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FREQUENCY AND ASSOCIATION OF SCOLIOSIS AMONG MIDDLE-AGED SCHOOL CHILDREN DUE TO HEAVY BAG PACKS THROUGH SCOLIOMETER

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Abstract

Background: *Scoliosis is a spinal deformity characterized by an abnormal S-shaped lateral curvature that disrupts normal spinal growth. As the condition progresses, it significantly impacts body posture, and pulmonary functions by reducing chest wall mobility and lung compliance. This leads to an increased respiratory rate at rest, during physical activity, and even during sleep. Recent studies estimate the prevalence of adolescent idiopathic scoliosis to range between 1% and 3%. Early detection of scoliosis is crucial to prevent further complications and deterioration of health.*

Objective: *The aim of the study is to determine the frequency and association of scoliosis in middle aged school children with use of heavy bag pack.*

Methodology: *The research was performed by the students of Sindh Institute of Physical Medicine and Rehabilitation (SIPMR). In the research, observational cross-sectional study was used as a study design. Sample size included 357 middle school children of grade 6 to 8 in Karachi, Pakistan. Adam's forward bending test was used in this study to check scoliosis and scoliometer was used to find the trunk angle rotation of spine. It was Found that whose trunk angle rotation was greater than 5 degrees than the subject had scoliosis.*

Results: *A total of 357 students of grade sixth, seventh and eighth have been enrolled in this study. Among these 164 were boys and 192 were girls. 81.8% 0f students have bag weight is >10% of body weight. 35.9% of students were diagnosed with scoliosis.*

Conclusion: *The frequency of scoliosis middle school children has higher frequency that is 35.9% .it is concluded that the increased amount of scoliosis in student is not due to improper carrying of Bag or heavy weight of bag. Early detection of scoliosis can prevent our future generation from the disabilities.*

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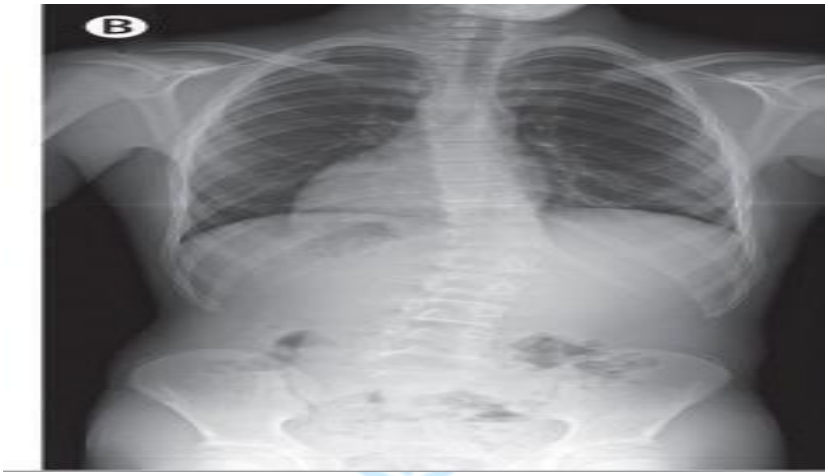
INTRODUCTION

Scoliosis is an abnormal sideways curve of the spine with a curve angle of greater than 10 degrees (Heriyani, Prayudha, & Pratama, 2018). There are three types of scoliosis infantile, juvenile and adolescent (Safikhani, Fakor, Soori, & Hejazian, 2006). Infantile scoliosis develops at the age of 0–3 years and shows a prevalence of 1 %. (Mau, 1981), Juvenile scoliosis develops at the age of 4–10 years and comprises 10–15 % of all idiopathic scoliosis in children (Coillard, Circo, & Rivard, 2010) (AIS) arises at the age of 11–18 years or around puberty. Scoliosis develops faster at the age of puberty. Slight abnormality in the body structure at growth spurt period may become severe if it is not detected earlier. The growth spurt in young women occurs at the age of 10–12 years and in men 13 –14years (Safikhani et al., 2006)



Backbone is basically made up of small vertebral segments that are cervical, thoracic, lumbar and sacral segments. The small vertebrae are connected by soft tissues such as cartilage and small underlying back muscles, all these helps to maintain the natural curves of spine that help the body to stay upright, sit, stand and walk properly. Mostly scoliosis is asymptomatic and patient rarely complaint of back pain. Abnormalities related to scoliosis in patients also depends on the region of the spine. According to the name of the region of spine, scoliosis is also named as 'thoracic scoliosis', 'lumbar scoliosis' or 'thoracolumbar scoliosis. Abnormality in the natural curve of spine effects the body posture and causes asymmetry in the body alignment such as uneven shoulder, hip alignment and much more. In result of this the gait pattern of the person also affected.

