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Relationship Between Backpack Weight and Prevalence of Dropped Shoulders in College Going Students-An Observational Study

Kajal Korani[1], Tayyaba Munawar[2]

[1]Intern – BPTh, RJS College of Physiotherapy, MUHS, Ahmednagar, India
[2]Associate Professor, RJS College Of Physiotherapy, MUHS, Ahmednagar, India

Abstract:
This study has been undertaken to determine and study the prevalence of dropped shoulders in young college going students. Carrying heavy backpacks places excessive stress on the muscles, leading to postural changes and muscle weakness. Posture was assessed using plumb line which is a simple, feasible and non-invasive method to assess dropped shoulders.

Index Terms – Dropped shoulders, Cranio-vertebral angle, Cranio-horizontal angle, Sagittal shoulder posture.

INTRODUCTION

Backpack use has been increased recently because of several factors including decreased availability of lockers at college, increased homework, larger textbook and other subjects being carried to college, etc. (1) All the neck, back and abdominal muscles work in harmony in order to help an individual carry heavy load like a backpack. (1)

The muscles which gets stressed mainly are deltoid, trapezius, levator scapulae, supraspinatus, infraspinatus, teres minor and major, latissimus dorsi, pectoralis major and minor along with sternocleidomastoid. (2) Due to forward head posture, there is increased tension, fatigue and compressive forces in and around cervical and shoulder region. (2) In order to withstand the load of heavy backpack, the student tends to bend his/her head and trunk forward, arch his/her back excessively leading them to face a lot of spinal deformities causing permanent postural deviations. (2) The student also tends to bend on the opposite side while carrying the backpack on single shoulder in order to compensate the weight, causing damage to shoulders and spine. (2) Bending forward while carrying the backpack has a negative impact on natural curvatures in lumbar spine too. (2)

There is high prevalence of back and neck pain in students i.e. 56.3%. (3) Grimmer et.al (2002) in their research concluded that carrying a backpack in lower position causes least postural changes from an unloaded position. (3) In order to maintain spinal stability, there should be appropriate backpack loading on spine closely and symmetrically. (4) Based on its epidemiologic, physiologic and biomechanical approaches the weight limit for the backpack has been recommended as 10-15% of the student's bodyweight. (5,6) Apart from physical factors, forward head posture for prolonged period of time and making repetitive movements also results in causing neck pain. (7) As many role of the clinical physician, it is also part of them to prevent the chronic disability or altered posture of the children and posture correction of the shoulder and neck that is more prone to get affected. (8) Methods to assess cervical and

sagittal shoulder posture (SSP) are plumb line method, photography method and x-ray method. [8,9] Changes in alignment of neck can produce strain of cervical joints and soft tissues as well as imbalanced muscle performance. Articular cartilage is vulnerable to sheer stress, whereas the epiphysis and apophyses are more susceptible to repetitive micro trauma. [9,10] Ideal alignment of head, neck and shoulder – the ear lobe is in line with the shoulder tip (acromion process) and high point of iliac crest. [10] This line is the lateral line of reference dividing the body into front and back halves equally (sagittal view). [10] When the backpack load is positioned posterior to the body, the center of gravity shifts posteriorly. [11] However, secondary ossification of vertebrae is not complete until the mid-twenties. Therefore, the spine may be susceptible to injury for a greater length of time, and therefore, proper backpack use should be emphasized during these years. [12] This shift is accomplished by either leaning forward at the ankle or hip or inclining the head, and the rigidity of postural muscles controlling these adjustments increases to support the load. [13] Moreover, external forces such as load carrying may also influence the growth, development, and maintenance of alignment of the human body. [14] Hence, as a part of clinical practice, physician or any health professional has to consider preventing the early chronic disability or pain that can hamper the Quality of Life of the students. [14]

NEED OF THE STUDY

Due to heavy backpack, the major postural abnormality seen in youth is dropped shoulders. So this study aims to find out the prevalence of relationship between heavy backpacks and dropped shoulders in college going students.

RESEARCH METHODOLOGY

Material:

1. Consent form
2. A postural plumb line
3. A demographic questionnaire that asked the gender and weight of students, weight of backpack, college type (public or private) and grade.
4. Weight of students were measured using a digital scale or weighing machine.
5. Weight of backpacks were measured using a digital scale or weighing machine.

