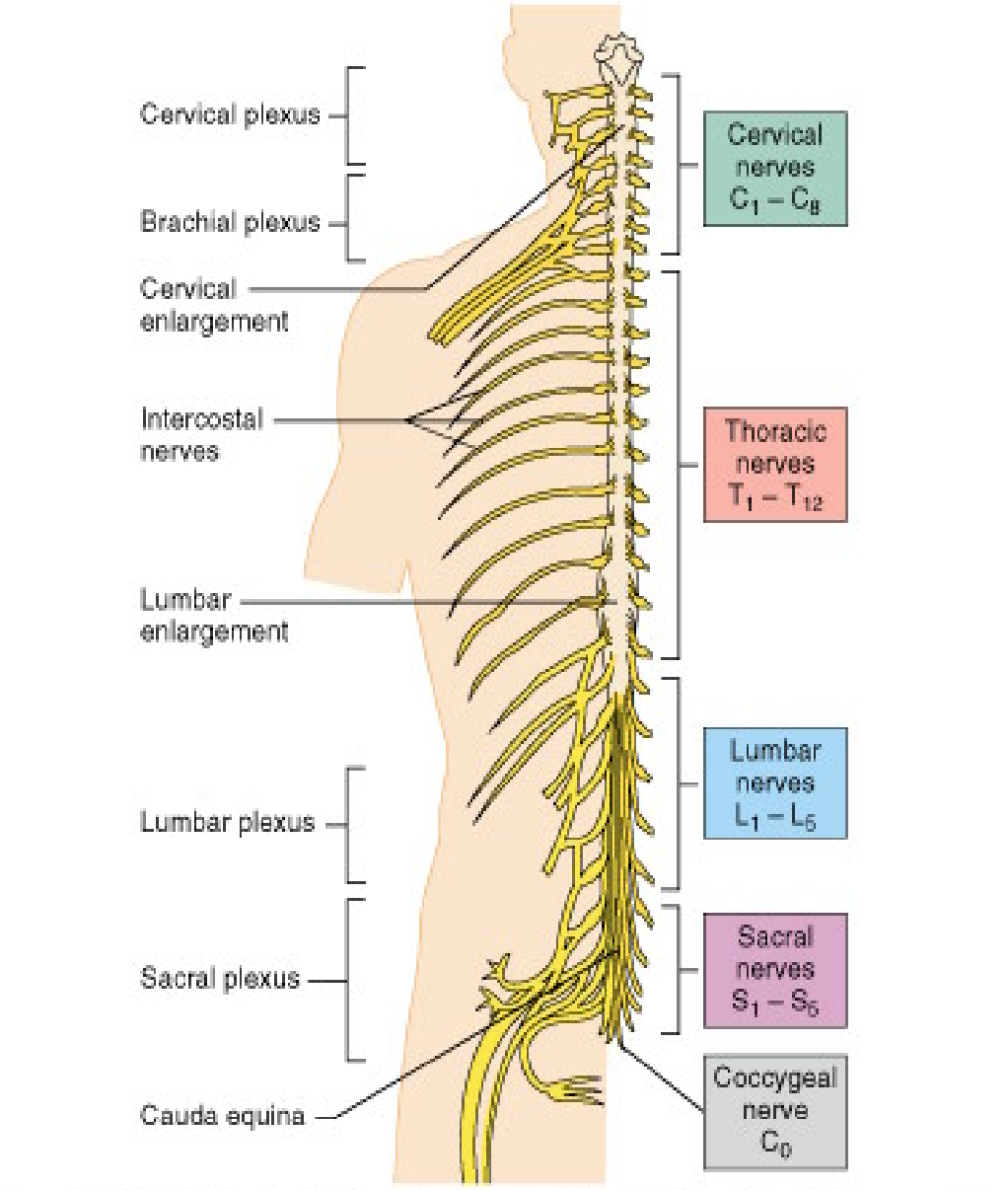

Figure (1:6): spinal nerves

1.2 Backpack syndrome

- Backpack

Back packs are used by the school-age students to carry school books, supplies, other articles, and equipment. Students often carry between 10 and 40+ lb (4.5-18 kg) on their backs to and from school and between classes [4].

- Etiology

A- Back packs can be threatening to the health of students when they are too heavy, packed, lifted, or worn improperly, previous factors are usually combined. Human beings have used their backs for centuries to carry heavy loads. The school students carry their backpacks in a variety of positions that can adversely affect them physically by affecting their spinal column and other bone structures that are not fully developed [4].

B- Wearing backpacks alters the mobility of spine, leading to passive movement (involuntary movement from an outside force), which is a risk factor for back pain [5]. Low back pain during the adolescent years can result in low back pain in adulthood [4].

- Characteristics

1. Poor posture.
2. Headache, fatigue, or both.
3. Low back pain that may become chronic.

4. Discomfort, pain, or both in the shoulder and neck.
5. Muscle spasms of neck and shoulders.
6. Pressure sores or blisters of the back or shoulders from straps or inappropriately packed objects [4].

- Healthy concerns.

1. Adverse Effects [4]:

   a. May cause long-term health problems resulting from neck, shoulder and back pain, as well as fatigue.

   b. Poor posture and pain resulting from leaning forward with neck thrust forward.

   c. Shoulder and arm strain from dragging back pack.

   d. Strain and stress on one side of the body curved by using only one shoulder strap.

   e. Numbness and tingling in the upper arm area due to straps pressure.

2. Schoolbag risk factors [4]:

   Risk factors for adverse effects on the spine include:

   a. A schoolbag that weighs more than 10 per cent of the child's weight.

   b. Holding the bag in one hand by its straps.

c. Carrying the bag over one shoulder.

d. An incorrectly packed backpack.

e. An incorrectly fitted backpack.

1.3 Backpack health problems

1.3.1 Back pain in students

Back pain is a common affliction and a leading cause of disability in adults, but only recently has back pain been documented in large – scale studies in children and adolescents [6]. Back pain in students is a serious concern. For adult, the strongest predictor of future back pain is previous back pain, so having back pain in childhood could have serious future implications [6]. The prevalence of non specific back pain increases from 10% in the preteen age years to 50% in 15 to 16 years old, children and adolescents rarely seek medical care for back pain and parents are not always aware that their children are experiencing back pain or other musculoskeletal pain or discomfort [6].

Studies of back pain in children have implicated numerous causative factors, including heavy back pack [7] and psychosocial issues [8]. Both sedentary life styles and involvement in competitive sports are associated with higher incidence back pain [6, 9].

Ergonomics awareness and posture training may offer an important preventive approach to back pain and should therefore be incorporated into

physical education programs. It is important for students to learn about the structure of spine and back care. Recognizing the natural curves of the normal spine and learning to maintain the natural curves while lifting and sitting may help reduce the risk of musculoskeletal disorder (MSD) [6].

Posture and back care are not currently emphasized in education curricula, and posture education may not be included in the standards required by individual state [6], however back care education can be improved when a physical education teacher or physical therapist is present and when classroom teacher is also present subsequently reinforcing the training.

1.3.2 Back pain related with backpack

In recent years, more attention has been paid to back pain in children, partly because it has lately been found to be more prevalent than previously thought. Recent studies suggested that 10-30% of healthy children experience back pain, especially low back, by their teenage years [10]. One common suspect for back pain in children is the school backpack, which has also received a greater deal of attention in the past few years [10]. A study in Italy found that the average load of backpack was 22% of the child's weight and that 1/3 of the children surveyed carried excess of 30% of their body weight at least one time per weak, their point prevalent for reporting back pain was nearly 16%. With life time prevalence is estimated to be 48% [11].

In Australia, over 20% of students aged 12-18 years had low back pain related to backpack use. The "U.S Consumer Product Safety Commission" reported that over 7000 emergency room visits in 2001 were related to students wearing backpack and handling books. With statistics in mind, researchers have recently begun to investigate the variables involved with children; backpack, posture and low- back pain [12].

Researchers examined changes in spinal posture of 985 Australian adolescents aged 12-18 who carried backpacks at school, researchers found significant differences in the students cranio-vertebral angel (CVA) or forward head angel when they wore loaded backpacks as compared to wearing empty backpacks. This forward head posture was apparent even when backpacks were positioned over both shoulders [12].

The largest differences in the student's cranio-vertebral angel or forward head angel were seen in younger students, suggesting that as the spine matures it develops deferent postural responses and adaptation to the load [12].Also, it was found that the cranio-vertebral angel was increased for students age 13-16 who carried backpack for at least 5 minutes duration and that weighted 15% of their body weight [30, 12].Some researchers found that younger student's aged 12 to 14 years who carried backpacks greater than 6% of their body weight were at greater risk of low back pain [13]. Organizations such as the American Occupational Therapy Association (AOTA, 2003), American Physical Association (APTA, 2003), and American Chiropractic Association (ACA, 2003) have focused on

prevention efforts such as educating parents, youth's and school administrators about this issue.

Although public health efforts globally endorse decreasing the present weight of student backpack, recommendations as to the percentage to body weight differ among organizations. The AOTA and APTA recommended wearing backpack no more than 15% of student body weight as this is a feasible yet prudent goal and it is better to be limited at 10% [(12)]. The ACA suggested wearing backpack no more than 5-10% of child's body weight secondary to the danger of excessive load placed upon maturing spine [(12)].Most importantly, students need to develop an awareness of these issues in order to monitor their own practices.

1.3.3 Carrying school bag and musculoskeletal symptoms

Parents, students, teachers and clinicians have expressed concern about school bags. Problems related to school bags include the weight of the bag, how it is packed, and how it is carried. In this section we explain the risk factors associated with the school bag use.

References to children of school bag on the web sites of the American Academy of Pediatrics (AAP), (AOTA) and (APTA) revealed a wide range of symptoms and complaints associated with back pack. Children report discomfort, aches, and pain in their necks; shoulders and back associated with a heavy school bag. Muscle weakness, tingling in the arms, stooped posture, and headaches have also been reported as associated

with carrying a heavy school bag. Children are not alone in this problematic situation; parents and teachers are concerned and describe signs of pressure; those signs are reported at the shoulder girdle caused by bags' straps or at palms during carrying a trolley [14]. Many researchers found that carrying backpacks affected posture and balance of students [15, 16, 17]. Carrying a heavy bag causes students to lean forward in order to balance their body against the bag's weight, this compensation has a greater effect when the subject carries a bag that weighed 15% of the body weight, the heavy bag makes it easier to fall and distort the natural curves in the middle and lower backs, causing muscle strain and irritation to the spine joints, the rib cage, and causes rounding of the shoulders [14].

1.3.4 Design and portage backpack.

Students wear /carry backpack in a variety of motions and positions, including walking up and down stairs, entering vehicles, riding bicycles, and walking over rough surface. Backpacks with two shoulder straps are the more common design.

However, students sometimes suspend the bag from one shoulder, dispensing with the use of the second strap. A comparison of double – and single- strap bags found that wearing a double –straps bag and using both straps was generally superior in terms of preference, practicality, comfort, balance and ease of walking and producing less neck discomfort and shoulder pressure and lower perceived exertion [6]. Carrying school bag in

one hand has been reported to be the most inefficient method, as it requires an energy expenditure of more than twice that of the back pack method [6].