Asymmetric degeneration increases the load on one side of body which leads to a progression of degeneration and deformities. Involvement of the thoracic spine (alone or in combination with the lumbar spine) is primarily responsible for the respiratory complications due to scoliosis. It hinders the movement of ribs as well as the lung compliance that increases the rate of breath (Tsiligiannis & Grivas, 2012). If the cobb's angle is >45deg than surgical intervention is needed. That's why early detection of scoliosis in adolescent is important and recommended by the professionals. It decreases the surgical intervention for treating scoliosis (Torell, Nordwall, & Nachemson, 1981). Scoliosis detection in school-age children is an effective way to prevent the prevalence and progression of the disease.

The clinical manifestation of AIS could range from asymptomatic or minor complaints to major cardiopulmonary and neurological symptoms (Heriyani et al., 2018) but in school-going children, there may be contributing factors that may cause scoliosis such as heavy backpacks, way of carrying bags, etc. School bags are a mandatory part of a student's life. With the passage of time, the weight of school bags increases which may alter the body posture of students. According to the American Academy of Orthopedic Surgeons, the weight of school bags

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should not exceed 15%of body weight and according to the American Physical Therapy Association (APTA), the weight of bags should not exceed 10% of their body weight (Jurak, Rađenović, Bolčević, Bartolac, & Medved, 2019).

The rate of scoliosis is increasing internationally in school-going children which forestalls the progressivity of scoliosis further and postural changes. Studies have shown that the AIS prevalence varies between 0.35% to 5.2%, and it is generally accepted to have an average of 2%–3% in children under age 16 (Scaturro et al., 2021; Yılmaz, Zateri, Ozkan, Kayalar, & Berk, 2020).

Even minor progressing scoliosis can lead adolescents to disabilities and challenges in their daily activities. Continuously carrying heavy bags causes stress on the vertebral section and alters the normal spinal curvature. These spinal changes can restrict normal development in children. There is very little research that has been done on the prevalence of AIS and the influence of school bags on the posture of school-going children. However, the significant component that causes scoliosis in school-going children is yet unidentified. So the study aimed to find out the frequency and association of scoliosis among middle school children due to heavy backpacks through a scoliometer.

Scoliosis has become a common problem among school children due to the heavy load on the spine. School-going adolescents have no idea of self-care or about managing their heavy bags and usually carry bags on one side, it causes postural changes and influences the formative development in children. The data will help the analysts to set the gauge for future investigations about scoliosis. The clinicians will get help from these findings to take preventive steps for the patients related to this condition. The researcher will inform the parents of the students who have a deviation of greater than 10 degrees and advise them for further follow-up. The Ministry of Well-being and the Service of Training should cooperate and put scoliosis examination inside the standard assessment of students.

Literature Review:

