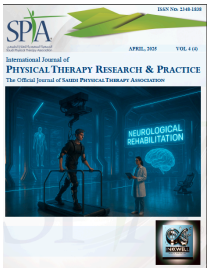

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Original Article

Parents' Perceptions of Backpack Use and Its Impact on Children's Musculoskeletal Health in Saudi Schools Over Three Semesters with Textbook Integration

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Abstract

Background: Musculoskeletal disorders are increasingly common among children, particularly due to heavy backpacks or improper backpack usage in school. In Saudi schools, the integration of heavier textbooks has exacerbated this issue, raising concerns about children's long-term musculoskeletal health. This study explores parents' perceptions of backpack use and its impact on their children's musculoskeletal health during the integration of textbooks over three consecutive semesters. **Methods:** An observational cross-sectional study was conducted from June 1 to August 11, 2024, in Saudi Arabia. Parents or guardians of students from schools implementing textbook integration for three consecutive semesters were recruited through convenience sampling. Data were collected using an online questionnaire. Descriptive statistics summarized the data, while Chi-square, Fisher's exact tests, and One-way ANOVA were used to analyze the influence of sociodemographic factors on perceptions using SPSS version 28, with a significance level of $p < 0.05$. **Results:** The study included 715 participants, primarily mothers (63.9%) and married individuals (86.8%). Most parents had a university education or higher (fathers 68.8%, mothers 65.3%), with fathers mostly employed in the governmental sector (61.9%). Half of the mothers were not working (50.7%), and 38.4% of families had a monthly income over 15,000 SAR. 81.5% of children carrying shoulder bags, 58.0% of which they chose themselves. Half spent under 15 minutes transporting their bags, mainly by private car (69.5%). A significant 81.0% of parents reported their child felt a sense of heaviness with the backpack, and 76.1% observed musculoskeletal issues, including shoulder pain (60.3%), fatigue (54.1%), neck pain (38.6%), upper back pain (39.5%), and low back pain (29.2%). Factors influencing discomfort included carrying shoulder bags ($p=0.001$), carrying bags for over 15 minutes ($p<0.001$), and walking to school ($p=0.008$). Overall, 59.2% exhibited inadequate knowledge, with married parents ($p<0.001$) and mothers ($p=0.008$) showing less knowledge. Fathers in the governmental sector had higher knowledge ($p=0.041$), as did mothers not working ($p=0.029$). Parents with children complaining of backpack-related heaviness had better knowledge ($p=0.001$), as did those with children in governmental schools ($p=0.031$). **Conclusion:** Heavy backpacks significantly affect children's musculoskeletal health, with prevalent complaints of pain and fatigue. Despite this, parents generally lack adequate knowledge about proper backpack usage. Educational programs are essential to improve awareness and promote proper backpack use, alongside recommendations to reduce textbook loads and integrate e-learning.

Keywords: Backpack Usage, Parents' Perceptions, Musculoskeletal Health, Children's Health, Textbook Integration.

Introduction

Musculoskeletal disorders are prevalent chronic non-communicable conditions that significantly contribute to disability rates in developed nations. These disorders consume a substantial portion of healthcare and social resources due to their wide prevalence and impact on individuals' functional abilities (Branco et al., 2016). Though it's a widespread habit, carrying school supplies in backpacks has gained attention since it's linked to musculoskeletal issues, including low back pain. This is especially important during the time of fast growth and development, when the soft tissues and bones experience amazing transformations, including the quick evolution of the spine's structure (Aundhakar et al., 2015; Minghelli et al., 2016). The weight of the backpack and how it affects the student's gait and posture can make them more susceptible to low back pain. Thus, it is imperative that these issues be resolved in order to protect children' musculoskeletal health throughout this vital stage of growth and development(Pau & Pau, 2010). Furthermore, most students do not carry their backpacks in the correct way (Layuk et al., 2020). Concern over school-age children and teenagers using backpacks has grown in recent times. The increasing prevalence of back pain, adverse postural alterations, and significant injury risk associated with excessive backpack-

carrying (Rateau, 2004). Synchronized with the integration of textbooks for three consecutive semesters which is the innovative educational system is designed to reshape our students in optimal ways, equipping them with the necessary skills and knowledge to become valuable human capital in the fiercely competitive labor market of the future, in the frame of 2030 inspiring vision (Nauzeer & Jaunky, 2021).