While examining the school bags design, we should have a look at three components [14]:

a. The back of the bag should be firm and padded to prevent and adequately reduce the pressure on the child's back, and the level of the back should be adjusted to the child back.

b. The straps should be padded and adjustable.

c. The handles should be smooth and comfortable for handling without any rough edges or sharp angles.

The bag size is another element, according to Stander Institution of Israel (SIL) it should be as the following:

a) Height: 40 ± 2cm (16 ± 3/4 in)

b) Width: 29 ± 1cm (11 ± 1/2 in)

c) If there is waist or hip belt, it should be at least 50mm (2in) wide, strap: 30 mm (1.25 in) wide or more and light weight materials are preferred [14].

1.4 Significance of study

Children often are seen tottering to school with heavy school bags that can negatively influence their health especially with this transitional period of life to adulthood over many years.

We can clearly notice the growing weight of school bags and its effects on health of the children that has become a matter of serious concern for every parent, schools, and authorities. They have also been expressing their concerns of the issue but nothing is being done to resolve this problem.

We find it of equal importance too to determine children's opinion on their individual daily school bag load. Up to my knowledge, no study in Palestine has evaluated the influence of backpack on student's backs before, for these reasons we were encouraged to perform this study.

1.4.1 Purpose of study

- The main aim of this study is to investigate the percentage of backpack weight to the students' body weight, and to determine the relationship between musculoskeletal symptoms and school backpacks carriage in this regard in Tulkarm district schools (Elementary and Secondary schools).

The specific objectives were:

- To identify the methods of carrying school backpacks *and* method of transport to arrive to school by elementary and secondary schools' students for males and females.

- To measure mean backpack weight and backpack weight to student's weight ratio among elementary and secondary schools' students for males and females.

- Describe self reported pain related to backpack use and evaluate the relationship between self reported pain and backpack weight in reference to students weight, also to study the duration of backpack use and posture when wearing a backpack for elementary and secondary schools children.

CHAPTER TWO

LITERATURE REVIEW

CHAPTER TWO
LITERATURE REVIEW

2.1 International Studies

In recent years, the media coverage as well as literature on backpack use in schoolchildren has increased around the world. This is mainly because there has been an increase in the size and weight of bags carried by schoolchildren and a change in school curriculums. These factors contribute to the anecdotal evidence of bodily pain in these children. In recent years, scientific literature in this field has increased its focus on childhood bodily pain, the type of school bag, the manner in which it is carried, its weight, and the duration of carriage, all of which can affect the cervical and shoulder posture of schoolchildren.

The loads carried by children to and from school have been the subject of recent attention [18, 19, 20,27,60,28,29]. Wiersema *et al.*, in 2003 found that children who carried a school bag that is more than 20% of their body weight were at an increased risk of (LBP) Low Back Pain ; therefore, requiring a visit to a physician [21]. Moreover, it increased risk for LBP, which lead to absence from school and sport for those children who carried their bag in one hand rather than on the shoulder harness [22][23].

Grimmer *et al.*, in 2000 also found positive association between longer periods spent carrying backpacks and LBP. Statistics showed that two thirds of the 1269 high school students included in the study stated they wore their backpacks over two shoulders [23].

Pascoe *et al.,* in 1997 reported that 11-13 years old students carried school bag weighting 17% of body weight had detrimental effects to the child's physical abilities [(24)]. The researchers considered the effect of carrying a school bag on posture and gait of 11-13 year old children and found that carrying a school bag decreases stride length, increases stride frequency and encourages a forward lean of the trunk. In the same study, 73.4% of children used only one strap of their school bags to carry material and their books [(24)]. One-strap bags seemed to encourage lateral spinal bending and shoulder elevation, while two straps backpack reduced these but significantly increased bending forward leaning of the head and trunk[(24)].

Negrini *et al.,* in 1999 measured the weight of backpacks of schoolchildren and found that the mean school bag weight was 9.3 kg with a maximum of 12.5 kg. (i.e. 22% of the body weight of the students investigated) [(25)]. Furthermore, 34% of the children carried more than 30% of their body weight for at least one week. A decrease in the load carried is advisable because the rates of LBP in children are approaching those seen in adult [(25)].

Whittfield *et al.,* in 2001 found the mean weight of school bag to be 6.6 kg and the mean relative school bag weight to be 11.7 % of body weight (13.2% for third- form students and 10.3% for sixth –form students)[(26)]. Most students used backpacks to transport their supplies, and these were predominantly carried on two shoulders. Heavy schoolbags,

long carriage durations and lack of access to lockers amongst third formers could contribute to the production or maintenance of musculoskeletal symptoms [26].

A study in Australia by Chansirinukor *et al.*,in 2001 examined the posture of 13 Australian high school students under the following load conditions: posture without a backpack, while carrying the bag on both shoulders, carrying the bag on the right shoulder only, a bag weighing 15% of the student's body weight, and after walking for 5 minutes. Results revealed that both backpack weight and time carried influenced cervical and shoulder posture [30]. Forward head posture increased when carrying a backpack, especially one with a heavy load. Carrying a backpack weighing 15% of body weight appeared to be too heavy to maintain standing posture for adolescents. In addition, this negatively affects the adolescent spine as it continues growing in periodic spurts until the age of 18 [30].

Moreover, Dockrell *et al* ., investigated the mean weight of school bags and effects of school bag carriage on the first year secondary students. The mean school bag weight was 6.2 kg and the mean percentage body weight carried in school bags was 12%, the level of reported discomfort was high, and the discomfort was mostly reported to be in the shoulder region followed to lesser degree by discomfort in the back [31]. In addition, Casey *et al* ., in 1996 have studied the weight of school bag, method of load carriage and distance of load carriage. The results showed that

students carried 15.2% of total body weight and 62% carried the bags on their back [32].

Whittifield *et al* ., in 2005 conducted study investigate the weight of school bag and prevalence of musculoskeletal symptoms among student in third and sixth- form with mean age between 13.6-17.1 years and school bag weight range from 13.2%-10.3% of their body weight respectively [33]. These weights may exceed the recommended guideline load weight limits.

The study showed a very high self –reported prevalence of musculoskeletal symptom. Amongst this group of students, about 77.1 % of them as well as the author believed that musculoskeletal symptoms were multifactor in origin. The carriage of heavy school bag was suspected to be a contributory factor [33].

Siambanes *et al.*, in 2004 investigated the influence of the school backpack on adolescent back pain. They found the mean average of backpack weight to be 10.6 pounds (4.5 Kg) and the ratio of backpack weight to student's weight range from 3 to 43.42%, with a median of 8.84%. The result of this study showed nonspecific mechanical back pain to be highly prevalent, and the reported severity and chronicity of pain were high [34]. Controlling for age, socioeconomic status, walking to and from school, and method of wear results indicated that backpack weight, measured as a percentage of body weight, was effective in predicting back pain ($P < 0.01$) [34]. Girls and those who walk to and from school were more likely to report pain ($P < 0.01$). The method of wear, socioeconomic status,

and age were not found to be significantly related to the prevalence of back pain [34].

Mackie *et al* ., in 2005 showed that the manipulation of backpack weight, hip-belt use, and shoulder strap length had a strong effect on shoulder strap tension and shoulder pressure. Backpack weight had the greatest influence on shoulder strap tension and shoulder pressure. Whereas hip-belt use and then shoulder strap adjustment had the next greatest effects [35]. As a result, school students should wear their backpacks with the least weight possible, use the hip-belt if present, allow a reasonable amount of looseness in the shoulder straps and should position the heaviest items closest to their back [35].

Hong *et al* ., in 2003 studied the effect of loads carriage on posture during stair walking and found that when the load is 10% or greater of the body weight, it induced greater trunk-forward inclination in subjects ascending stairs, whereas athletic bags were found to cause greater trunk range of motion than backpack during stair descent [36]. Lai *et al*., in 2001 demonstrated restrictive effect on lung volumes when school-bag load is heavier than 10% of child's body weight and found the detrimental effect of a kyphotic posture on pulmonary mechanics and the necessity for health-care professionals to advocate proper postural advice to schoolchildren, teachers and parents [37].

Negiri *et al*., in 2007 investigated the postural effect of load on the spine, it found that both types of load (symmetrical and asymmetrical)

induced changes in children's posture [38]. Skoffer *et al*., in 2007 found that carrying the school bag in an asymmetric manner played a role in occurrence of low back pain [39]. Study by Sheir-Neiss *et al*., in 2003 emphasized the association of backpack use and back pain in adolescent aged between 12-18 years. They found the use of backpacks during the school day and backpack weights were independently associated with back pain [40].

Grimmer *et al*., in 1999, the researchers examining the effect of backpack weight on adolescent head on neck posture showed a significant change in cranio-vertebral angle that was found at every year level, when comparing standing posture with no backpack with posture when carrying a backpack. This change appeared greatest for the youngest students [41].

Korvessis *et al* ., in 2005 investigated the influence of backpacks on spinal curves, shoulder level, trunk alignment and back pain in adolescent, the result showed that girls suffered from Dorsal Pain (DP) more often and of much more intensity than boys . They also suffered from a decrease in the angle known as Cranio-Cervical angel (CCA) and a shoulder and upper trunk shift [42]. Asymmetrically backpack carrying was associated with high intensity of back pain. Symmetric backpack carrying was highly recommended [42]. Navuluri *et al* ., in 2006 found that the correlation between pain and backpack weight per body mass index among girls was positive and significant, but negative and non-significant among boys [43].

In addition, Petronell *et al*., in 2006 found that carrying school bag may have an effect on the developing spine the results shows deviations posture in the lateral and posterior area [44].

The "Italian Backpack Study" tried to investigate schoolchildren's subjective perceptions of their daily backpack loads to ascertain whether an association exists between these sensations or the load itself and back pain, and to identify the school, family, and personal factors that determine the backpack load. Of the participants, 79.1% felt that their bags were too heavy, 65.7% reported fatigue, and 46.1% complained of back pain [45] .

Back pain was associated with feeling of fatigue during carrying of the bag and the amount of time spent carrying the bag more than the weight of the bag. Researchers found that daily backpack carrying is a frequent cause of discomfort for schoolchildren [45]. Moreover, there was an association between this load and back pain, as a result, (schools, parents, students) bear responsibility for the load carried, and all should modify current behavior to reduce the stress of the bags on students. Suggestions include having teachers take into consideration the weight of the difference subjects, “not only in terms of their intellectual content, but also in terms of the load they place on the shoulders of their students,” to prevent students from carrying multiple heavy texts one night, and a very light bag the next. The researchers also recommend that parents monitor what their children carry to school each day [45]. There are also some reports of other problems associated with backpack i.e. functional scoliosis, rucksack palsy and reduced lung functions. [46, 47].

The 10% cutoff was recommended, along with a variety of practical methods to help schools achieve that goal for middle and high school students [48].

Skagg *et al*., in 2006 founded 37% of children aged between 11-14 years old to have back pain that was associated with use of a heavier back pack (P = 0.001). This study identified two factors associated with self-reported back pain in early adolescents that are amenable to change: availability of school lockers and lighter backpacks [49].

Goodgold *et al*., in 2002 related backpack use with incidence of back pain in children, researchers found that younger children carried proportionally greater backpack loads. Fifty-five percent of all subjects carried a load greater than 15% of their body weight [50].