Epidemiological studies reported that approximately 2-3% of school children worldwide are affected with scoliosis, risk factors including gender, genetics, and external factors like sitting posture, and heavy bag packs (Hresko, 2013; Konieczny, Senyurt, & Krauspe, 2013). In school-going children, the use of heavy backpacks, carrying bags on one side, and inappropriate sitting posture are widespread. This causes disturbance in the spine or may lead to scoliosis in adolescents. It also leads to musculoskeletal pain and postural disturbance. A meta-analysis concluded that there is a greater percentage of lumbar region deformity in middle school students and this might be due to the peak growth rate in females (Taleschian-Tabrizi et al., 2022). In contrast to this study, another systematic review by Yamato et al. stated that back pain was not strongly associated with heavy bags in school children (Yamato, Maher, Traeger, Wiliams, & Kamper, 2018). Tahirbegolli et al. investigated the factors causing idiopathic scoliosis in children. The study reported that 26.1% of female students have trunck angle rotation > 5deg but the factors causing scoliosis were not clearly stated in the study (Tahirbegolli et al., 2021). Kahlid et al. assessed the whether way of carrying bags caused scoliosis in students or not. This cross-sectional study reported that an average of 68.3% carry a bag on one side of the shoulder. Students who carried single-strap bags were more prone to scoliosis and neck and shoulder region pain (Kahlid et al., 2022). A study conducted in India used the scoliometer mobile app for the screening of scoliosis among school children and reported that 3.4% had positive scoliosis and 0.7% had scoliosis >7o using the scoliometer app (Talasila, Gorantla, & Thomas, 2017). In contrast to this, Hu et al. found the prevalence of AIS in China's schools by using the Adams forward bending test and scoliometer was 2.00% (Hu et al., 2022). An epidemiological study estimated the prevalence of AIS in Turkey was 2.3%. the investigator uses radiological confirmation of scoliosis after diagnosis through a scoliometer and Adams test (Yılmaz et al., 2020). Another study reported the prevalence rate of AIS in students was 2.93%. It concluded that school-based screening for scoliosis is important. The earlier detection of scoliosis will prevent further complications and reduce surgical interventions for scoliosis (Komang-Agung, Dwi-Purnomo, & Susilowati, 2017).

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The literature established a strong relationship between scoliosis and school-going children. However, few studies gave robust evidence on factors causing scoliosis in students. So, this cross-sectional study aimed to investigate the frequency of scoliosis in Karachi schools and also its association with heavy backpacks of students. Heavy backpacks force children to adjust their posture to compensate for the additional weight, often leading to abnormal spinal stress (Brackley, Stevenson, & Selinger, 2009).). When carried on one shoulder, the uneven weight distribution can cause compensatory scoliosis, which may become permanent if not addressed early and be the major contributor of causing spinal deformity in students (Lindstrom-Hazel, 2009; Rai & Agarawal, 2013).

Methodology

An observational cross-study was conducted to investigate the frequency of scoliosis among middle school children in South District, Karachi. In this study, 357 sample sizes of students from randomly selected schools were taken. The minimum sample size for this research was calculated using the open epi version 3 with a 95% confidence interval and 5% margin error. Whereas previous frequency was 36.73%. The sample was determined by a convenient sampling method to collect data after getting prior permission from the institutional review board (IRB). The 357 participants were recruited from the south district of Karachi who fit in the inclusion criteria. Self-designed questionnaires were distributed among participants

Participants were enrolled based on inclusion and exclusion criteria.

Inclusion criteria were made as Students must be between the grade of 6 to 8 to participate in the program between the age group of 11-15 years. Both male and female students were taken equally and who had already been diagnosed with scoliosis or who were being treated for it. Exclusion criteria were made as students who had spinal fractures or any congenital deformity were not taken in the study as a participant. A written informed consent was given to the students, who did not consent was excluded from the study. The questionnaire was thoroughly explained before the participant filled it. Before going through the procedure, students were guided for

measurements of Axial Trunk Rotation (ATR) and weight of their bags and other anthropometric measurements. To determine the severity of scoliosis Adams forward bending test was performed along with the scoliometer (Senkoylu, Ilhan, Altun, Samartzis, & Luk, 2021).

If the deviation of spine was found less than 5 degrees, the spine was considered as a normal, and if the deviation was greater than 5 degrees, the spine was considered as scoliotic (Prowse, Pope, Gerdhem, & Abbott, 2016). Those with scoliometer readings of more than 5° were suggested for further opinions to prevent later complications. Frequency rates were calculated for scoliosis at a predefined Cobb angle of 10° and 5°, the latter for comparison with the previous frequency and prevalence related study, Curve type and distribution over spine was considered.

Study variable was demonstrated as a dependent which was axial trunk rotation and Independent were school bag and age, Self-design questionnaire was distributed among participants and anthropometric

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were variables were i.e. height, body weight, and school bag were measured. A scoliometer was used to measure the Axial trunk rotation. Data was entered and analyzed using the statistical package of spss version 21. Frequencies and percentages were reported for categorical variables. Mean and SD was used to report continuous data and the chi-square test was used to find the association of different variables.

