Prevalence of Musculoskeletal Disorder among Preparatory School Children in Egypt

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Abstract

Background and Objective: To investigate the prevalence of musculoskeletal pain, detect spinal deformities, and identify the prevalence of poor posture and the main risk factors among school children in the Sharqiyah government. **Material and Methods:** Three hundred seven preparatory-grades students participated in this study. Their age ranged from 11 to 15 years. Musculoskeletal symptoms were investigated using Nordic Musculoskeletal Questionnaire (NMQ) via direct interviewing. Child and bag weight was assessed using a digital scale, and a scoliometer was used to evaluate the lateral curvature of the thoracic region. **Results:** There were a higher prevalence of neck, shoulder, upper, and lower back pain amongst the students of the three grades, with a significant association between BMI, gender, and exercises as risk factor for developing a musculoskeletal disorder. There was no significant spinal deviation except for students in preparatory I. **Conclusion:** musculoskeletal disorders are prevalent among preparatory school students, which could be a permanent problem in adulthood if not managed appropriately. Preventive measures should be considered to minimize musculoskeletal problems among children.

Key Words: Musculoskeletal symptoms, preparatory school children, sciliometer.

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Introduction:

During critical children's developmental stages, children spend much time in schools with many ergonomic hazards in the school setting, and behavior forms specified to children make them at higher risk of environmental dangers than adults [1].

School environments should be focused on applying ergonomic principles. Fatigue, musculoskeletal pain, spinal deviations, shoulder level changes, injuries, as well as psychological disorders are only some of the adverse outcomes that can result from a lack of fit between a student's body dimensions and the dimensions of school furniture, as well as unhealthy bag behavior. Children are the promising productive generation that will contribute to a country's economic growth and development; therefore, they must be given the opportunities they need to succeed in a healthy environment. However, there has been a lack of coordinated effort to spread ergonomic ideas to healthcare professionals and other stakeholders in children's health [2].

Many factors can influence students' sitting posture in regular school environments, containing anthropometric measures of school children as well as school furniture's dimension and design aspects [3].

Sitting position performed by children in school may lead to musculoskeletal disorders. Children usually sit in bad postures with their trunk, back, and neck flexed or rotated for a prolonged time in the classroom and in-home activities. When the students' posture is compromised by awkward body posture while sitting, putting the heavy carrying of school bags, which remains a yearly problem, can damage and danger their musculoskeletal system [4,5].

Musculoskeletal system disorders affect adults and are becoming more common in children. The worldwide published research has information about musculoskeletal problems. Physical deformities progress over time and cause several complications in individuals if not corrected timely. The consequences of incorrect posture are broad, so they can be evaluated in terms of physical, psychological, social, and economic contemplation [6].

A significant meta-analysis found that about 30 percent of children aged 11 or 17 had terrible posture, whereas 30-50 percent of adolescents had back pain; the prevalence increases with age [7].

The weight of school backpacks varies depending on the day of the week, the educational concepts of the school, as well as the students themselves. The estimated average weight differs considerably from the prior literature. Most studies, however, demonstrate that the weights lifted by schoolchildren are far greater than the suggested limits [8,9].

The Nordic musculoskeletal questionnaire (NMQ) can be administered as either a questionnaire or a structured interview. It was created as a result of a project supported by the Nordic Council of Ministers. The goal was to develop and evaluate a standardized questionnaire approach allowing comparisons of lower back, neck, shoulder, and overall complaints about using it in epidemiological research [10,11,12].

Force, repetitions, and abnormal postures are the primary risk factors for musculoskeletal disorders (MSDs). MSDs can be caused by any of these factors or by a combination of them. The structure of the equipment, environment, workplace arrangement, and essential duties should be assessed when trying to lower the risk factor. Following the development and implementation of appropriate ergonomic interventions, employees are less exposed to the risk factor probability of getting MSDs [13,14].