Recent studies by Haselgrove *et al*., in 2008 connected the school bag load with spinal pain in adolescent. The researchers found the prevalence of back and neck pain to be approximately 50%; 53% of female reported neck pain compared with 44% of males (P < 0.01) and almost half of participants carried their school bag for more than 30 minutes per day with 85% carrying their bag over both shoulders [51]. School bags were felt to be heavy by 54% and cause fatigue by 51%. Carrying a school bag for more than 30 minutes daily and taking an inactive form of transport to school (car or bus) increased odds of having both back (OR 1.40, 95% CI 1.08 to 1.82) and neck pain (OR 1.47, 95% CI 1.13 to 1.19) [51].

Macias *et al*., in 2008 showed how much pressure did the backpack straps had over both shoulders [52]. The researchers found pressure at 10%, 20%, and 30% of bag weight loads on both shoulders during low-back or high back conditions; these were higher than the pressure threshold (approximately 30 mm hg) to occlude skin blood flow. In addition, asymmetry and high pressure exerted for extended periods may help explain the shoulder and back pain attributed to back packs [52].

More recent study by Ramprasad *et al*., in 2010 investigated the effect of Backpack weight in postural angle. The researchers compared the postural angles with no backpacks and with backpacks weighting 5% to 25% of the subject body weight. The results showed the CV angle to change significantly after 15% of backpack load ($P < 0.05$) [53]. The HON and HNOT angles changed significantly after 10% of Backpack load ($p<0.05$) The Trunk and lower limb angle also changed significantly after 5% of backpack load ($P < 0.05$). Preadolescent children who carried a backpack weighing 15% of their body weight had changes in all their postural angles [53].

Brackley *et al*., in 2009 was conducted to evaluate the changes in children trunk forward lean (TFL), cranio-vertebral angle (CVA), and spinal lordosis angle (LA) that occurred with high, medium and low load placement during standing and walking [54]. The results of this study indicated that significant changes occurred in (TFL) and (CVA) when the backpack was loaded to 15% of the body weight, the researchers found that

the low load placement in the backpack produce a fewer change in CVA and LA [54].

Studies in 2008-2009 recommend and emphasized that the backpack load should be limited to 10% of body weight because an increases to 15% to 20% may lead to posture change, heart rate change, and lower limb dynamics change for children while walking [55,56, 57].

In a more recent study in by Neuschwander *et al*., in 2010 concluded that backpack loads were responsible for a significant amount of back pain in children, which in part, may be due to changes in lumbar disc height or curvature. This was the first upright MRI study to document reduced disc height and greater lumbar asymmetry for common backpack loads in children [58].

Chow *et al* .,in 2010 the researcher analyzed the change of spinal curvature and repositioning error when carrying a backpack loaded at 15% of body weight at different CG (center gravity) location anterior or posterior at (T7, T12 or L3) in school children [59].

The researchers found both spinal curvature and repositioning error were affected by backpack anterior – posterior position- and CG level. Results suggested that alternative carriage by changing the backpack position occasionally between anterior and posterior positions might help to relieve the effect of backpack on spine [59].

In Malaysian in 2007, the researchers investigated the change in Ground Reaction forces (GRF) and trunk inclination among primary

students when carrying heavy backpacks on boys aged between 9-11 years old. It was found that significant differences in GRF occurred at loads of 20% of body weight and significant differences in trunk inclination of the students when carrying heavy school bag more than 15% of body weight. The researcher demonstrated the backpack should not exceed 15% of body weight [61].

Puckree *et al 2004* ., in South Africa studied the relationship between pain and school bag by carriage in students aged between 11-14 years. It was found that shoulder and other bodily pains that were experienced by the sample of scholars were strongly related to the type of bag and the gender of the children. Although the weight carried did not exceeds 10% of body weight yet there was increase in pain [62] .In a study conducted in Saudi Arabia, they investigated the percentage of body weight represented by school backpack and the researchers recommended that the school bag limit not to be more than 5-10% of student body weight [63].

2.2 Regional Studies

Locally, Al Fageeh *etal*., in 2009 investigated the relationship between the load weight ratio of a schoolchild with lung vital capacity, potential back pain, and postural problem. The researcher found statistically significant correlation between extra load weight ratio and less vital capacity, less of motion in flexion, extension, and left and right lateral bending. Moreover, positive relationship was found between back pain and extra load weigh ratio [64].

CHAPTER THREE

METHODOLOGY

CHAPTER THREE
METHODOLOGY

3.1 Study Design

This is a cross-sectional study conducted on healthy male and female students aged 8-15 years old from third to ninth grade in elementary and secondary schools. It was conducted between March and April of 2009. The selection of students was randomly done from those who attended Tulkarm governmental Schools. For the sake of a comprehensive study, Tulkarm district was divided into four regions as follows:

1. Al-Sh`araweyeh.
2. Al-kafreyat.
3. Wadi-Alashaer.
4. The city and suburbs.

Appropriate schools were selected in coordination with Directorate of Education; one male's and one female's in each of Al-Sh`araweyeh, Al-kafreyat, and Wadi-Alashaer and eight schools from the city and its suburbs (Four female and four male schools).

Five students were selected from each class. After that, the students were interviewed by the researcher during the school days (Sunday - Thursday). Subsequently, data collection was done during the interviewing period.

Data collection was accomplished through two steps:

- ***First step***

The height of each student was measured by a portable height measurement scale. The body weight of each student was measured by electronic scale (personal scale QE, 2003) and special electronic scale for the weight of their school bag (empty* and full) in grams (e-Accura, SA13-QT) respectively.

- ***Second step***

After recording the height of each student and weighting each student's body as well as weighting bags, each student was interviewed alone in the laboratory room at school. This was done to answer a questionnaire about the relation between the weight of the carried school bag and musculoskeletal symptoms. This method was only used for grades third, fourth, fifth and sixth because the student in elementary school needs help to understand the information in the questionnaire, on average, the interview time took approximately fifteen minutes for each student. Students at secondary schools (seventh, eighth, and ninth grades) completed the questionnaire themselves in about fifteen minutes.

3.2 Sampling

The total number of governmental students in Tulkarm district is 41,221 (20578 males and 20643 females) [(65)]. The study population

* Empty Bag just measured and no importance to calculate the significant value because it similar for all calsses

included students in the grade levels of third to ninth. The numbers of male and female students in all governmental schools in Tulkarm district are shown in table (3:1).

Table (3:1) The total numbers of students in the study population by grade.

Grade	Number of students
3rd	3304
4th	3307
5th	3405
6th	3399
7th	3518
8th	3560
9th	3623
Total number of student	24151

Initially, the sample size* was calculated as 2% of the total study population (483 students). However, the researcher increased the number of the selected students to 800 students because:

1- Increasing the sample number would increase the accuracy of scientific research

2- The classes selected for study included more than one section in the same grade.

* $S = 4z^2 .p\ (1-p)/w^2{}_Z)$
Z=1.96 confidence interval 95%.
P= prevalence of problem among Palestine children 0.05.
W=confidence interval 20%.

Table (3:2): The Distribution of Schools According To The Region.

Region	Selected school	# of Students
Al-sh`araweiyh	Zeta Boys school	36
	Attil girls School (Elementary and secondary)	80
Al-kafreat	Kofor-Sor Boys school	40
	Kofor-Sor Girls school	30
Wadi- Ashaer	Bl`aa elementary and secondary Boys School	70
	Ramin Girls school	50
The city and Suburbs	Kaled Ben S`aeed Boys school	70
	Al-Hamdalla Boys School	50
	al-kasse Girls school	60
	Mahmood Alhamshari Girls school	50
	Zanobia Girls school	50
	Fatima Al- Zahra`a Girls School	54
	Helmi –Hanon Boys School	80
	Abed Al-majed Thaih Boys School	50

The researcher took permission to visit the governmental school by sending a letter from "An-Najah University" to the "Directorate of Education" in Tulkarm. After that the researcher coordinated the schools' principals and supervisors to visit the selected schools.

The researcher selected two age groups:

A. Elementary age (6-12 years), most major developmental problems have been identified. However, many problems are subtle and they remain undetected until they undergo further development as children enter the school environment. When this occurs, they begin to face increased physical and mental demands. Numerous health, emotional, and developmental problems can occur during this age span. [(4)].

B. Adolescents (13-18 years) are transitional from childhood to adulthood. This period is characterized by many rapid physical,

emotional, and sexual changes. In addition, it is imperative that this age group succession meets numerous developmental tasks. These challenging tasks and rapid succession of changes contribute to stress–related illness, dysfunctional family, interpersonal conflict, and antisocial behavior [(4)].

3.3 Inclusion Criteria

1- Third to ninth grade students in participating schools conditioned to be 8-15 years old.

2- Male and female students.

3- Generally healthy students'.

4- Students attending governmental Tulkarm districts schools.

5- Students with back pain.

3.4 Exclusion Criteria

The researcher excluded Students**:**

1- Not attending to governmental Tulkarm district schools.

2- Who are unable to stand on the weighting scale.

3- Who are not carrying or unable to carry school bag.

4- Who have disabilities and health problems.

5- Who are unable to provide data sufficiently.

6- Above fifteen or below eight years old.

3.5 Questionnaire

A structural questionnaire that contains close-ended questions was developed for this study.

The questionnaire contained two sections:

- ***The first section*** contains personal details including age, gender, stages, classes, residence, weight of student, weight of school bag; full and empty, and height of student. In this section the researcher deleted the question that related to their medical history (students who complaining of disabilities) because it is not appropriate for this purpose of study.

- ***The second section*** contains reproductive data that is used to assess the effect of backpack on students back. This section contains eleven questions pertaining to the use of the backpack and musculoskeletal pain[*]. These questions are covered by the duration of carrying school bag, method of travelling to school, and method of carrying school bag.

In the same section, the questions covered the[**] perceived load (perceived weight and perceived fatigue) by asking the student if his /her

[*] Musculoskeletal pain: is a common cause of both short –and term disabilities [(74)] and affects the bones, muscles, ligaments, tendons, and nerves. It can be acute (having a rapid onset with severe symptoms) or chronic (long-lasting). Musculoskeletal pain can be localized in one area, or widespread [(75)].

[**] Perceived load in term means both weight and fatigue were strongly associated with back pain (shoulder, Neck, lower back) [(51)].

parents help in carrying back pack, if the student has fatigue* during carrying the school bag, if he/she rests during that, and if he /she sways right and left or bends forward while carrying the school bag for students in the 3th,4th,5th grades the last question explained if he/she was repositioning the bag while carrying it . There are also some questions of whether there is back pain as they carry the backpack and where the site of the pain is. Lifetime prevalence of back pain was identified by a question asking whether the student had ever experienced back pain.

- **Calculation of Body Mass Index (BMI).**

BMI was calculated as weight (in kg) divided by the square of height (in meters). BMI was classified into three categories as follows [66]:

1- Under weight <18.5.

2- Normal 18.5-25.

3- Over weight > 25.

Table (3:3): The Distribution of Students According To Body Mass Index Groups.

Group	Number of students	Percentage%
<18.5	243	%30.4
18.5-25	468	%58.5
>25	89	%11.1
Total	800	%100.0

* Fatigue: is probably the most common symptom of illness affecting suffers of most –acute and chronic conditions. Fatigue is also universal complaint that may sometimes be related medical diagnosis or therapeutic treatments [76].

- **Calculation of School bag weight as a percentage of body weight:**

$$B.W\ to\ S.W\ ratio = \frac{Bag\ Wieght}{Student\ Wieght} \times 100\%$$

3.6 Research Questions

Q1. What is the percentage of weight carried by students in their school backpacks to their bodyweight?