The literature reveals a concerning prevalence of musculoskeletal disorders among schoolchildren, particularly related to improper backpack usage. For instance, a cross-sectional study in 2017 found that 74.1% of participating schoolchildren reported back pain, with female students being five times more likely to experience this issue compared to their male counterparts (Ali El-Nagar, 2017). Similar findings were echoed in a study by Kellis (2010), reinforcing the trend observed in various educational contexts investigation (Puszczalowska-Lizis et al., 2021).

Further emphasizing this issue, a 2019 study focusing on parents of school-age children revealed that only a small percentage of mothers (37.6%) and fathers (36.9%) were aware of the risks associated with incorrect schoolbag weight and carrying techniques on spinal alignment and growth. Alarmingly, just 28.9% of mothers and 37.6% of fathers understood the recommended weight for schoolbags. Moreover, many parents did not routinely check their children's backpacks for unnecessary items (Alsiddiky et al., 2019). A 2020 study corroborated these findings, indicating that approximately 72% of children carried backpacks exceeding recommended weight limits, with parents reporting frequent complaints of neck (69%) and shoulder pain (78%) among these children (Dhakal Chalise et al., 2020).

Despite these insights, a gap remains in the literature regarding the impact of textbook integration on musculoskeletal health. Previous studies have primarily focused on the prevalence of musculoskeletal issues without addressing how the integration of heavier textbooks affects these outcomes. Consequently, This study aims to explore parents' perceptions of backpack usage and its impact on their children's musculoskeletal health during the integration of textbooks for three consecutive semesters. Specifically, it seeks to assess parents' awareness and understanding of the potential musculoskeletal health risks associated with this practice, and to explore their attitudes and concerns regarding their children's backpack usage. Additionally, the study aims to gather insights from parents on their expectations and suggestions for improving the integration of textbooks in a way that minimizes the impact on musculoskeletal health. Based on these findings, the study will provide recommendations to promote better backpack usage practices and safeguard the musculoskeletal health of high school students. Furthermore, the research will examine the effect of sociodemographic factors on parents' perceptions of backpack usage and its impact on their children's musculoskeletal health during the integration of textbooks across three semesters.

Methodology

Study Participants, Data Collection, Recruitment, and Sampling Technique

The study employed an observational, survey-based cross-sectional design, conducted from June 1, 2024, to August 11, 2024, in Saudi Arabia.

A convenience sampling technique was used to select participants, focusing on parents or guardians of school students in Saudi Arabia whose

children were enrolled in schools. Hospitals, primary centers, public parks, shopping centers, and social networking sites like X (previously Twitter), Telegram, and WhatsApp were among the places where participants were sought out.

Interested participants were sent to an online questionnaire, where they were informed about the purpose of the research and their rights as volunteers, and offered the opportunity to decline participation if they chose not to participate. A validated, reliable online questionnaire that was adapted from a previous study was used to gather data with permission (Alamer et al., 2022). The questionnaire was administered through Google Forms.

Data Collection Tool

We used a questionnaire consisting of two main sections. The first section included 17 questions covering demographic data (such as marital status, education, monthly income, occupation, and number of children...etc). The second section comprised 15 questions designed to gather insights into parents' perceptions of backpack usage and its impact on their children's musculoskeletal health. These questions explored parents' understanding of the potential health effects of backpack usage, their knowledge of proper backpack ergonomics, and their overall satisfaction with the implementation of the textbook integration system.

Inclusion and Exclusion Criteria

Parents or guardians of Saudi Arabian students currently enrolled in schools where textbook integration has been implemented for three semesters in three consecutive semesters were included in the study. Completing the online survey and giving informed consent were prerequisites for participation. The study did not include parents whose children were not enrolled in school, or who were incapable or unwilling to give informed consent or finish the online survey.

Sample Size

The study's total participant count of 714 exceeded the minimally necessary sample size of roughly 385 participants. Using the Raosoft sample size calculator, this minimum was determined with a 95% confidence level and a ±5% margin of error.

Data Analysis

Descriptive statistics, such as counts, percentages, and mean values with standard deviations, were used in the study to summarize the data. Using Chi-square and Fisher's exact tests for categorical variables and One-way ANOVA for numerical variables, the researchers looked at how parents' perceptions of backpack usage and its effects on their children's musculoskeletal health during the textbook integration period were influenced by sociodemographic factors. A p-value of less than 0.05 was considered statistically significant. The Statistical Package for Social Sciences (SPSS), version 28, was used for all statistical analyses.