Data Analysis Procedure:

IBM spss licensed version 21 descriptive test and the standardized tool of frequency and percentages was used for the analysis of data. Frequency distribution and cross-tabulation were applied to find out the frequency and association of scoliosis among middle school children. Results are shown in the form of tables, pie charts, and bar charts.

Results

A total 357 students were included in the study. The mean ± SD of age was 13.22 ± 1.41 years. The gender distribution of students participated in the study were 45.9% males and 53.8% females. Of the total participants 144 were of sixth class students, 135 were of seventh class students, and 78 were eighth class students.

81.8% of students have bag weight is >10% of body weight. (table 1)

Characteristic	N	%
Gender		
Girls	164	45.9
Boys	192	53.8
Class		
Sixth	144	40.3
Seventh	135	37.8
Eight	78	21.8
Carrying school bag		
Single shoulder	107	30.0
Double shoulder	243	68.1
Trolley case	7	2.0
Mode of travel		

Table 1: Frequencies.

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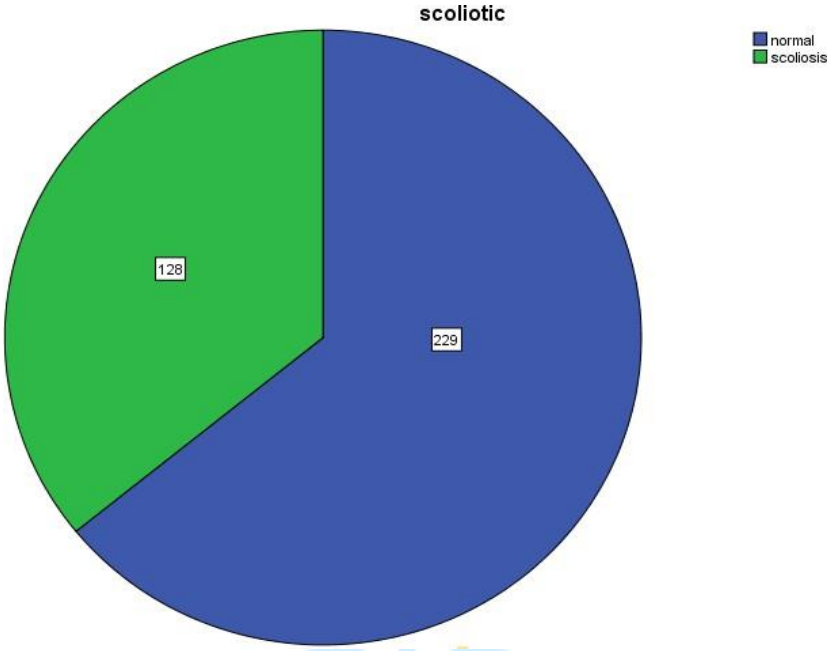

Out of 357 students 128 students have scoliosis.

There is a statistically significant difference found between scoliotic and classes. Students of class seven have greater percentage of scoliosis.

	Classes			P_value
	6th	7th	8th	
Scoliotic normal scoliosis	91	79	59	0.041
	53 (36.80%)	56 (41.48%)	19 (24.35%)	
Total	144	135	78	357

Table 2 Association of class with scoliosis

chi- square test applied, p-value < 0.05 taken as significant.
But there no statistically significant difference was found in frequency distribution of heavy bagpacks to scoliosis. (table 3)