Q2. Is there a relationship between the weight of schoolbags and the occurrence of neck, shoulder, and low back pain in students?

Q3.Does carrying a school bag affects students' posture?

Q4. Is there a relationship (association) between ratio (bag weight to body weight) with occurrence of fatigue and musculoskeletal symptoms?

Q5. Is there a relationship (association) between gender with occurrence of fatigue and musculoskeletal symptoms?

Q6. Is there a relationship (association) between method of carrying school bag with occurrence of fatigue and musculoskeletal symptoms?

Q7. Is there a relationship (association) between transportation with occurrence of fatigue and musculoskeletal symptoms?

Q8. Is there a relationship (association) between time to arrive school with occurrence of fatigue and musculoskeletal symptoms?

Q9. Is there a relationship (association) between grade with occurrence of fatigue and musculoskeletal symptoms?

Q10. Is there a relationship (association) between area of residence with occurrence of fatigue and musculoskeletal?

3.7 Data Analysis

After collection, the data was entered into computer and analyzed using SPSS (Statistical Package for Social Sciences) software, version16. In addition to descriptive statistics (means, frequencies, etc), a multinomial regression analysis was performed to investigate the association of certain factors (gender, school bag carry method, bag weight to student weight ratio, etc) on occurrence of musculoskeletal pain and fatigue during carry of school bag. Odds ratios were obtained from the analysis and used to compare the different levels of the same factor for relative risk of occurrence of musculoskeletal pain and fatigue. All factors of interest were simultaneously fitted in the regression model such that the effects of one factor are adjusted for the effects of all the other factors in the model.

3.8 Ethical Consideration

A formal letter from “An-Najah University” was sent to the director of “Directorate of Education” in Tulkarm district to give permission for the researcher to conduct the study in the district schools.

Through contact with the students to collect data about backpack, the researcher explained to them the importance and the objectives of the

study. The researcher dealt privately with information that was taken from each student.

3.9 Limitations of study

1. The difficulty of coordination with the selected schools because the study was made at the same time of the school trips.
2. The difficulty of choosing students because of the midterm exam.
3. The teachers were on strike.
4. Some selected schools don’t have the classes that the study needs.

CHAPTER FOUR

RESULTS

CHAPTER FOUR
RESULTS

4.1 Descriptive Analysis of the Study Sample.

Total number of students in this study was 800, including 371 females (46.4%) and 429 Males (53.6%). The number of students according to educational stage was 409 (51.1%) in the elementary schools and 391 (48.9%) in the secondary schools. 58% of students lived in the city and suburbs and 42% lived in surrounding villages. The distribution of students according to grade is shown in Table (4:1).

Table (4:1) Distribution of the students according to grade level.

Grade	Number of students	Percentage, %
3rd	101	12,6%
4th	101	12,6%
5th	97	12,1%
6th	111	13,9%
7th	137	17,1%
8th	124	15,5%
9th	129	16,1%
Total	800	100,0%

Table (4:2) shows the distribution of students according to the ratio of school bag weight to the student weight. The results showed that 27% of students usually carry school bag weighing < 10% of their body weight, 73% of students carry school bags weighing 10% or more of their body weight (23% carry bags more than 15% of their body weight).

Table (4:2): Distribution of students according to the ratio of school bag weight to body weight

Ratio of school bag to student weight	Number of Students	Percentage%
< 10%	216	27
≥10% and ≤15%	400	50
> 15%	184	23
Total	800	100

Half of the sampled students (50.6%) declared that school bag felt heavy sometimes, while 42.1 % felt their school bag was always heavy (only 7.2% did not feel that school bag was heavy). On the other hand, 38.4% of sampled students complained of always getting tiered while carrying their school bag, 35.1% of students felt tired sometimes, (26.5%) do not feel tired while carrying school bag. This indicates that a good proportion of students spend intensive energy to carry the school bag before arriving to school.

Figure (4:1) shows the method of transport to school by students. Most of students (75%) walk to school, 18% use cars, 4.2% use the bus, and about 2% of students use more than one method (e.g. walking + bus, walking + car, walking + bicycle).

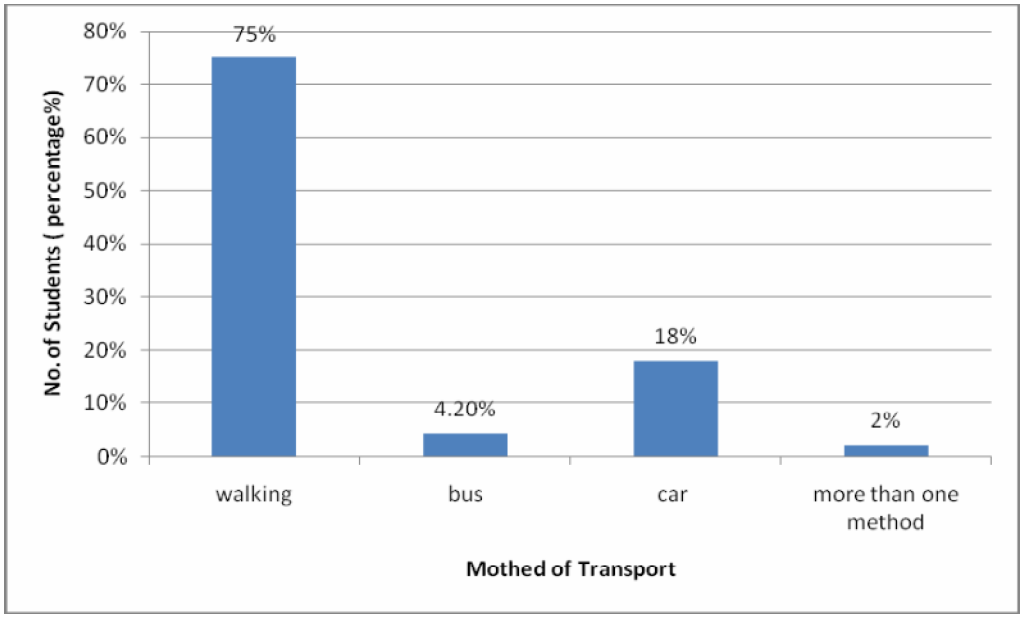

Figure (4:1): Method of transport to arrive to school.

Figure (4:2) shows the time (in minutes) the students take to get to school. Large proportion of students (65.7%) takes 5 to 15 minutes to get to school and less than (5%) of students take more than 30 minutes to reach school.

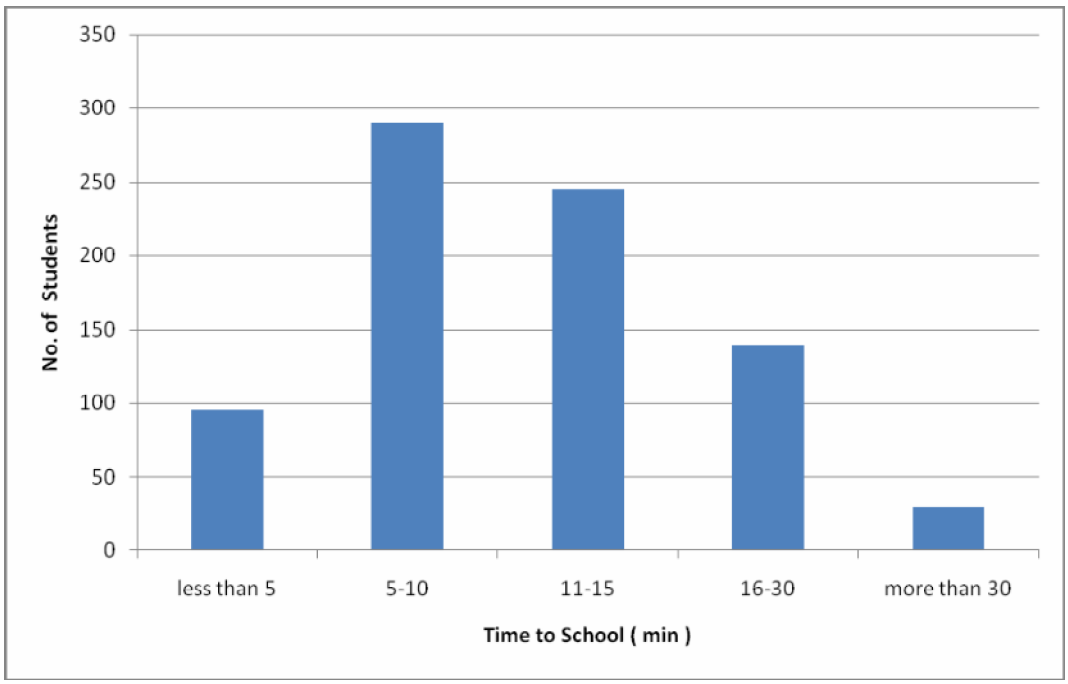

Figure (4:2): Time it takes students to get to school.

Table (4:3) shows the number and percentages of students who complained of pain (neck, shoulder and lower back) in general (during their everyday life) and those who complained of pain (neck. shoulder. lower back) while or after carrying school bag. The percentage of students who complained of continuous (persistent) pain during everyday life was 8.8% and 24.4% of students complained from non-persistent pain. Due to carry of school bag the percentage of students complaining persistent pain increased to 31.6% and the percentage of students who have non-persistent pain increased to 37.9%. As we reported musculoskeletal pain 47.8% of students had shoulder pain, 21.6% had lower back pain, and 18.2% had neck pain.

Table (4:3): Distribution of students based on frequency of occurrence of musculoskeletal pain in general and musculoskeletal pain due to carrying school bag.

	Occurrence of pain		
	None (%)	**Sometimes (%)**	**Always (%)**
Pain in low back, neck, or shoulder in everyday life.	535 (66.9%)	195 (24.4%)	70 (8.8%)
Pain in low back, neck, or shoulder while carrying school bag.	244 (30.5%)	303 (37.9%)	253 (31.6%)

Table (4:4) shows the distribution of students who sway right and left, or bend forward while carrying school bag or repositioning the bag because of it its weight. About 14% of the students always sway while carrying the bag. This indicates that there is significant weight placed on the back of students. Of all sampled students, 31.6% take a break for one to

four minutes while carrying school bag (Figure 4:3). This indicates that the weight of school bag is heavy and causes body fatigue to students.

Table (4:4): Distribution of the students according to their behavior related to school bag.

	NO	Sometimes	Yes
Sway left and right or bend forward due to the weight of school bag or repositioning the bag.	470 (58.8%)	217 (27.1%)	113 (14.1%)
Take a rest while carrying school bag.	547 (68.4%)	----------	253 (31.6%)
Parents help in carrying School bag.	36 (4.5%)	----------	764 (95.5%)

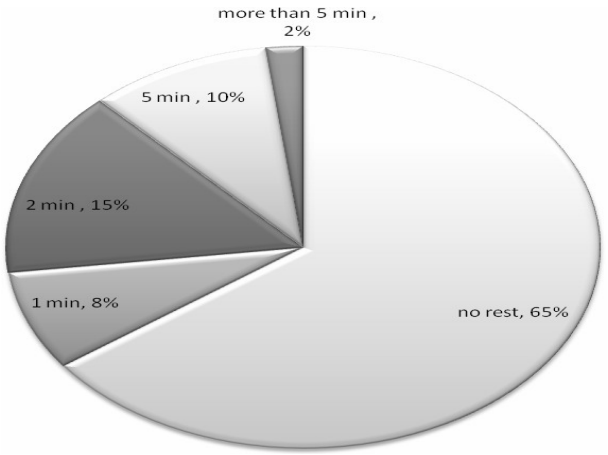

Figure (4:3): Rest time students take because of carrying school bag.