A scoliometer is a small, non-invasive inclinometer; it is a protractor used to measure the vertebral rotation and rib humping seen in scoliosis with the forward-bending test. Scoliometer is commonly used in school screenings [15,16].

Therefore, this study aimed to investigate the following among school children in the Sharqiyah government:

- The prevalence of musculoskeletal pain.
- Identify the prevalence of poor posture and the main risk factors.
- Detecting spinal deformities.

Methods:

Design:

The study was a randomized screening trial. Individuals and their assessors were blinded to the hypothesis of the study. Written informed consent was obtained, and the procedures followed were consistent with the clearance granted by the Institutional Ethical Committee (Heliopolis University).

Ethical committee **NO. HU.REC. H.8-2022**

I- Subjects:

School children of both sexes, ages ranging from 11 to 15 years, with the following criteria, would participate in this study:

1. Normal students with no congenital anomalies, injuries, or mental disturbances.
2. Three hundred seven pupils from preparatory school in Sharqiyah governorate.

Materials and methods:

1- Musculoskeletal symptoms were investigated using Nordic Musculoskeletal Questionnaire (NMQ) via direct interviewing [10,12].

2- Child and bag weight was assessed using a digital scale.

3- Scoliometere was used to assess the lateral curvature of the thoracic region.

Procedures:

1. Each child in the study was screened via the questionnaire.
2. Both the child and his school bag were weighed on a digital scale.
3. Informed consent to participate in this study was taken from parents or school guardians.
4. Scoliometer measured any deviation of the thoracic curve by putting the apparatus while the child was forward bending.

Confidentiality:

The investigator ensured that the subjects pseudonymously would be maintained on all documents, and subjects were identified by code. The investigators maintained a separate log for decoding subjects. Also, they carried signed informed consent for each subject in strict confidence. The investigators kept all study documents and subjects' data in separate lockers with limited access to the study personnel.

Randomization method:

A cluster sampling was followed by choosing schools representative for every governmental, or experimental school category.

Sample size calculation & statistical method:

χ^2 tests - Variance: Difference from constant (one sample case)

Analysis: A priori: Compute the required sample size

Input: Tail(s) = One

Ratio var1/var0 = 1.3056

α err prob = 0.05

Power (1-β err prob) = 0.95

Output: Lower critical χ^2 = 347.7963

Upper critical χ^2 = 347.7963

Df = 306

Total sample size = 307

Actual power = 0.9504047

Based on the above calculation, the recommended sample size is 307.

Statistical analysis:

Descriptive statistics of frequencies as well as percentages were used to present the subjects' demographic and musculoskeletal complaints data. One-way ANOVA was conducted to compare the grades' anthropometric, bag weight, and scoliometer measurements. The prevalence of musculoskeletal complaints at every anatomical location was calculated. The association among subjects' characteristics, risk factors, and musculoskeletal complaints were analyzed utilizing the Chi-square test of association and logistic regression. The 5% level of probability represented statistical significance. The statistics package for social sciences (SPSS) edition 25 for Windows was used to conduct all statistical analyses (IBM SPSS, Chicago, IL, USA).

Subjects' characteristics

307 primary-grade students participated in this study. Their age ranged from 11 to 15 years. 49.5% of the subjects were girls, and 50.5% were boys. 60.3% of students were normal weight, and 42.7% participated in exercises. **(Table 1)** shows the subjects' characteristics.

Results

Anthropometric, bag weight, and scoliometer measurement of the three grades:

The BMI of preparatory III students was significantly higher than that of students of preparatory I ($p < 0.01$), and no substantial difference between preparatory I and II ($p > 0.05$). There was no significant difference between grades in bag weight and scoliometer measurement ($p > 0.05$). **(Table 2).**

Table 1. Participants' characteristics

	N	%
Grade		
Preparatory 1	111	36.2
Preparatory II	73	23.8
Preparatory III	123	40.1
Gender		
Girls	152	49.5
Boys	155	50.5
Weight status		
Underweight (< 18.5 kg/m^2)	60	19.5
Normal weight (18.5–24.9 kg/m^2)	185	60.3
Overweight (25.0–29.9 kg/m^2)	51	16.6
Obese (≥ 30 kg/m^2)	11	3.6
Exercise		
Yes	131	42.7
No	176	57.3

Table 2. Anthropometric, bag weight, and scoliometer measurements of the three grades.