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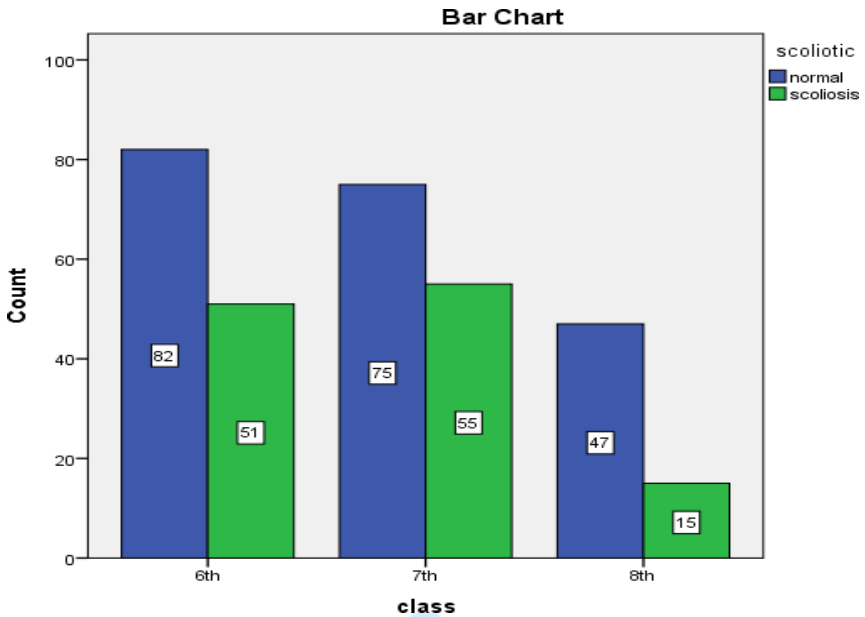

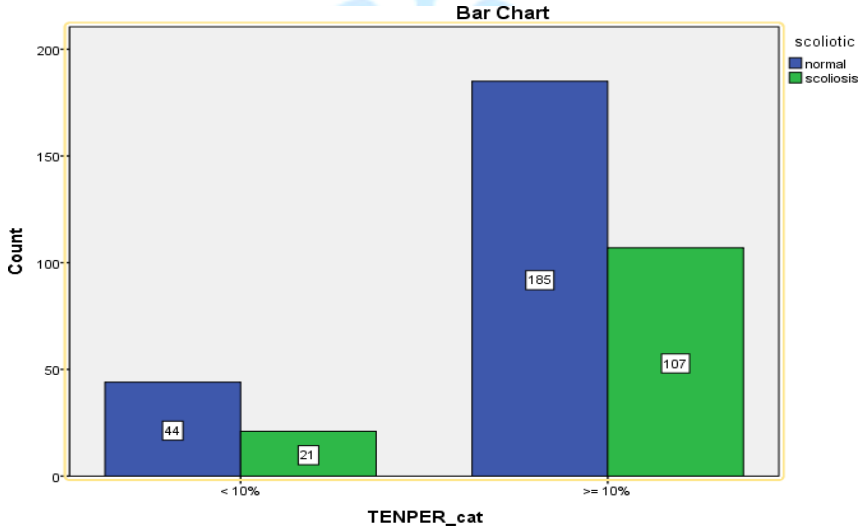

Table 3 Association of scoliosis with heavy bagpacks.

	Bag weight		p-value
	<10%	>=10%	
Scoliotic normal	44	185	0.510
abnormal	21	107	
total	65	292	357

Chi square test is applied, p-value is > 0.05 taken as insignificant.

There is no significant relation found between scoliosis and bmi. Out of total majority of students carrying bag on their both shoulders (243, 68.1%), travel through bus (166 , 46.5%) and carrying bag four times a day (242 , 67.8%).

Discussion:

The spine structurally and functionally plays an important role in the biomechanics of the human

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body changes in spine structure cause changes in biomechanics. Studies reported that rib deformities are adapted due to lateral force imposed by the scoliotic spine (Barba, Ignasiak, Villa, Galbusera, & Bassani, 2021; Wren et al., 2017) In the current study scoliometer scale is used for assessing the angle of trunk rotation in middle school children of Karachi, whereas Previous studies have used different assessment tools, android application for visual analysis and another study done by Daniel M. Coelho used the scoliometer to measure the scoliotic curvature of participants (Coelho, Bonagamba, & Oliveira, 2013). This study was designed to find the frequency and association of scoliosis with heavy backpacks among middle school children. It was conducted on middle school children from grade 6 to 8 and both genders (boys and girls) were included. In this study, 357 participants were included from which 35.9% of students have trunk angle rotation >5 degrees which was considered as scoliotic while in other countries the percentage of AIS is less than this like China 1.02%, Turkey 2.3%, Indonesia 2.93%, Germany 5.2%.% (Hu et al., 2022; Kamtsiuris, Atzpodien, Ellert, Schlack, & Schlaud, 2007; Komang-Agung et al., 2017; Yılmaz et al., 2020; Zhang et al., 2015). The highest frequency of scoliosis is seen among the students of seventh grade (41.48%) than those in the sixth grade (36.80%) and then those in the eighth grade (24.35%). Another study done by Heriyani et al. reported that the percentage of scoliosis is greater in students of aged >10 years (27.5%) than students aged <10 years (25.29%) (Heriyani et al., 2018). There is a statistically significant difference found in the class to scoliosis ($p < 0.05$).