Most students (84.2%) carry their bags on both shoulders. Less than 12% carry bags on one shoulder, while about 4% alternate among one shoulder, two shoulders or use wheel bag (Figure 4:3). Use other methods to carry school bag

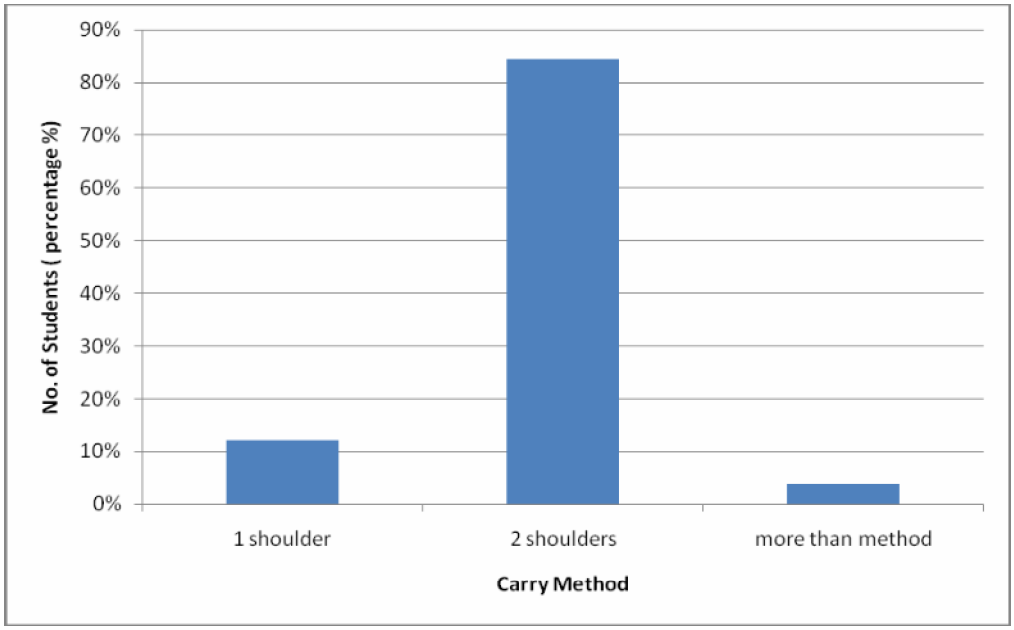

Figure (4:4): Distribution of students according to the way they carry school bag

Averages of student age, weight, height, BMI, bag weight and bag weight to student weight ratio are presented in Table (4:5) by grade and gender. The means increased with increasing class level.

Table (4:5): Averages of student age, weight, height, BMI, bag weight (empty and full), and bag weight to student weight ratio by grade and gender.

Class	Gender	# of Students	Age (SD) (year)	Student weight (SD) (Kg)	Height of student (SD) (cm)	BMI (SD)	Bag weight Empty (SD) (Kg)	Bag weight Full (SD) (Kg)	Student weight \ bag weight(Ratio)* (SD)
3rd	M	64	8.45 (0.517)	30.328(5.666)	131.422(7.331)	17.346(2.537)	0.654(0.255)	4.040(0.635)	0.137(0.32)
	F	37	8.54 (0.660)	30.951(8.334)	130.1081(6.131)	18.103(3.814)	0.669(0.283)	4.493(0.787)	0.151(0.036)
4th	M	68	9.77 (0.536)	35.376(9.331)	136.757(6.309)	18.709(3.537)	0.612(0.221)	4.165(0.788)	0.122(0.277)
	F	33	9.67 (0.79)	32.512(6.592)	130.108(6.967)	17.300(2.144)	0.634(0.301)	4.539(0.855)	0.142(0.31)
5th	M	40	10.66(0.614)	39.027(7.662)	141.400(6.417)	19.400(2.823)	0.660(0.285)	4.537(0.900)	0.124(0.033)
	F	57	10.43(0.521)	38.433(8.757)	141.114(8.292)	19.212(3.526)	0.624(0.217)	5.043(0.793)	0.137(0.036)
6th	M	56	11.86(0.545)	42.770(10.489)	146.018(6.664)	19.906(3.933)	0.682(0.222)	5.079(1.139)	0.124(0.036)
	F	55	11.54(0.644)	43.435(12.270)	146.067(13.413)	21.831(1.712)	0.683(0.239)	5.208(0.727)	0.127(0.0322)
7th	M	76	12.72(0.585)	47.593(11.825)	152.895(8.425)	20.152(3.668)	0.673(0.269)	5.564(1.243)	0.122(0.039)
	F	61	12.42(0.502)	48.613(10.040)	153.926(6.600)	20.463(3.806)	0.704(0.244)	5.546(0.843)	0.118(0.029)
8th	M	62	13.69(0.436)	58.711(16.176)	161.556(8.839)	22.276(4.887)	0.704(0.230)	5.517(1.567)	0.100(0.040)
	F	62	13.54(0.538)	50.855(7.306)	156.605(5.906)	20.743(2.841)	0.632(0.238)	5.785(0.942)	0.115(0.025)
9th	M	63	14.86(0.329)	62.119(17.055)	169.151(9.973)	21.680(5.675)	0.717(0.226)	7.217(1.616)	0.123(0.040)
	F	66	14.71(0.421)	56.253(12.116)	160.295(7.754)	21.864(4.367)	0.664(0.240)	6.053(1.050)	0.111(0.025)

*** School bag weight \ Student weight = RESULT× %**

4.2 Analytical findings

4.2.1 Factors Associated with Development of Musculoskeletal Pain while Carrying School Bag

Table (4:6) shows the significance of the factors affecting occurrence of the musculoskeletal pain while carrying school bag. The results showed that grade, time to arrive to school, ratio of the bag weight to body weight, and right-left swaying had significant relationships with occurrence of pain, while residence, transport, and carry method had no significant relationship ($P > 0.10$) with occurrence of pain. However, gender tended to be significant ($P = 0.061$).

Table(4:6): Significance of factor effects on Occurrence of pain.

	Wald's Chi-Square	df	P- Value
Gender	3,521	1	0.061
Class	27,404	6	0.000
Residence	1,624	1	0.202
Transport	2,166	3	0.539
Carry Method	1,456	2	0.483
Time To Arrive School	14,412	4	0.006
Ratio	7,606	2	0.022
Right and Left swaying or bending forward or repositioning the bag	54,136	2	0.000

Table (4:7) shows relative risk of occurrence of musculoskeletal pain for levels of factors from the multinomial regression analysis. Males had lower risk than females (relative risk = 0.775, $P = 0.061$).

Comparison of grades, taking third grade as reference category, showed that as grade got higher the risk of developing pain increased.

Students in the ninth grade had 3.44 times higher risk of developing musculoskeletal pain compared to third grade students (P << 0.001).

Table(4:7) Relative risk of various levels of the factors investigated for relation with musculoskeletal pain while or after carrying school bag.

Factor	Odds Ratio	P-Value
Gender		
Females	Reference	
Males	0.775	0.061
Grade		
3rd	Reference	
4th	1.314	0.356
5th	1.881	0.031
6th	2.553	0.001
7th	2.886	0.000
8th	2.201	0.005
9th	3.435	0.000
Area of Residence		
City	Reference	
Village	1.217	0.202
Transportation Method		
Walk	Reference	
Bus	0.733	0.363
Car	1.099	0.623
Other	0.644	0.324
Carry Method		
One Shoulder	Reference	
Two Shoulders	0.773	0.265
Other	0.680	0.350
Time Spent to Arrive The School		
1-5 min	Reference	
6-10 min	1.209	0.430
11-15 min	1.657	0.041
16-30 min	2.262	0.004
>30 min	2.547	0.016
Ratio of bag weight to student weight		
<10%	Reference	
10%-15%	1.214	0.277
>15%	1.790	0.007
Right –Left swaying or Bending Forward during carry of school bag		
No	Reference	
sometimes	2.134	0.000
yes	4.777	0.000

As time to school got longer, the risk of developing pain increased; students who take 11-15 minutes to get to school had 1.657 times higher risk compared to students who take less than 5 minutes (P = 0.04), those who take 16-30 minutes to arrive to school had 2.262 times higher risk than those who take less than 5 minutes (P =0.004), and students who take more than 30 minutes to arrive to school had 2.547 times higher risk (P = 0.016).

However, there was no significant difference between students who take 6-10 minutes and the reference category(RR = 1.209, P = 0.430).

Students who carry school bags weighing more than 15% of their weight had significantly higher risk of developing musculoskeletal pain than students carrying bags weighing less than 10% of their body weight (RR = 1.79, P = 0.007). However, there was no significant difference in risk of developing musculoskeletal pain between students carrying bags 10-15% of their weight relative to students carrying bags less than 10% of their body weight (RR=1.214, PP = 0.277).

Swaying left and right or bending forward or repositioning bags were highly associated with the development of musculoskeletal pain. As shown in Table (4:7), students who sometimes sway left and right or bend forward while carrying school bag had 2.13 times higher risk compared to students who never sway or bend forward (P = 0.000), while students who always sway left and right or bend forward during carrying the school bag had 4.777 times higher risk compared to students who never sway or bend forward (P = 0.000).

4.2.2 Factors Associated with occurrence of fatigue while carrying school bag

Table (4:8) shows the significance of the factors affecting occurrence of fatigue while carrying school bag. The results showed that gender, grade, time to arrive to school, ratio of bag weight to body weight, carry method and right-left swaying were significantly associated (P <<0.05) with occurrence of fatigue, while area of residence and transport had no significant relationships (P > 0.10) with occurrence of fatigue.

Table(4:8): Significance (P values) of factor effects on occurrence of fatigue while carrying school bag.

	Wald's Chi-Square	df	P -Value
Gender	9.153	1	0.002
Class	36.368	6	0.000
Residence	.909	1	0.340
Transport	2.910	3	0.406
Carry method	9.042	2	0.011
Time to arrive to school	23.988	4	0.000
Ratio	11.497	2	0.003
Right and Left swaying or bending forward or repositioning the bag	121.100	2	0.000

Table (4:9) shows the relative risk of occurrence of fatigue while carrying school bag. Males had lower risk than females (relative risk = 0.641. P = 0.002). As grade got higher, the risk of developing pain increased. For example, Students in the ninth grade had 3.327 times higher risk of developing musculoskeletal pain compared to third grade students (P << 0.001).

Comparison of carry methods, showed that students who carry their school bags on one shoulder had higher risk of feeling fatigue than those who carry their bags on two shoulders (P = 0.005). As the time to get to school got longer the risk of feeling fatigue increased. Students who take 6-10 minutes to get to school had 1.78 times higher risk relative to students who take less than 5 minutes (P = 0.015). Those who take 11-15 minutes had 2.451 times higher risk (P = 0.000). Students who take 16-30 minutes to arrive to school had 3.727 times higher risk (P = 0.000). And students who take >30 minutes to arrive to school had 3.7 times higher risk than those who take less than 5 minutes (P = 0.001).