Methodology:

1. Study design – Observational study
2. Study setting – RJS college of physiotherapy, SJS hospital, Kopargaon.
3. Study population – College students of age group 20 to 25 years
4. Total sample size – 100

PROCEDURE:

Instructions were given to the participants about the study, its benefits and risk were explained. A written consent was taken from the participants. 100 subjects were selected based on inclusion and exclusion criteria of the study. Then by using the random sampling technique, the subjects were randomly allocated to two groups based on the weight of backpack and the subject.

Group A included the subjects carrying the weight of backpack more than 10% of their bodyweight.

Group B included the subjects carrying the weight of backpack less than or equal to 10% of their bodyweight.

Evaluation was done throughout 6 weeks in order to check for dropped shoulders on every alternate day.

RESULTS AND DISCUSSION

1) Analysis and interpretation:

The data analysis was done with R statistical analysis software. Chi-square test was used to determine the result for Group A and Group B.

Table 1: Mean age of group A and group B

MEAN AGE OF GROUP A	MEAN AGE OF GROUP B
22.5	23.4

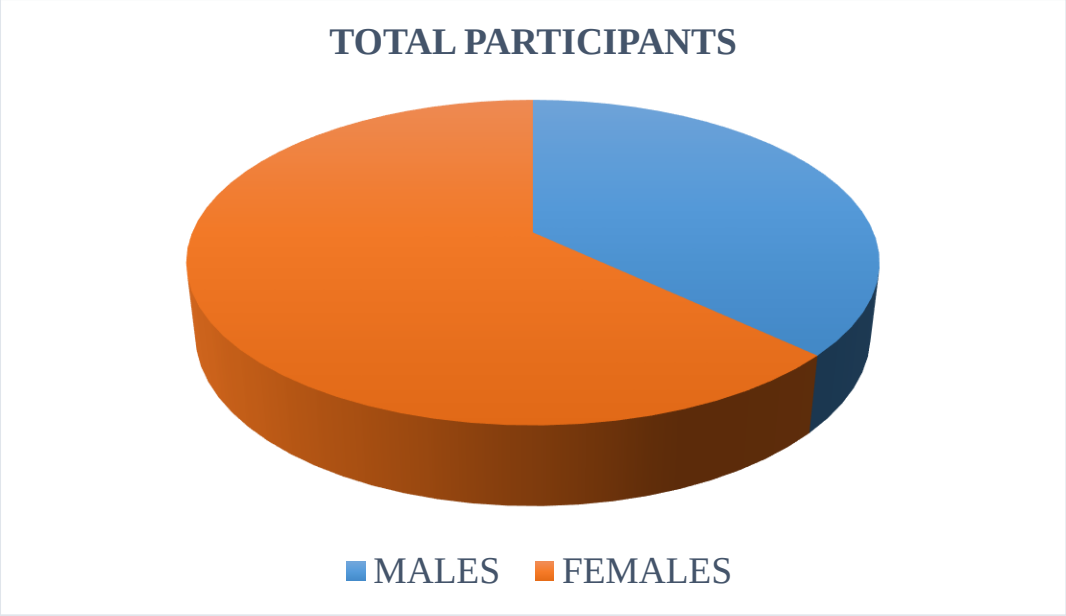
The table shows the mean age of group A is 22.5 years and group B is 23.4 years