	Preparatory I	Preparatory II	Preparatory III	p-value
Age, mean ± (SD), years	11.92 ± 0.26	13.02 ± 0.16	14.18 ± 0.39	0.001
BMI, mean ± (SD), kg/m^2	21.03 ± 3.31	21.71 ± 4.57	22.60 ± 4.25	0.01
Bag weight (kg)	2.52 ± 0.50	2.59 ± 0.49	2.50 ± 0.50	0.51
Scoliometere (degrees)	2.91 ± 2.56	3.27 ± 3.01	3.32 ± 2.84	0.47

SD, standard deviation; p-value, level of significance; a significant difference

Prevalence of musculoskeletal complaints among students.

The common sites of musculoskeletal complaints among students were neck (38.8), shoulder (33.2%), upper back (26.4%), and lower back (20.8%). The least common sites of musculoskeletal complaint were hips (10.1%) and knees (13%). The highest complaint was in the neck in preparatory I (35.1%) and preparatory III students (44.7%), while the highest complaint in preparatory II was shoulder (37%). The other common sites of musculoskeletal complaints among students of preparatory I was shoulder (31.5%), upper back (27%), and ankle (26.1%); in preparatory II were neck (34.2), upper back (26%), and elbows (23.3%) and in preparatory III were shoulder (32.5%), upper back (26%) and lower back (22.8%). **(Table 3).**

Table 3. Prevalence of body part complaints among students:

Body Parts	Preparatory I		Preparatory II		Preparatory III		Total	
	N	%	N	%	N	%	N	%
Neck	39	**35.1**	25	**34.2**	55	**44.7**	119	**38.8**
Shoulders	35	**31.5**	27	**37**	40	**32.5**	102	**33.2**
Elbows	16	**14.4**	17	**23.3**	25	**20.3**	58	**18.9**
Wrist	19	**17.1**	10	**13.7**	26	**21.1**	55	**17.9**
Upper back	30	**27**	19	**26**	32	**26**	81	**26.4**
Lower back	27	**24.3**	9	**12.3**	28	**22.8**	64	**20.8**
Hips	9	**8.1**	3	**4.1**	19	**15.4**	31	**10.1**
Knees	13	**11.7**	9	**12.3**	18	**14.6**	40	**13**
Ankle	29	**26.1**	6	**8.2**	16	**13**	51	**16.6**

Associations of subjects' characteristics and prevalence of musculoskeletal complaints:

Comparison of the frequency of musculoskeletal complaints of the neck, shoulders, upper as well as lower back with subjects' characteristics indicates a significant difference in upper back complaints between gender as girls showed a higher percentage than boys ($p < 0.001$), a substantial difference in shoulder complains between weight status as students with obesity showed the higher percentage ($p < 0.001$) and a significant difference with exercises as students participating in exercises showed a lower percentage of the neck and upper back complains ($p < 0.001$). There was no substantial difference in musculoskeletal complaints between grades ($p > 0.05$). **(Table 4).**

Table 4. Association of participants' characteristics and prevalence of musculoskeletal complaints.