Scoring System

To explore parents' perceptions of backpack usage for their children during the textbook integration period, a scoring system was developed. The scoring system consisted of 7 questions (1A, 2-7). Questions 1A to 5 were scored 1 point for a correct or "yes" response, while Question 6 was given 8 points and Question 7 was given 7 points for correct answers. The total score was 20 points. Parents who scored equal to or less than the mean score were considered to have inadequate knowledge,

while those who scored above the mean were deemed to have adequate knowledge.

Ethical Considerations

The study was approved with the designation REC/PEA/BU-FM/2023/82 by the Scientific Research and Ethics Committee, Faculty of Medicine, Al-Baha University. The questionnaire asked an introductory question in order to guarantee informed consent and preserve confidentiality. To secure the information, strict labeling and handling guidelines were put in place, and no personally identifiable information was gathered.

Results

The study included a total of 715 participants, the majority of whom were mothers (63.9%, n=456). Most participants were married (86.8%, n=620). Regarding educational attainment, 68.8% of fathers (n=491) and 65.3% of mothers (n=466) had a university education or above. Most fathers were employed in the governmental sector (61.9%, n=442), while half of the mothers were not working (50.7%, n=362). The majority of families had a monthly income of more than 15,000 SAR (38.4%, n=274), as presented in Table1.

Table 1. Demographics of Study Participants

Items		**n**	**%**
Respondent	Mother	456	63.9
	Father	192	26.9
	Sister	22	3.1
	Brother	34	4.8
	uncle or aunt	5	0.7
	Grand Father/Mother	5	0.7
	Mother	456	63.9
Marital status	Married	620	86.8
	Divorced	64	9.0
	Widow	30	4.2
Father education	Illiterate	21	2.9
	Secondary / below	202	28.3
	University / above	491	68.8
Mother education	Illiterate	17	2.4
	Secondary / below	231	32.4
	University / above	466	65.3
Father work	Not working	66	9.2
	Governmental sector	442	61.9
	Private sector	206	28.9
Mother work	Not working	362	50.7
	Governmental sector	254	35.6
	Private sector	98	13.7
Income status	Less than 5000 SAR	56	7.8
	From 5000 to 10,000 SAR	190	26.6
	From 10,000 to 15,000 SAR	194	27.2
	More than 15,000 SAR	274	38.4

Demographic and School-Related Characteristics of Children

The children had an average of 2.08 (SD=1.91) siblings, with 2.12 (SD=1.77) male and 2.0 (SD=1.91) female children on average. The mean age was 11.10 years (SD=3.84), with 55.3% male and 44.7% female. Most attended governmental schools (77.7%), carrying shoulder bags (81.5%) chosen by the child (58.0%). Half spent under 15 minutes transporting the bag, with 69.5% using private cars, 19.3% buses, and 11.2% walking to school, as presented in Table 2.

Table 2: Demographic and School-Related Characteristics of Children

Items		**n**	**%**
Number of children (Mean)	2.08	1.91	
Male children (Mean)	2.12	1.77	
Female children (Mean)	2.0	1.91	
Child age in years (Mean)	11.1	3.84	
Gender	Male	395	55.3
	Female	319	44.7
School type	Governmental	555	77.7
	Private	159	22.3
Type of school bag carried by the child	Shoulder bag	582	81.5
	Bag with wheels	132	18.5
Who chooses the schoolbag?	Parents	300	42.0
	The child	414	58.0
Time spent carrying the school bag	Less than 15 minutes	362	50.7
	More than 15 minutes	352	49.3
Mode of transportation to the school	Walking	80	11.2
	Bus	138	19.3
	Private car	496	69.5

Parental Assessment of Child's Backpack-Related Discomfort and Pain

The majority of parents (81.0%) reported that their child had complained about experiencing a sense of heaviness or burden associated with their backpack. Furthermore, 76.1% of parents had noticed musculoskeletal discomfort or pain in their child related to carrying a backpack during the integration of textbooks for three consecutive semesters. The most commonly reported issues were shoulder pain (60.3%), fatigue (54.1%), neck pain (38.6%), upper back pain (39.5%), and low back pain (29.2%). In terms of severity, 50.6% of parents rated the discomfort or pain as moderate, 26.3% as severe, and 21.3% as mild. Regarding frequency, 39.2% of children experienced the issues occasionally (2-3 times a month), 31.5% frequently (once a week), 15.8% very frequently (more than once a week), and 13.4% rarely (once a month or less) Table 3.