Table 2: Table representing gender wise distribution of subjects

TOTAL SUBJECTS	GENDER	
	MALE	FEMALE
100	37	63

Out of total 100 subjects, 37 were males and 63 were females

Chart 1: Pie chart representing gender wise distribution



Out of 100 subjects 63 were females and 37 were males

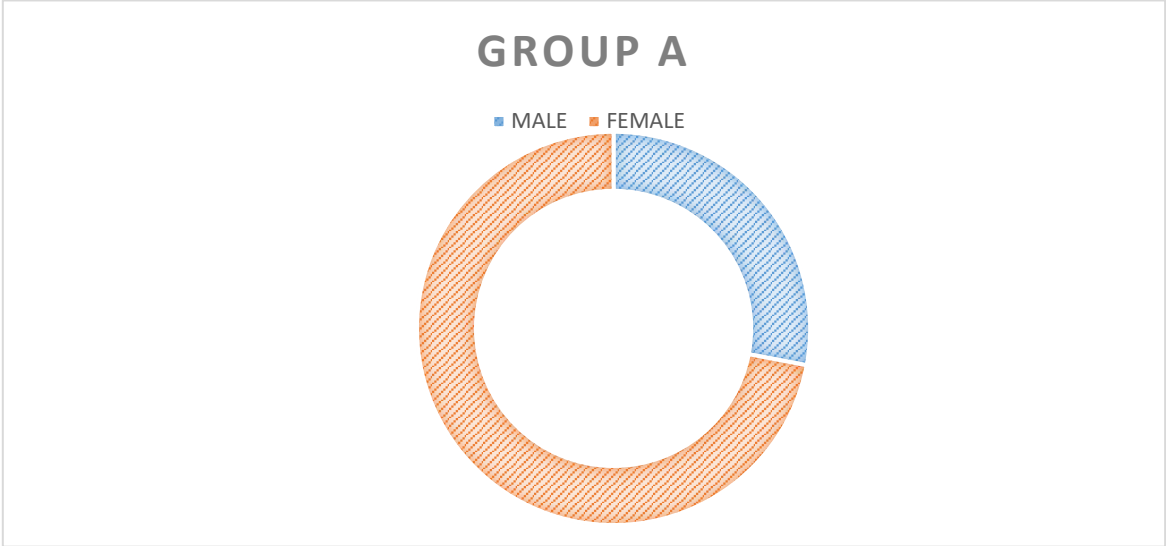
Group A (Non-standard)

Table 3: Gender-wise distribution of subjects in group A

GENDER	FREQUENCY	PERCENTAGE
Male	14	28%
Female	36	72%

Out of total 50 subjects in group A, 14 were males and 36 were females

Chart 2: Pie chart representing gender-wise distribution in group A



Group B (Standard)

Table 4: Gender-wise distribution of group B

GENDER	FREQUENCY	PERCENTAGE
MALE	23	46%
FEMALE	27	54%

Out of 50 subjects, 23 were male and 27 were female.

Chart 3: Pie chart representing gender-wise distribution of group B

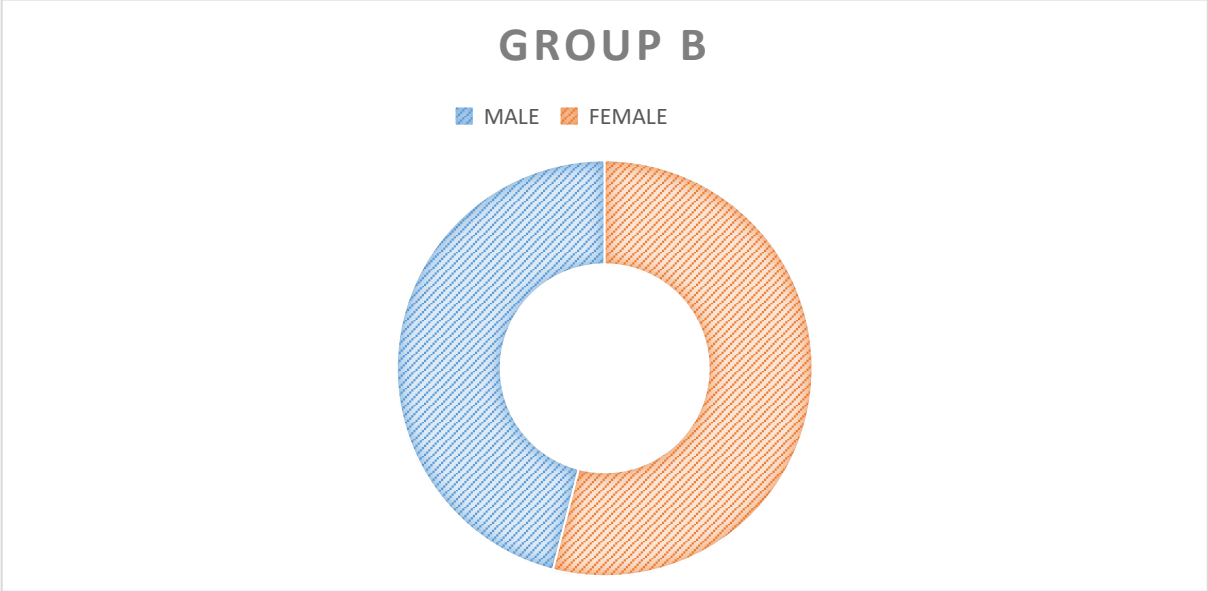


Table 5: Prevalence of dropped shoulders in group A

TOTAL	MEAN		STANDARD DEVATION		P VALUE
	BODY WEIGHT	BACKPACK WEIGHT	BODY WEIGHT	BACKPACK WEIGHT	
50	59.388	6.518	10.402	1.025	<0.05

Chi square test was used to find p value of group A. Mean body weight of the subjects in group A was found to be 59.38±10.40 & mean back pack weight of the subjects in group A was found to be 6.51±1.02. Calculated p value is 1.55416E-21 which is less than 0.05. Hence, it shows significant relationship between backpack weight and prevalence of dropped shoulders in group A.