Students who carry school bags of more than 10% of their body weight had significantly higher risk (P < 0.05) of feeling tired than students carrying bags weighing less than 10% of their body weight (RR of 1.516. and 2.064 for students who carry school bags of 10%-15% and those who carry bags >15% of their body weight. respectively).

Swaying left and right or bending forward was also highly associated with fatigue. Students who sometimes sway left and right or bend forward during carrying the school bag had 4.48 times higher risk of fatigue compared to students who never sway or bend forward (P = 0.000). while those who always sway left and right or bend forward while carrying school bag had 7.915 times higher risk compared to students who never sway or bend forward (P = 0.000).

Table (4:9) Relative risk of various levels of the factors investigated for relation with fatigue while carrying school bag.

Factor	Odds Ratio	P-Value
Gender		
Females	Reference	
Males	0.641	0.002
Grade		
3rd	Reference	
4th	0.929	0.790
5th	1.933	0.021
6th	1.959	0.015
7th	3.110	0.000
8th	1.967	0.015
9th	3.327	0.000
Area of residence		
City	Reference	
Village	0.866	0.644
Method of transport		
Walk	Reference	
Bus	1.180	0.635
Car	1.042	0.829
Others	0.551	0.111
Carry method		
One shoulder	Reference	
Two shoulders	0.516	0.005
Other	0.853	0.710
Time spent to arrive to school		
1-5 min	Reference	
6-10 min	1.780	0.015
11-15 min	2.451	0.000
16-30 min	3.727	0.000
> 30 min	3.788	0.001
Ratio of bag weight to student weight		
< 10%	Reference	
10%-15%	1.516	0.018
> 15%	2.064	0.001
Right –left swaying or bending forward during carry school bag		
No	Reference	
Sometimes	4.483	0.000
Yes	7.915	0.000

CHAPTER FIVE

DISCUSSION, CONCLOUSIONS and RECOMMENDATIONS

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DISCUSSION, CONCLOUSIONS and RECOMMENDATIONS

5.1 Discussion

The interest of carrying backpacks, particularly with regards to children, has dramatically increased in recent years. The aim of the present study, one of the first in Palestine, was to investigate the influence of certain factors on occurrence of fatigue and musculoskeletal pain, namely; gender, school grade, residence, ratio of school bag weight to student's weight, method of carrying school bag, duration of carrying of school bag, method of transportation to school, and right-left swaying or bending forward. The results of this study showed that grade, time to arrive to school, ratio and right-left swaying or bending forward or repositioning bag were significantly associated ($P < 0.05$) with musculoskeletal pain, while gender, carry method, residence area, and method of transport were not associated ($P > 0.05$) with musculoskeletal pain (although the effect of gender was close to significance, $P = 0.06$). On the other hand, the results showed that gender, grade, time to arrive to school, ratio of school bag weight to student weight, carry method, and right-left swaying, or bending forward or repositioning bag were significantly associated ($P << 0.05$) with occurrence of fatigue, while area of residence and transport had no significant relationships ($P > 0.05$) with occurrence of fatigue.

❖ Weight of school bag

The mean weight of full school bags in the study was 5.27 kg. For male students the mean was 5.19 kg and for female students it was 5.354. For primary schools, it was 4.63 kg and for secondary schools it was 5.94 kg. The mean weight of school bags in our study was less than those found by other studies [11, 25, 32, 40]. A study in New Zealand [32] found that the mean bag weight was 7.0 kg for third grade and 6.3 kg for sixth grade compared to 4.21 and 5.14 kg for third and sixth grades in this study. Although the age range is not comparable, yet another study on students aged 12-18 years reported that the mean of bag weight was 8.3 kg [40]. In other studies, students with mean age of 11.6 years had bag weights averaging about 9 kg [11, 25]. The range of bag weights in our study was 2.44 –10.10 kg. The larger bag weight found in this study may be explained by the fact that some students bring more books to school in some days than other days. The mean of school bag weight differed slightly according to gender; boys carry a mean weight of 5.192 kg, compared to girls who carry a mean weight of 5.354 kg. These findings are consistent with those of another study [67] where girls carried on average 0.25 kg heavier bags than boys but differ from those found by another study [31] where, on average, boys carried heavier (3.1-11.3 kg) schoolbags than girls (1.6-10.7kg).

As previously explained, the difference in bag weights on a day to day basis was found to be a factor in determining the average school bag weight. Also, the number of additional materials carried by the student is a

factor. This is a reflection of the various demands on school children from their schools. Also, there is another important reason for the heavy weight of the school bag related to the increasing number of curricular school books in recent years.

School bag weight as a percentage of body weight. The mean of school bag weight as a percentage of body weight carried by students was 12. 36%. Other studies had similar findings [26, 8, 40, 35, 32]. In contrast, other studies found lower percentages 8.2%, 8.84% [67, 69], and 10% for students in Saudi Arabia [63]. Other studies found considerable higher percentages of body weight: 30% [25], 17% [24], 19% for fifth grade, 21% for sixth grade, 14% for seventh grade, and 15% for eighth grade [50].

In this study female students carried bags of greater percentage of their body weights (average of 12.59 %) than male students (average of 12.16%). The average ratio of school bag weight to body weight (percentage) was higher for primary school students (13.179%) than secondary school students (11.506%). This is a critical finding which means that primary school students, in spite of their smaller height and weight, carry heavier school bags than secondary school students. This may be due in part to the greater number of subjects taken at school by the younger age group. This may also reflect the lack of experience and inability of this age group in deciding the necessary books and supplies to take to school, as well as the experience of family and teachers. This implies the necessity of providing lockers for school students.

The mean of school bag weight to body weight ratio in our study was 12.36%. 73% of students carried bag weights >10% or more of their body weight. Some global associations ATOA and ACA [71], and global studies [48, 70, 56, 63] recommend that the ratio should not exceed 10% of body weight. In this study there was significant relationship ($P < 0.05$) between ratio of bag weight to student weight and musculoskeletal pain. Students carrying bags exceeding 15% of their body weight had 1.79 times higher risk of pain compared to students carrying ≤ 10% of their body weight.

❖ **School bag related to musculoskeletal pain.**

In this study the results showed that the percentage of students who complained of continuous (persistent) pain during everyday life was 8.8%, and 24.4% of students complained from non-persistent pain. The percentage of students who complained persistent pain increased to 31.6% during carrying the school bag and increased to 37.9% for students who had non-persistent pain. For pain related to school bag carrying, 47.8% of students had shoulder pain, 21.6% had lower back pain, and 18.2% had neck pain. These findings were consistent with other studies; a study held in Dubline schools [31] showed that the majority of discomfort (65%) was reported in the shoulder region, followed by 30% reported in back. High levels of discomfort were also reported by van Gent et al [68] where 43.6% of their subjects complained of neck and or shoulder pain. In Puckree et al study [62], 86.9% of their subjects reported pain in the areas of shoulder, neck and back. Study in California also reported 64% of the students

having back pain at some time, 41.3% felt this pain when carrying their backpack, and almost all of them reported feeling relief upon taking off their backpack [69]. In New Zealand study, 77.1% of students reported experiencing some type of musculoskeletal symptom which they felt may be attributable to schoolbag carriage [33].

The results of this study showed that grade, time to arrive to school, ratio of the bag weight to body weight had significant relationships with occurrence of pain ($P < 0.05$), these results are compatible with other studies that have reported a positive association between school bag weight along with other school bag factors and reported MSD. In a study in South Australian an association was found between school bag weight ratio and reported LBP, and even stronger positive association between school bag carriage duration and reported LBP, but the boys had shown stronger positive association between school bag carriage and reported LBP than girls [13]. Significant associations ($P < 0.01$) were found between non-specific back pain and carrying of school bag greater than 20% of body weight, school bag carrying by hand, and walking to school [21]. In North America, a study found that school bag weight (odds ratio 1.98, $P < 0.0001$, median 14.4%, range 1-41% of body weight) and duration of carriage were associated with higher incidence of reported back pain in 12-18 year school students [40]. A cross-sectional study in California found that backpack weight measured as a percentage of body weight was effective in predicting back pain, in addition, girls and those who walked to and from school were more likely to report back pain ($p<0.01$) ,the age and mode of carriage were

not significantly related to the prevalence back pain [69] . A study in South Africa showed that shoulder pain and other body pains were strongly related to the type of school bag worn and gender of the child [62]. Another study showed that back pain was associated with the use of heavy backpacks (P = 0.001) [49]. Along with these studies, a study conducted in New Zealand showed that musculoskeletal symptoms were reported by 77% of the students. Symptoms were most prevalent in the neck, shoulder, and upper and lower back. Although musculoskeletal symptoms are believed to be of a multi factorial origin, carrying of heavy school bags is suspected to be a contributing factor to musculoskeletal pain for secondary school students [33]. Another study is consistent with our study in that it showed that heavier relative backpack weight was associated with upper and mid back pain. It also showed that heavier relative backpack weight was associated with decreased sport time in school, and greater chiropractic utilization [48]. The results of this study showed that 42.1% of students felt that the school bag is always heavy, 31.6% took a rest while carrying the school bag due to its weight and 38.4% of sampled students complained of always getting tired while carrying school bag. The results showed that gender, grade, time to arrive to school, ratio of bag weight to body weight, carry method and right-left swaying or bending forward and repositioning bag were significantly associated ($P << 0.05$) with occurrence of fatigue. This indicates that a good proportion of students spend intensive energy to carry the school bag before arriving to school.

These indicators show that the school bag generally affects the health of students; this is compatible with other studies showed that carrying heavy school bags has an effect on cardiovascular effort [46], and also develops musculoskeletal symptoms in students [26]. 59% of students reported discomfort due to carrying school bag The majority of discomfort (65%) was reported in the shoulder region, followed by 30% reported in the back [31] .

Probably, the most important factor in our study is that the student swaying left and right or bending forward and repositioning bag because of heavy bag weight was associated with increased the risk of musculoskeletal pain and fatigue. I think this negatively affects the posture of the student, especially because they are of the age when their musculoskeletal system is still developing. This is supported by the results of a study by Grimmer *et al.,* in 1999 which showed a significant change in the cranio-vertebral angle when carrying a heavy school bag [7]. It also alters the posture and gait of the students carrying heavy school bags [24].

Carrying a backpack weighing 15% of the body weight appeared to be too heavy to maintain standing posture for adolescents [30]. The 15% load condition induced a significant increase in trunk forward lean and prolonged blood pressure recovery time [70].

Another study by Ramprasad *et al.,* in 2010 indicated that significant changes occurred in TFL and CVA when the backpack was loaded to 15% body weight [54]. Also, little change in temporal-spatial gait parameters was noted during backpack use with loads limited to 15% body weight [53].

Yet another study by Neuschwander *et al.*, in 2010 used magnetic resonance imaging (MRI) to examine the effect of backpacks on the intervertebral discs. According to the results, backpacks alter the fluid content of these discs, which is a risk factor for disc herniation and osteoarthritis [58]. Backpack carrying, particularly asymmetrically, results in a shift of the upper trunk, shoulder and cervical lordosis, resulting in an increase of back pain during school periods and holidays [42].