	Neck		Shoulders		Upper back		Lower back	
	Yes	No	Yes	No	Yes	No	Yes	No
Grade								
Preparatory 1	39 (35.1%)	72 (64.9%)	35 (31.5%)	76 (68.5%)	30 (27%)	81 (37%)	27 (24.3%)	84 (75.7%)
Preparatory II	25 34.2)%)	48 (65.8%)	27 (37%)	46 (63%)	19 (26%)	54 (74%)	9 (12.3%)	64 (87.7%)
Preparatory III	55 (44.7%)	68 (55.3%)	40 (32.5%)	83 (67.5%)	32 (26%)	91 (74%)	28 (22.8%)	95 (77.2%)
	χ^2 = 3.07 p = 0.21		**χ^2 = 0.63 p = 0.72**		**χ^2 = 0.03 p = 0.98**		**χ^2 = 4.29 p = 0.11**	
Gender								
Girls	64 (42.1%)	88 (57.9%)	43 (28.3%)	109 (71.7%)	59 (38.8%)	93 (61.2%)	29 (19.1%)	123 (80.9%)
Boys	55 (35.5%)	100 (64.5%)	59 (38.1%)	96 (61.9%)	22 (14.2%)	133 (85.8%)	35 (22.6%)	120 (77.4%)
	χ^2 = 1.41 p = 0.24		**χ^2 = 3.31 p = 0.07**		**χ^2 = 23.95 p = 0.001**		**χ^2 = 0.57 p = 0.45**	
Weight status								
Underweight	29 (48.3%)	31 (51.7%)	14 (23.3%)	46 (76.7%)	14 (23.3%)	46 (76.7%)	11 (18.3%)	49 (81.7%)
Normal weight	67 (36.2%)	118 (63.8%)	72 (38.9%)	113 (61.1%)	53 (28.6%)	132 (71.4%)	41 (22.2%)	144 (77.8%)
Overweight	21 (41.2%)	30 (58.8%)	11 (21.6%)	40 (78.4%)	12 (23.5%)	39 (76.5%)	10 (19.6%)	41 (80.4%)
Obese	2 (18.2%)	9 (81.8%)	5 (45.5%)	6 (54.4%)	2 (18.2%)	9 (81.8%)	2 (18.2%)	9 (81.8%)
	χ^2 = 4.76 p = 0.19		**χ^2 = 9.29 p = 0.02**		**χ^2 = 1.14 p = 0.77**		**χ^2 = 0.51 p = 0.91**	
Exercise								
Yes	31 (23.7%)	100 (76.3%)	49 (37.4%)	82 (62.6%)	18 (13.7%)	113 (86.3%)	29 (22.1%)	102 (77.9%)
No	88 (50%)	88 (50%)	53 (30.1%)	123 (69.9%)	63 (35.8%)	113 (64.2%)	35 (19.9%)	141 (80.1%)
	χ^2 = 21.94 p = 0.001		**χ^2 = 1.79 p = 0.18**		**χ^2 = 18.81 p = 0.001**		**χ^2 = 0.23 p = 0.63**	

χ^2, Chi-squared test; p-value, level of significance

Associations of musculoskeletal complaints with possible risk factors:

Neck complaints were significantly associated with grades. Preparatory II (odd = 0.54) and Preparatory III (odd = 0.5) had a lower probability than preparatory I. Neck complaints were significantly associated with the absence of exercise (odd = 3.74), while good spinal alignment (Scoliometere) had a lower probability of neck complaints (odd = 0.84).

Upper back complaints were significantly associated with girls (Odd = 3.26). Students who did not participate in the exercise had a higher probability of upper back complaints (odd = 2.54). **(Table 5).** Hip complaints were significantly associated with grades. Preparatory III had a lower probability than preparatory I (Odd = 0.14) and was significantly associated with Scoliometere (odd = 1.2). Knee complaints were significantly associated with BMI (odd = 1.22). Students who did not participate in the exercise had a higher probability of ankle complaints (odd = 1.12). **(Table 6).**

Table 5. Association of possible risk factors with neck, shoulders, upper, and lower back complaints:

	Neck		Shoulders		Upper back		Lower back	
	Odd ratio (95% CI)	p-value	Odd ratio (95% CI)	p-value	Odd ratio (95% CI)	p-value	Odd ratio (95% CI)	p-value
Grade (Preparatory 1)		0.04		0.68		0.88		0.14
Preparatory II	**0.54 (0.3-0.96)**	**0.03**	0.9 (0.51-1.58)	0.71	1.04 (0.55-1.98)	0.89	1.05 (0.56-1.96)	0.89
Preparatory III	**0.5 (0.26-0.98)**	**0.04**	1.2 (0.64-2.24)	0.57	1.2 (0.58-2.48)	0.62	0.47 (0.2-1.08)	0.07
Gender (girls)	0.98 (0.57-1.67)	0.93	0.78 (0.46-1.31)	0.35	**3.26 (1.79-5.96)**	**0.001**	0.76 (0.41-1.4)	0.37
BMI	0.96 (0.9-1.02)	0.22	0.96 (0.89-1.02)	0.18	1.01 (0.95-1.09)	0.68	1.02 (0.95-1.1)	0.53
Bag weight	1.23 (0.74-2.03)	0.42	0.83 (0.51-1.35)	0.44	0.99 (0.57-1.73)	0.97	0.87 (0.49-1.55)	0.64
Scilometer	**0.84 (0.76-0.93)**	**0.001**	1.02 (0.93-1.11)	0.66	0.93 (0.84-1.04)	0.20	0.95 (0.86-1.06)	0.37
Exercise (NO)	**3.74 (1.89-7.41)**	**0.001**	0.6 (0.31-1.16)	**0.13**	**2.54 (1.2-5.41)**	**0.01**	0.55 (0.25-1.23)	0.15

CI, confidence interval; p-value, level of significance

Table 6. Association of possible risk factors with elbows, wrist, hips, knees, and ankle complaints:

	Elbows		Wrist		Hips		Knees		Ankle	
	Odd ratio (95% CI)	p-value	Odd ratio (95% CI)	p-value	Odd ratio (95% CI)	p-value	Odd ratio (95% CI)	p-value	Odd ratio (95% CI)	p-value
Grade (Preparatory 1)		0.12		0.38		0.02		0.90		0.02
Preparatory II	0.53 (0.26-1.09)	0.09	0.79 (0.4-.55)	0.49	0.42 (0.15-1.18)	0.1	1.05 7(0.46-2.4)	0.90	**2.02 (1-4.1)**	0.05
Preparatory III	1.17 (0.56-2.46)	0.68	0.56 (0.25-1.28)	0.17	**0.14 (0.03-0.61)**	**0.009**	0.84 (0.33-2.14)	0.72	0.59 (0.21-1.63)	0.31
Gender (girls)	1.91 (0.99-3.68)	0.05	0.75 (0.39-1.42)	0.38	0.33 (0.11-1.01)	0.054	0.49 (0.22-1.06)	0.07	1.14 (0.56-2.26)	0.71
BMI	0.92 (0.85-1)	0.05	1.04 (0.97-1.12)	0.29	1.31 (0.59-0.85)	0.36	**1.22 (1.12-1.33)**	**0.001**	0.94 (0.87-1.03)	0.19
Bag weight	1.37 (0.74-2.52)	0.31	0.78 (0.43-.43)	0.42	1.4 (0.53-3.64)	0.49	0.63 (0.3-1.29)	0.20	1.15 (0.6-2.19)	0.67
Scoliometere	0.89 (0.79-1.01)	0.07	0.97 (0.87.08)	0.58	**1.2 (1.01-1.42)**	**0.03**	1.02 (0.9-1.15)	0.77	0.95 (0.84-1.08)	0.42
Exercise (NO)	1.84 (0.79-4.25)	0.15	1.37 (0.6-3.1)	0.45	0.41 (0.05-3.48)	0.41	0.6 (0.23-1.6)	0.31	1.12 (0.54-1.19)	0.001

CI, confidence interval; p-value, level of significance

Discussion

This study aimed to investigate the following among school children in the Sharqiyah government:

- The prevalence of musculoskeletal pain.
- Identify the prevalence of poor posture and the main risk factors.
- Detecting spinal deformities.