Table 6: Prevalence of dropped shoulders in group B

TOTAL	MEAN		STANDARD DEVATION		P VALUE
	BODY WEIGHT	BACKPACK WEIGHT	BODY WEIGHT	BACKPACK WEIGHT	
50	59.418	4.178	10.91	1.27	<0.05

Chi square test was used to find p value of group B. Mean body weight of the subjects in group B was found to be 59.41±10.91 & mean back pack weight of the subjects in group B was found to be 4.17±1.27. Calculated p value is 1.45416E-21 which is less than 0.05. Hence, it shows significant relationship between backpack weight and prevalence of dropped shoulders in group B.

Table 7: Table representing the degree of freedom, p value, calculated value and tabular value based on chi-square test formula.

X^2	100	
Degree Of Freedom	3	
P Value	1.55416E-21	P value < 0.05
Calculated	74.7	
Tabular	7.81	

The table represents that total number of participants were 100. Degree of freedom was found to be 3. The p value was found to be 1.55416E-21 which is less than 0.05 which shows significant relationship between backpack weight and prevalence of dropped shoulders.

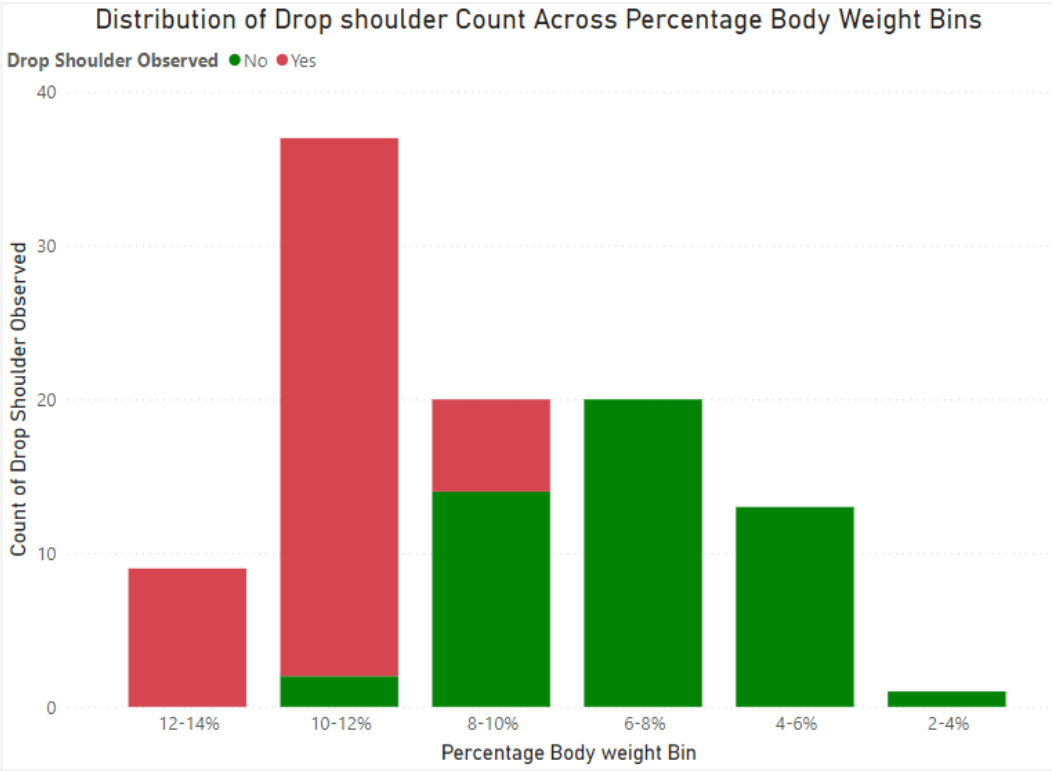
By chi square test the calculated value was found to be greater than tabular value. Hence, the test rejects the null hypothesis and accepts the alternative hypothesis.