5.2 Conclusions

Our study involved a large cross –sectional sample of students who attended Tulkarm governmental schools. The main aims of our study were to investigate the percentage of backpack weight to body weight, and to determine the relationship between musculoskeletal symptoms and fatigue during school backpack carriage. Results revealed that 73% of students carry schoolbags weighing 10% or more of their body weight that exceeded the approximate guide line of 10% body weight. Also, our results showed the percentage of students who complained of continuous (persistent) pain during everyday life was 8.8% and 24.4% of students complained from non-persistent pain. Due to carrying school bag the percentage of students complaining persistent pain increased to 31.6% and the percentage of students who have non-persistent pain increased to 37.9%. As we reported musculoskeletal pain 47.8% of students had shoulder pain, 21.6% had lower back pain, and 18.2% had neck pain. Almost half of the sampled students (50.6%) declared that school bag felt heavy sometimes, while 42.1

% felt their school bag was always heavy. 38.4% of sampled students complained of always getting tiered while carrying their school bag while 35.1% of students felt tired sometimes. The results showed that class level, time to arrive to school; ratio of the bag weight to body weight, and right-left swaying had significant relationships with occurrence of musculoskeletal pain. The results show that gender, grade, time to arrive to school, ratio of bag weight to body weight, carry method and right-left swaying were significantly associated ($P << 0.05$) with occurrence of fatigue. Future research work in schools is required to confirm these results. In particular, longitudinal population studies on the risk factors for musculoskeletal pain in secondary and elementary school students are needed.

5.3 Recommendations

Overweight school bags will bring additional stress and fatigue to primary and secondary students. As a physiotherapist worker and health provider, I recommend that, as a precautionary measure, students should avoid carrying school bags that exceed 10% of their body weight. Also, we need the MOH and MOED to act promptly to solve this major health issue starting with a National Plan to provide all students with *Electronic book*. The following are some suggested measures for responsible people to take in order to help students reduce the weight of their school bags hence securing their health.

1- Recommendations for Schools

- Raise awareness of the issue.
- Promote home/school cooperation on the issue.
- Include back care in health education programs (Ergonomics awareness and posture training).
- Lockers for students to store and retrieve books and other items should be installed where possible.
- Encourage students to use school bags, pencil cases and other stationery items that are made of durable but light-weight materials.
- Schools should explain to parents the role they play in reducing the weight of school bags.

2- Recommendations for Parents.

- Parents should be urged to select school bags and items which are made of light-weight materials.
- Remind and help their children to pack school bags every day according to the timetable.
- Instead of carrying textbooks home, photocopy relevant chapters.
- Regularly ask your child if their backpack is causing fatigue or pain.
- See your doctor if your child complains of back pain.

3- Recommendations for authors of books.

Consider the weight of schoolbags when writing textbooks.

- Coordinate with school communities in finding solutions.

4- Recommendation for students and parents.

There are two guidelines for safe and proper backpack use that the students take into account:

1-Choose it right

- The size should be proportional to the size of the child.
- Choose a back pack with padded shoulder straps that fits your child's size.
- Use the stabilizing waist strap around the waist and the child can use that strap to stabilize the load and prevent injuries

2- Carry and lift it right.

- Face the backpack and bend at the knees before you lift it.
- Use both shoulder straps; make them comfortable but not too tight.
- Adjust the shoulder straps so that the bottom of the backpack is just above the child's waist.
- Pack the heaviest items so they are closest to the child's back.
- Make sure that items can't move around during transit.

Look for signs of pain. Such as, red marks from straps and poor posture. This indicates if a backpack fits poorly or is overloaded.

All the above recommendations should be added to a comprehensive school health-promotion. So, students in schools will be healthy and have correct posture. for more details about recommendation see appendix (E).

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Appendixes

Appendix (A)
Arabic questionnaire

جامعة النجاح الوطنية

كليه الدراسات العليا

برنامج الصحة العامة

أخي الطالب / أختي الطالبة

السلام عليكم و رحمة الله و بركاته...

تقوم الباحثة بإجراء دراسة ميدانية تهدف إلى دراسة تأثير الحقائب المدرسية على أطفال المدارس. و لأننا نهتم بصحتك الجسدية و ندرك تماما أنك أنت/ي الذي تستطيع إعطاءنا صورة حقيقية عن ذلك الموضوع فإننا نرجو منك التعاون مع الباحثة في تعبئة هذه الاستمارة علما بأن الإجابات لن تستخدم إلا في أغراض البحث العلمي. و إنني أشكرك كثيرا على وقتك و تعاونك أنت و المدرسة التي تدرس فيها لأنهي هذا المشروع البحثي .

الباحثة

ألاء القطو

بسم الله الرحمن الرحيم

استبيان حول تأثير الحقائب المدرسية على ظهور أطفال المدارس

1. المعلومات الشخصية

* عمر الطالب ☐ سنه .

* الجنـــــس : ذكر ☐ أنثى ☐

*المرحلة الدراسية : أساسية دنيا ☐ أساسية عليا ☐

*الصف: الثالث ☐ الرابع ☐ الخامس ☐
السادس ☐ السابع ☐ الثامن ☐ التاسع ☐

* وزن الطالب : ☐ كغم.

*وزن الحقيبـــة المدرسية : مليئة ☐ كغم. فارغة: ☐ كغم

*طول الطالب : ☐ سم.

*هل تشكوإين من أية مشاكل صحية مثل كسر سابق أو أزمة صـــدرية أو عمليـــات جراحيـــه تتسبب في عدم التمكن من الوصول للمدرسة ماشيا أو عدم التمكن من حمل الحقيبة المدرسية؟

نعم ☐ لا ☐

2 - **الطالب و الحقيبة المدرسية :**

***هل يساعدك إحدى والديك في حمل الحقيبة المدرسية؟**

نعم ☐ لا ☐

*كيف تذهب\اين إلى مدرستك ؟

مشيـــــــــــــا :

نعم ☐ لا ☐

في الباص :

نعم ☐ لا ☐

في السيارة :

نعم ☐ لا ☐

على الدراجة:

نعم ☐ لا ☐

*كم من الوقت تأخذ\اين و أنت ذاهب\اة إلى المدرسة حاملا\اة الحقيبة على ظهرك ؟

أقل من 5 دقائق ☐ 5 -10 دقائق ☐ 11 - 15 دقيقة ☐ 16 -30 دقيقه ☐

أكثر من 30دقيقة ☐

*كيف تحمل\اين حقيبتك المدرسية؟

على كتف واحد

نعم ☐ لا ☐

على الكتفين

نعم ☐ لا ☐

في يد واحدة

نعم ☐ لا ☐

في اليدين

نعم ☐ لا ☐

تجرها عن طريق العجلات

نعم ☐ لا ☐ أحياناً ☐

*هل تشكو\اين من الألم في اسفل ظهرك أو رقبتك أو كتفك بشكل عام (أثناء الحياه اليوميه) ؟

*هل تشعرا\ين بالألم في أسفل ظهرك أو رقبتك أو كتفك بعد أو إثناء حملك حقيبتك المدرسية؟

اذا كانت اجابتك بنعم او احيانا هل الألم الذي تشعره في:

الرقبه

نعم ☐ لا ☐

الكتف

نعم ☐ لا ☐

اسفل الظهر

نعم ☐ لا ☐

*عندما تكون حاملا\اة حقيبتك المدرسية هل تتمايل\اين يمينا و يسارا أو تنحني للأمام نتيجة وزنها؟

نعم ☐ لا ☐ أحياناً ☐

*هل تعتقدا\ين أن حقيبتك المدرسية ثقيلة الوزن؟

نعم ☐ لا ☐ أحياناً ☐

*هل تأخذا\ين وقت من الاستراحة أثناء سيرك إلى المدرسة بسبب الحقيبة؟

نعم ☐ لا ☐

*كم من الوقت تأخذا\ين أثناء هذه الاستراحة ؟

دقيقه ☐ دقيقتين ☐ خمسه دقائق ☐ أو أكثر ☐

*هل حمل الحقيبة المدرسية يجعلك متعبا\اة؟

نعم ☐ لا ☐ أحياناً ☐

وشكرا لتعاونكم

Appendix (B)

English Questionnaire

An-Najah National University

Faculty of Graduate Studies

Public Health

Study about Influence of backpacks on students backs

1- **Personal information**:

*Age: ☐ years.

*Gender: male☐ fema☐

*Education level: prelimina☐ secon☐y

*Grade: 3 grade☐ 4grade☐ 5grade☐

6grade☐ 7grade☐ 8grade☐ 9grade☐

* Student weight ☐ Kg

*Weight of school bag: full☐ Kg empt☐ Kg

* Height of student: ☐ cm

* Do you have any previous medical problem such as fracture or surgery?

☐ Yes ☐ No

2. <u>Student and school bag</u>.

*Do your parents help you carry your schoolbag?

☐ Yes ☐ No

How do you go to school?

Walking:

☐ Yes ☐ No

Bus:

☐ Yes ☐ No

Car:

☐ Yes ☐ No

Bicycle:

☐ Yes ☐ No

* How much time does it take to travel from home to school while carrying the school bag?

5> minutes ☐ 5-10 minute ☐ 11-15 min ☐

16-30 minutes ☐ < 30 minut ☐

*How do you carry your school bag?

On one shoulder

☐ Yes ☐ No

On two shoulders

☐ Yes ☐ No

By one hand

☐ Yes ☐ No

By two hands

☐ Yes ☐ No

* Kind of parents help such as (parents helps there to carry the bag on his shoulders, Parents carrying cases their children until they reach school).

*Do you suffer from pain in your lower back, neck or shoulder in daily life?

Yes ☐ No ☐ sometimes ☐

*Do you feel pain after or while carrying the school bag?

Yes ☐ No ☐ sometimes ☐

If you answered yes or sometimes, do you feel that pain in the
Neck

☐ Yes ☐ No

Shoulder

☐ Yes ☐ No

Lower back

☐ Yes ☐ No

* When you are carrying the school bag, do you sway left and right, or bend forward or repositioning his /her bag as a result of weight?

Yes ☐ No ☐ Sometimes ☐

Do you think your school bag is too heavy?*

Yes ☐ No ☐ Sometimes ☐

Do you take a break from carrying the school bag while carrying it?*

☐ Yes ☐ No

*How much time does this break take?

1minute ☐ 2minutes ☐ 5minu ☐ or m ☐

* Does carrying your bag make you tired?