Table 3: Parental Assessment of Child's Backpack-Related Discomfort and Pain

Items		n	%
Has your child complained about experiencing a sense of heaviness or burden associated with their backpack?	No	136	19.0
	Yes	578	81.0
Have you noticed any musculoskeletal discomfort or pain in your child related to carrying a backpack during the integration of textbooks for three consecutive semesters?	No	171	23.9
	Yes	543	76.1
If yes, please state specifically:	Shoulder pain	327	60.3
	Fatigue	293	54.1
	Neck pain	209	38.6
	Upper back pain	214	39.5
	Low back pain	158	29.2
	Foot pain	78	14.4
	Hand and wrist pain	125	23.1
	Thigh pain	43	7.9
	Elbow pain	33	6.1
	Spinal deformity	19	3.5
How would you rate the severity of the musculoskeletal discomfort or pain experienced by your child?	None	9	1.7
	Mild	115	21.3
	Moderate	273	50.6
	Severe	142	26.3
How often does your child experience musculoskeletal discomfort or pain related to carrying a backpack?"	Rarely (once a month or less)	73	13.4
	Occasionally (2-3 times a month)	213	39.2
	Frequently (once a week)	171	31.5
	Very frequently (more than once a week)	86	15.8

Exploring Parents' Perceptions of Backpack Usage and Its Impact on Children's Musculoskeletal Health

A majority of parents (59.3%) had received some education on proper backpack usage, primarily from social media (38.7%). In terms of recommended backpack weight, 47.6% knew it should be less than 10% of the child's body weight. Most parents (63.3%) prepared their child's backpack, with 72.1% checking and removing unnecessary contents, and 64.6% seeking updates on backpack safety.

Regarding desirable backpack features was a backpack with two shoulder straps rather than one (54.8%), a lightweight backpack (48.3%), and a backpack with multiple compartments for weight distribution (38.7%). Other notable features included padded shoulder straps (42.0%) and a size that fits the child's age and weight (46.8%). However, knowledge of proper carrying techniques, such as using both shoulders (77.3%) and other recommended methods, was more limited. Regarding potential musculoskeletal impacts, parents were most aware of neck pain (59.9%), shoulder pain (63.7%), and fatigue (51.0%), but

fewer recognized risks to the lower back, posture, and other areas, as presented in Table 4.

Table 4: Exploring Parents' Perceptions of Backpack Usage and Its Impact on Children's Musculoskeletal Health.

Items		**n**	**%**
1A- Did you get an education about school bag	No	221	40.7
	Yes	322	59.3
1B-1If yes, where?	At payback selling shop	28	6.9
	Awareness campaigns	68	16.7
	School Directions	142	35.0
	Social media	157	38.7
	Self-education	5	1.2
	Family and friend	6	1.5
2- Awareness of parents regarding recommended weight of school backpack Recommended weight of school backpack	Less than 10 % of body weight	340	47.6
	10 to 15 % of body weight	271	38.0
	15 to 20 % of body weight	87	12.2
	More than 20 % of the body weight	16	2.2
3- Do you Prepare your child school bag?	No	262	36.7
	Yes	452	63.3
4- Do you Check the school bag and remove unnecessary contents?	No	199	27.9
	Yes	515	72.1
5- Do you Search for updates on school bag safety	No	253	35.4
	Yes	461	64.6
6- Features of school backpack	Backpack with two shoulder straps rather than one.#	391	54.8
	Backpack with multiple compartments for distribution of weight.#	276	38.7
	Lightweight backpack#	345	48.3
	Backpack with padded shoulder straps#	300	42.0
	Size of the backpack should fit for child’s age and weight#	334	46.8
	Backpack with wide shoulder straps#	191	26.8
	Padding at the rear of the backpack which comes into contact with the back and shoulders#	225	31.5
	Backpack with waist straps#	90	12.6
	Backpack with abdominal straps	65	9.1
	Heavy backpack	29	4.1
	Backpack with thin clothing straps	38	5.3
7- Carrying methods of school backpack	The school bag should be carried on two shoulders, not on one shoulder #	552	77.3
	To lift the backpack, it is best to bend your knees, then take it #	237	33.2
	Wear the backpack after placing it on the table, at	280	39.2