Table 8: Table representing the probability of a larger value of x^2 along with the degree of freedom in order to calculate p value

Percentage Points of the Chi-Square Distribution

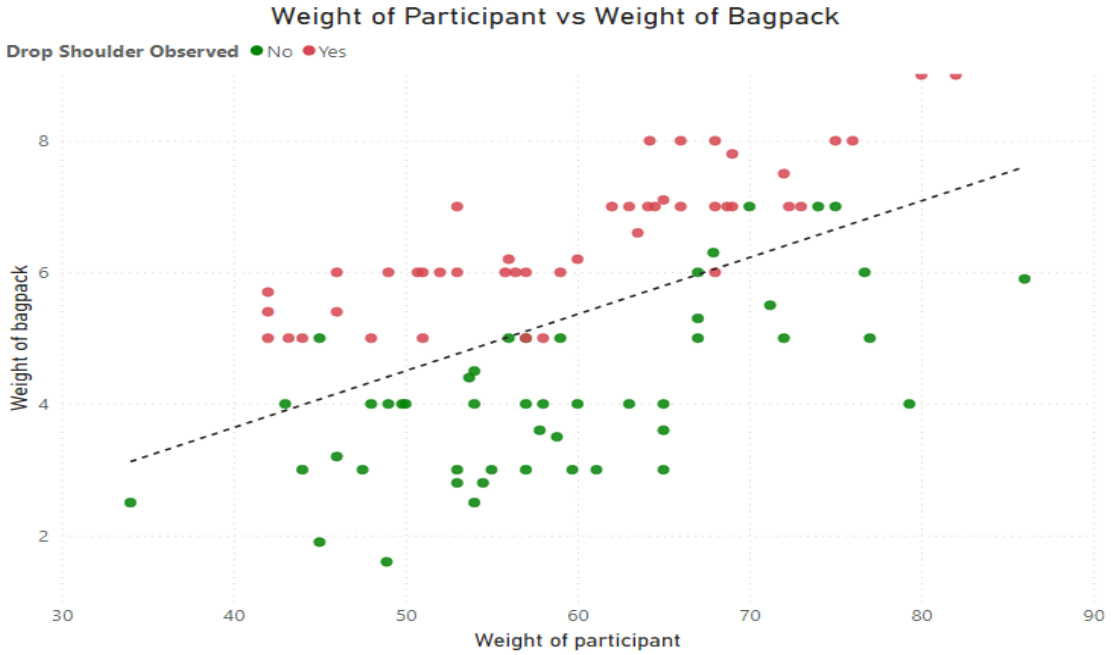
Degrees of Freedom	Probability of a larger value of x^2								
	0.99	0.95	0.90	0.75	0.50	0.25	0.10	0.05	0.01
1	0.000	0.004	0.016	0.102	0.455	1.32	2.71	3.84	6.63
2	0.020	0.103	0.211	0.575	1.386	2.77	4.61	5.99	9.21
3	0.115	0.352	0.584	1.212	2.366	4.11	6.25	7.81	11.34
4	0.297	0.711	1.064	1.923	3.357	5.39	7.78	9.49	13.28
5	0.554	1.145	1.610	2.675	4.351	6.63	9.24	11.07	15.09
6	0.872	1.635	2.204	3.455	5.348	7.84	10.64	12.59	16.81
7	1.239	2.167	2.833	4.255	6.346	9.04	12.02	14.07	18.48
8	1.647	2.733	3.490	5.071	7.344	10.22	13.36	15.51	20.09
9	2.088	3.325	4.168	5.899	8.343	11.39	14.68	16.92	21.67
10	2.558	3.940	4.865	6.737	9.342	12.55	15.99	18.31	23.21

Graph 1: Bar graph representing the count of prevalence of dropped shoulders by comparing group A and group B



The bar graph shows that the prevalence of dropped shoulders is mostly seen in the subjects carrying heavy backpack of more than 10% of their bodyweight.

Graph 2: The line diagram shows that there is a linear relationship between weight of backpack and bodyweight of subject.



The line graph showing linear relationship between weight of backpack and bodyweight of subject along with prevalence of dropped shoulders.

DISCUSSION

Now-a-days, use of backpack has been increased significantly because of several factors including unavailability of lockers at college, increased homework, unavailability of smart boards, larger textbooks and other subjects being carried to college. Heavy backpack weight can lead to many musculoskeletal disorders in population like dropped shoulders, foot blisters, stress fractures, low back injuries and rucksack palsy. Symptoms like pain, alteration of posture, muscle weakness due to excessive overloading can lead to prolonged damage to the body.