The association between scoliosis and BMI with scoliosis is insignificant. 81.8% of students have bag weight is >10% of body weight.

The Asymmetry of carrying a Bag and the heavy weight of the bag pack affect students' body structure and spine according to literature but the results show that about 107 (30%) students carry a Bag on a single shoulder and 243 (68.1%) students carry the bag on a double shoulder. So there is no significant relationship between the way of carrying a bag and scoliosis (Drzał-Grabiec, Snela, Rachwał, Podgórska, & Rykała, 2015; Korovessis, Koureas, & Papazisis, 2004; Suri, Shojaei, & Bazrgari, 2020)

Female students have a greater percentage of potential scoliosis (36.73% with scoliometer and 16.33% with visual inspection) than male students (19.23% and 5.13%) (Menger & Sin, 2023). similarly, in current study scoliometer used for the examination of scoliosis in students the result shows 35.9% of student's scoliotic in nature. scoliosis can also be analysed by observational assessment because it causes the asymmetry at shoulder, spine or imbalance of overall posture (Calloni, Huisman, Poretti, & Soares, 2017).

Scoliometer is the scoliotic scale the measures the angle of trunk rotation if the angle is greater than >5 that individual diagnose the scoliosis. those students and their parents should be counselled and that individual should the refer for further examination. Through this study it is concluded that heavyweight of bagpack cannot lead students to scoliosis. there is no significant association of heavy weight of bag pack and scoliosis

The result indicated that the frequency of scoliosis in middle age school children increased with age. Developing of scoliosis causes change in posture, musculoskeletal and gait problems (Janicki & Alman, 2007). While performing the scoliometer examination researcher asked for back pain in students with scoliosis but students did not complain about back pain. According to the study done by Ramirez et al. there is no significant difference found between scoliosis and back pain (Ramirez, CHARLES E JOHNSTON, & Browne, 1997). This study will significantly help the analyst to set the gauge for future investigation about scoliosis. The clinician will get help from these findings to take preventive steps for the patient related to their condition. The individual whose ATR > 5 will be referred for further follow-ups so we can prevent the progressivity of scoliosis.

Limitations:

The sample size of the study was small and a limited number of schools were selected from Karachi. So, the generalizability of the results of the current study is questionable. The students diagnosed with scoliosis were not referred for further X-ray examination. Due to lack of time, researchers were not able to conduct the counseling session for individual whose ATR >5 and yet now through these result the modification of

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school bagpack weight is not possible until the further examination of other school students should be needed.

Strength of Study:

Through this research, it cannot just evaluate the frequency of scoliosis in middle school children but we take special consideration of heavy bag pack weight as a confounding factor of scoliosis in students . Previously no other study taken place in karachi schools related to scoliosis associated with heavy bagpack.

Weakness of Study:

This study can't further proceed due to lack of resources. we cannot take follow ups on participant whose ATR is >5. The study is limited to the students of karachi District South schools.

Conclusion

The frequency of scoliosis middle school children has higher frequency that is 35.9% .it is concluded that the increased amount of scoliosis in student is not due to improper carrying of Bag or heavy weight of bag. Early detection of scoliosis can prevent our future generation from the disabilities.

Recommendations

Through the results of this study, we can further conduct this assessment in other schools. We can modify the bag weights according to time table of students' daily classes. We can conduct the awareness sessions in different school for the awareness and hazards or heavy weights of bag pack in future.

Conflict of interest:

There is no conflict of interest.

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