Yes ☐ No ☐ Sometimes ☐

Thanks for your Cooperation

Appendix (C)

Relationship between two variables by using fisher exact test

	Column variable		
Row variable	Gender	Grade	Class
Parents help child to carry school bag	N.S.	N.S. P > 0.05	N.S. (P > 0.05 (CI99%)
Transport Method to school	N.S.	(P < 0.01 CI 99%)	N.S. (P > 0.05 CI 99%)
Time spent carrying school bag	*** (CI 99%)	*** (P < 0.01 CI 99%)	*** (P < 0.01 CI 99%)
Student complaining of pain (Neck, shoulder, low back) in general	(CI 99%)	*** (P<0.01 CI 99%)	*** (P < 0.01 CI 99%)
Student complaining of pain (Neck, shoulder, low back) during or after carrying school bag.	***	*** (P < 0.01 CI 99%)	*** (P < 0.01 CI 99%)
Student complain of neck pain during or after carrying school bag	N.S.	(P < 0.01)	** (P < 0.01 CI 99%)
Student complain shoulder pain during or after carrying school bag	**	N.S. (P > 0.05)	N.S. (P > 0.05 CI 99%)
Student complaining of low back pain during or after carrying school bag	N.S.	*** (P < 0.01)	*** (P < 0.01 CI 99%)
Student sawing right and left or bending forward due to school bag weight	N.S.	** (P < 0.05 CI 99%)	N.S. (P > 0.05 CI 99%)
Student feeling school bag too heavy	***	*** (P < 0.01 CI 99%)	*** (P < 0.01 CI 99%)

Student taking a rest time during carrying school bag	N.S.	N.S. (P>0.05)	*** (P < 0.01 CI 99%)
Rest Time spent due to carrying school bag	***	*** (P<0.01 CI 99%)	*** (P < 0.01 CI 99%)
Student getting tiered during carrying school bag	***	*** (P < 0.05 CI 99%)	*** (P < 0.01 CI 99%)
Student method in carrying school bag	* **	*** (P < 0.01 CI 99%)	*** (P < 0.01 CI 99%)

- N.S: Not significant (P>0.05).
- ** Significant relationship (P<0.05).
- *** Strong significant relationship (P <0.01)

Appendix (D)

Significant differences between the means through the use of (T-test for equality means).

	Dependant variable					
independent variable	Student weight \Kg	Height student \Cm	B M I	Bag Weight Empty	Bag Weight Full	Bag Weight \ Student Weight
Gender	P= 0.580 N.S	P=0.659 N.S	P=452 N.S	P=0.481 N.S	P=0.080 N.S	P=0.060 ****
Grade	P=0.000 ***	P=0.000 ***	P=0.000 ***	P=0.076 N.S	P=0.000 ***	P=0.000 ***
Residence	P=0.000 ***	P=0.000	P=0.366 N.S	P=0.000 ***	P=0.000 ***	P=0.000 ***
Parent help child to carry school bag	P=952 N.S	P=0.865 N.S	P=0.791 N.S	Non	P=0.995 N.S	P=0.909 N.S
Student complain neck pain	P=0.874 N.S	P=0.002 ***	P=0.880 N.S	Non	P=0.003 ***	P=0.655 N.S
Students complain shoulder pain during or after carry school bag	P0.827 N.S	P=0.091 N.S	P=0.949 N.S	Non	P=0.001 ***	P=0.029 **
Students complain low back pain during Or after carry school bag	P=0.000 ***	P=0.000 N.S	P=0.390 N.S	Non	P=0.000 ***	P=0.518 N.S
Student taking rest during carry school bag	P=0.112 N.S	P=0.658 N.S	P=0.078 ****	Non	P=0.578 N.S	P=0.046 ***

- N.S = not significant.
- ** Significant relationship P <0.05.
- *** Strong significant relationship P <0.01.
- **** tended to be significant.

Appendix (E)

Recommendations

Overweight school bags will bring additional stress and fatigue to primary and secondary students. As a physiotherapist worker and health provider, I recommend that, as a precautionary measure, students should avoid carrying school bags that exceed 10% of their body weight. The following are some suggested measures for responsible people to take in order to help students reduce the weight of their school bags hence securing their health.

1. Recommendations for Schools.

- Raise awareness of the issue.
- Promote home/school cooperation on the issue.
- Include back care in health education programs.
- Lockers for students to store and retrieve books and other items should be installed where possible.
- Encourage students to use school bags, pencil cases and other stationery items that are made of durable but light-weight materials.
- Demonstrate to students the correct manner and posture in carrying school bags and explain the adverse effects that over-weight schoolbags can have.
- Encourage the students to store books in their school locker, and only bring home those needed for homework.

2. Recommendations for Parents.

Home-school cooperation is important to raise awareness of the issue and to communicate with the school in finding solutions through:

- Schools should explain to parents the role they play in reducing the weight of school bags.
- Parents should be urged to select school bags and items which are made of light-weight materials.
- Instead of carrying textbooks home, photocopy relevant chapters.
- Discourage their children from bringing magazines, toys and unnecessary items to school.
- Remind and help their children to pack school bags every day according to the timetable.
- Regularly clean out the backpack, since your child may be storing unneeded items.
- Regularly ask your child if their backpack is causing fatigue or pain. If so, lighten the load and adjust the fittings.
- See your doctor if your child complains of back pain.
- If your child insists they need to bring home more books than they can comfortably carry, see their teacher.

3. Recommendations for authors of books.

- Consider the weight of schoolbags when writing textbooks.
- Coordinate with school communities in finding solutions.

4. Recommendations for students and parents.

There are three guidelines for safe and proper backpack use that the students take into account:

1-Choose it right

- The size should be proportional to the size of the child. Looking at the child's back, the height of the backpack should be no more than three quarters of the length between the child's shoulder blades and waist. Larger than that is too large for the child and invites the child to fill it to capacity, which will exceed health and safety limits.
- Choose a back pack with padded shoulder straps that fits your child's size. (A backpack that's too large will bend forwards the buttocks, stressing the child's lower back and shoulder. Look for backpacks that have padded shoulder straps to prevent pinching nerves in and around the shoulder and neck area.
- Use the stabilizing waist strap around the waist and the child can use that strap to stabilize the load and prevent injuries that occur when the load swings wildly, taking the child with it.

2- Pack it right.

- The backpack should weigh less than 10 percent of your child's body weight – for example, a child of 40 kg should carry less than 4kg in their backpack. Ideally, the child in this example should only carry around 2–3kg of books.

- Pack the heaviest items so they are closest to the child's back. If the heaviest items are packed further away, this throws out the child's centre of gravity and causes unnecessary back strain.
- Make sure that items can't move around during transit, as this could decentralize your child's centre of gravity.
- Don't carry lots of equipment at the same time. Such as; sports gear, musical instruments or art materials.

3- Carry and lift it right.

- Face the backpack before you lift it.
- Bend at the knees.
- Using both hands, check the weight of the pack.
- Lift with your legs, not your back
- Carefully put one shoulder strap on at a time. Never sling the pack onto one shoulder.
- Use both shoulder straps; make them comfortable but not too tight. Carrying the backpack on one shoulder, can cause long-term neck, shoulder, back, and postural problems.
- When taking off the backpack, slip an arm through one shoulder strap, and then the other.
- Look for signs of pain. Such as, red marks from straps and poor posture. This indicates if a backpack fits poorly or is overloaded.
- Adjust the shoulder straps so that the bottom of the backpack is just above the child's waist – don't allow them to wear the backpack slung low over their buttocks.

- Your child should lift the backpack with a straight back, using their thigh muscles. The backpack should be lifted with both hands and held close to the body. When fitted correctly, the backpack should form comfortably to the child’s back, rather than hang off their shoulders.

All the above recommendations should be added to a comprehensive school health-promotion. So, students in schools will be healthy and have correct posture.

جامعة النجاح الوطنية
كلية الدراسات العليا

تأثير الحقائب المدرسية على ظهور الطلاب - دراسة مقطعية لمدارس محافظة طولكرم

إعداد
آلاء أسيد خليل القطو

أشراف
د. خليل عيسى
أ. د. غسان أبو حجله

قدمت هذه الأطروحة استكمالا لمتطلبات الحصول على درجه الماجستير في الصحة العامة بكلية الدراسات العليا في جامعة النجاح الوطنية في نابلس - فلسطين.

2012م

تأثير الحقائب المدرسية على ظهور الطلاب - دراسة مقطعية لمدارس محافظة طولكرم

إعداد

آلاء أسيد خليل القطو

أشراف

د. خليل عيسى

أ. د. غسان أبو حجله

الملخص

هناك قلق واضح ومستمر بشأن الحقائب المدرسية ثقيلة الوزن والأثار السلبية الناجمة عنها والتي تشكل خطرا على الجهاز العضلي الحركي والعصبي أيضا.و بناءً على هذه المشكلة المتزايده التي تواجه طلابنا وقله التثقيف الصحي بشأنها لقد أجريت دراسة مقطعية لمدارس محافظة طولكرم الابتدائيه والأعداديه للذكور والأناث من الصف الثالث حتى الصف التاسع وقد شملت الدراسه 800 طالب و طالبة تم أخذهم عن طريق استخدام العينه العشوائية .أستخدمت الأستبانة كأداة لجمع المعلومات من الطالب ومن ثم تم قياس وزن الطالب ووزن الحقيبة وتم قياس طول الطالب أيضا. حيث كان الهدف من اجراء البحث هو قياس نسبه وزن الحقيبة المدرسية با النسبه لوزن الطالب وتحديد العلاقه مابين الالام العضلية الحركيه والتعب الناجم عن حمل الحقيبه المدرسية.وقدأظهرت النتائج ما يلي :معدل وزن الحقيبة المدرسية المليئه 5.267 كغم,ومتوسط نسبة وزن الحقيبة با النسبة لوزن الطالب 12,364%.وأيضا 73 % من الطلاب يحملون حقائب مدرسية تزن 10% أو أكثر من وزن أجسامهم .وفيما يتعلق ب الالام الناتجة عن حمل الحقيبة المدرسية فأن 47 % من الطلاب يشكون من الام في الكتف ،21.6% يشكون من الم أسفل الظهر و 18.2% يشكون من ألم في الرقبه .اضافة الى ذالك 38.4% من الطلاب يشعرون بالتعب باستمرار اثناء حمل الحقيبه المدرسية.

وقد تبين بعد الدراسه التحليلة انه يوجد علاقة ($P < 0.05$) مابين الصف، الوقت الذي يستغرقه الطالب للوصول الى المدرسة,نسبه وزن الحقيبه لوزن الطالب و التمايل يميناو يسارا والانحناء للأمام اوالخلف نتيجه حمل الحقيبة المدرسية وحدوث الألم العضلي الحركي عند

الطلاب بينما لاتوجد ($P > 0.10$) علاقه ما بين مكان الاقامه,طريقه الوصول للمدرسة، وطريقه حمل الحقيبه المدرسية وحدوث الألم .

اضافة الى ذالك يوجد علاقة ($P < 0.05$) مابين الجنس، الصف، الوقت الذي يستغرقه الطالب للوصول الى المدرسة،نسبه وزن الحقيبه لوزن الطالب,طريقه حمل الحقيبه المدرسية و التمايل يميناو يسارا والانحناء للأمام اوالخلف نتيجه حمل الحقيبة المدرسية وحدوث التعب عند الطلاب بينما لاتوجد ($P > 0.10$) علاقه ما بين مكان الاقامه،طريقه الوصول للمدرسة وحدوث التعب .وبناءاعلى النتائج التى توصلت اليها فأنه يجب على كل من وزارة الصحة ووزارة التربية والتعليم العمل جاهدة من أجل وضع خطة وطنية لتوفير ما يسمى ب" الكتاب الالكتروني" لكل طالب/ة . اضافة الى ذالك يجب اتخاذ تدابير وقائية لحل هذه المشكله الصحية بحيث ان يحدد وزن الحقيبه المدرسية مابين5 -10% بالنسبة لوزن الطالب وان يكون هناك برنامج توعوي لكل من المدرسة ،الطالب ،الأهل فيما يتعلق بكيفية التعامل مع الحقيبة المدرسية .وفي النهاية هناك دائما حاجة لمزيد من البحوث في هذا المجال والمزيد من الدراسات المتعمقة لتحديد عوامل الخطر للألام الجسدية عند أطفال المدارس .