The aim of our research was to study the relationship between weight of backpack and prevalence of dropped shoulders in college going students.

Consent was signed and data was collected from Group A and Group B. Data was analyzed by using chi square test for Group A as well as Group B.

Mean bodyweight of the subjects in Group A was found to be 59±10.40 and mean backpack weight of the subjects in Group A was found to be 6.51±1.02. Calculated p value is 1.55416E-21 which is less than 0.05($p<0.05$) shows significant relationship between weight of backpack and prevalence of dropped shoulders in group A i.e., more the backpack load high is the prevalence of dropped shoulders.

Mean bodyweight of the subjects in Group B was found to be 59.41±10.91 and mean backpack weight of the subjects in Group B was found to be 4.17±1.27. Calculate p value is 1.45416E-21 which is less than 0.05($p<0.05$) shows significant relationship between backpack weight and prevalence of dropped shoulders in Group B

We have found prevalence of dropped shoulders in both the groups i.e Group A (P value=1.55416E-21<0.05) and Group B (P value=1.45416E-21<0.05). Our results also illustrate that Group A (non-standard) shows high prevalence of dropped shoulders in comparison with Group B (standard) which shows less prevalence of dropped shoulders.

The findings of our result is similar with the study conducted by Vaghela N et.al 2019 who observed the effect of backpack loading on cervical and sagittal shoulder posture in standing and dynamic activity and revealed that there is significant reduction in the CVA, increase in CHA and SSP while carrying a backpack weight 18% of their bodyweight over both shoulders.

A study by Zakeri Y et.al in (2016) to find the prevalence of scoliosis, lordosis, kyphosis along with dropped shoulders in elementary students which carrying heavy backpack demonstrated that non-standard weight increases the prevalence of spinal as well as shoulder deformities which can endanger the physical health of the future society.

Mackie H et.al in (2014) studied postural and subjective responses for backpack carriage and, found that posture, RPE and muscular strain and perceived ability to walk and balance were significantly affected when student's backpack load reached 10% of their bodyweight.

Heavy backpacks (more than 10% of body weight) can alter the normal biomechanics of body in such a way that all the neck, back and abdominal muscles which work in synergy to help an individual carry a heavy load like a backpack gets stressed due to excessive weight of backpacks. Muscles which are involved in lifting of heavy backpack load are deltoid, trapezius including all the 3 fibres i.e., upper, middle and lower trapezius fibres, levator scapulae, supraspinatus, infraspinatus, teres major and minor, pectoralis major and minor, latissimus dorsi along with sternocleidomastoid. This overloading on the muscles causes fatigue resulting into muscle weakness and alteration of posture. Such biomechanical alterations make the body unsuitable for performing certain activities of daily living (ADL's).

Findings of these studies suggest that we should take all necessary measure to reduce the backpack weight

and students should also be guided for proper techniques of lifting backpacks. Moreover backpack designs should also be considered as an important factor to minimize the postural alteration which give rise to pain and discomfort among the population.

Conclusion

From the results it is concluded that there is high prevalence of dropped shoulders among 20 to 25 years of individuals carrying heavy backpack loads.

In summary, significant difference was found while comparing the subjects carrying heavy backpack i.e., > 10% of their bodyweight with the subjects carrying less heavy backpack i.e., ≤ 10% of their bodyweight. This implies that the weight of the backpack has an effect on alteration of shoulder posture, suggesting that carrying a backpack weighing more than 10% of bodyweight would be too heavy for college students aged 20 to 25 years to be able to maintain their normal postural alignment- in other words, carrying a load less than 10% of bodyweight could be recommended.

Limitations

1. The sample size of this study was less.
2. Postural alterations other than dropped shoulders were not included in this study.
3. In gender distribution, the female ratio was more than the male ratio.
4. In our study, type of backpack was not taken into consideration.
5. The study has just focused on bodyweight and not on body type.

Suggestions and Future scope

1. A similar study can be done while considering a larger population.
2. Study can also be done on various age groups.
3. Various outcome measures such as photography method, X-ray, posture analysis using EMG and biofeedback can be used.
4. Further studies should take account of body type as an important factor.
5. Studies can be done using both the genders differently, in order to check whether there is any significant role of gender in relation to postural alteration.

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