Our findings are consistent with those of **Fuglkjær et al. (2017)** [17], who searched with the assistance of a research librarian. Both MeSH words and free text were used for the related search terms in MEDLINE, while the subject header and abstract terms were utilized in EMBASE: "prevalence," "incidence," "musculoskeletal disorder," "musculoskeletal injury," "musculoskeletal pain," "extremity," "limb," "children," "adolescents," "pediatric." A total of 2660 titles were discovered in MEDLINE and EMBASE, and 29 papers could be read in full through reference searches. Lower-limb complaints were more prevalent than upper-limb complaints in both younger (aged 0–12) and older children (aged 10–19), with the ankle/foot and knee being the most frequent site of MEC. Two investigations found that ankle/foot complaints in younger children were around twice as common as knee complaints, compared to the previous study's findings of nearly equal prevalence rates for the two locations. 5 of the 6 studies found knee issues in older children were between 0.2 and 2.8 times more common than ankle/foot symptoms [18].

In the younger children, three of the general population studies classified the complaints of the lower extremities into a traumatic or non-traumatic mode of onset, but two were based on the same cohort of children. All three reported about two times more non-traumatic complaints than traumatic complaints [19].

In limited agreement with our results, **Abdelati et al. (2017)** [20] used a structured interview questionnaire to collect data about the socio-demographic characteristics of the students, leisure activities and school achievement of the students, family characteristics of students, musculoskeletal complaints related to school bag carriage by students, students' subjective perception of stability while carrying bag, students' knowledge about school bag characteristics, students' believes related to school bag use. Self-reported students' practices related to school bag use. They found that 44 % of students carried school bags that weighed

more than 10% of their body weight. Regarding the relative bag weight, students' mean relative bag weight was maximum in the fourth grade and decreased significantly and steadily in the sixth grade.

The proper method to utilize a backpack is to place the heaviest objects in the bag nearest to the child's back; nevertheless, doing so shifts the child's center of gravity and puts undue pressure on their back [21]. Using slanting partitions within the main compartment, a vertically arranged backpack load resulted in significantly less shoulder, neck, lower back, and overall perceived discomfort. A vertically arranged load would result in less torque on the shoulders due to the load center of mass being horizontally closer to the person's center of mass; Avoid twisting during lifting since it might harm the facet joints and intervertebral disks when accompanied by loads [22].

Furthermore, our result came in accordance with **Brackley et al. (2009)** [23] stated that in comparison to the high and mid load positions in the backpack, the lower load placement induced fewer shifts in cranio-vertebral angle from the first standing baseline test and more periodic variations in lumbar lordosis. They found that carrying a backpack centered at the third lumbar vertebra level (low on the back) was associated with the least postural displacement. Increased postural displacement and attenuated imbalance result from raising the center of mass during heavy load placement, which means the body needs more energy to keep equilibrium. According to previous research, a higher trunk inclination angle has been linked to excessive load placement [24].

The students' back, shoulder, and neck pain can be caused by postural changes while wearing the backpack; the postural changes will cause an increase in muscle activity that leads to muscle strain and, eventually, muscle soreness. Both the spinal column's relative orientation and the distribution of stresses within the spinal column are known to change in response to variations in trunk posture. This altered trunk posture may cause the body to experience strain, which may cause muscle fatigue and microtrauma and ultimately result in musculoskeletal problems. When children and young adults carry heavier and heavier backpacks, the weight puts pressure on their lumbar discs, leading to discomfort and perhaps long-term damage [20].

There was a significant association between obesity and excessive use of computers and phones. Viewing computer and phone screens decreases energy disbursement, less time performing physical activity, and increases their consumption of obesogenic foods. There is a relationship between obesity and musculoskeletal disorders [25].

Conclusion

There is a prevalence of musculoskeletal disorders amongst preparatory school students, which could be a permanent problem in adulthood if not managed appropriately. So, preventive measures should be considered to minimize musculoskeletal problems among children.

Conflict of interest

The authors confirmed that this article content has no conflict of interest.

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