	waist level #		
	The shoulder strap should be tight to keep the load closer to the back#	208	29.1
	It is best to place the backpack in the middle of the back#	182	25.5
	The shoulder straps should be firm and sufficiently fastened#	166	23.2
	The bottom of the backpack should not be lower than the waist#	140	19.6
8- MSK side effects of school backpack miscarriage Can affect the muscles and spine and produce musculoskeletal health issues	Can produce neck pain	428	59.9
	Can produce shoulder pain	455	63.7
	Can produce fatigue	364	51.0
	Can produce low back pain	336	47.1
	Can affect the posture and cause spinal deformity	277	38.8
	Can produce Shoulder pain	277	38.8
	Can produce Upper back pain	224	31.4
	Can produce Foot pain	136	19.0
	Can produce Hand and wrist pain	161	22.5
	Can produce Thigh pain	83	11.6
	Can produce Elbow pain	88	12.3

The most popular opinion, held by 45.4% (324) of respondents, was to redesign the curriculum to reduce the number of textbooks and materials students need to carry, redesigning the schoolbag 20.4% (146), and moving toward E-learning 15.8% (113), as presented in Figure 1.

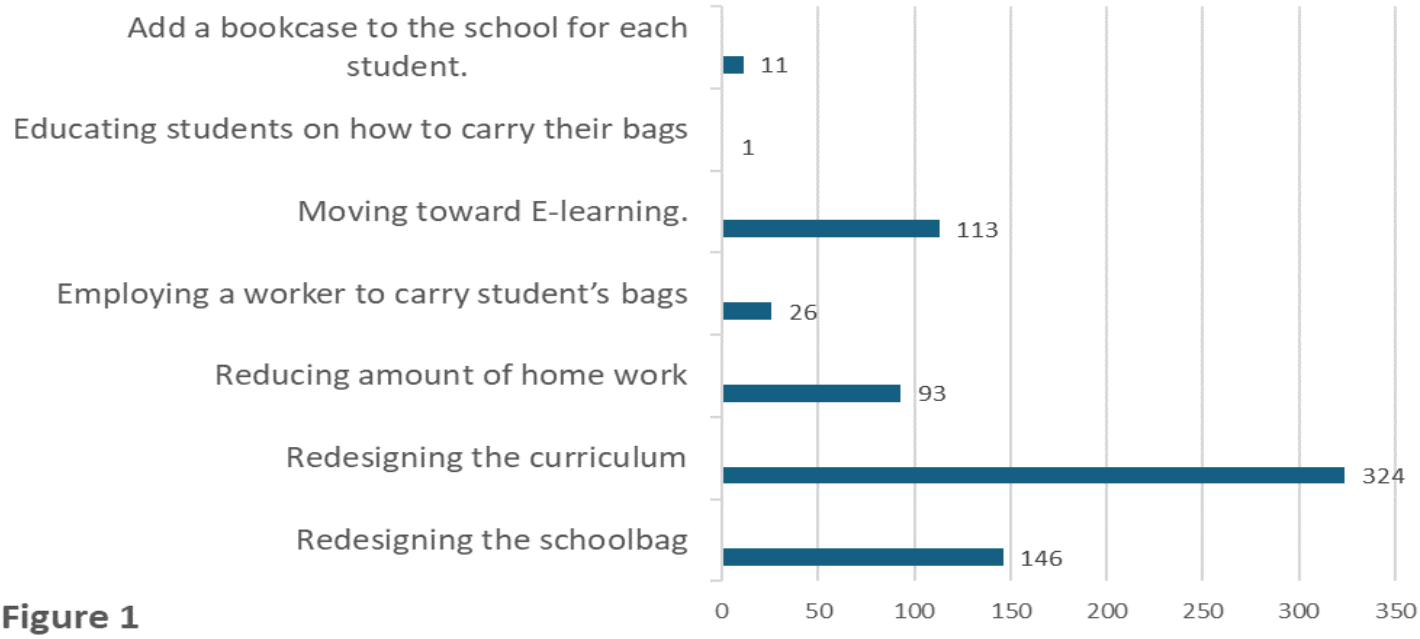

Figure 1. Exploring Parents' Perceptions of Backpack Usage and Its Impact on Children's Musculoskeletal Health

Overall Level of Knowledge of Parents Regarding Backpack Usage

The mean score was 8.53 out of a maximum of 20 points, with a median score of 8. The standard deviation was 3.69. More specifically, 59.2% (423) of parents exhibited inadequate knowledge, while only 40.8% (291) had adequate knowledge, as presented in Figure 2.

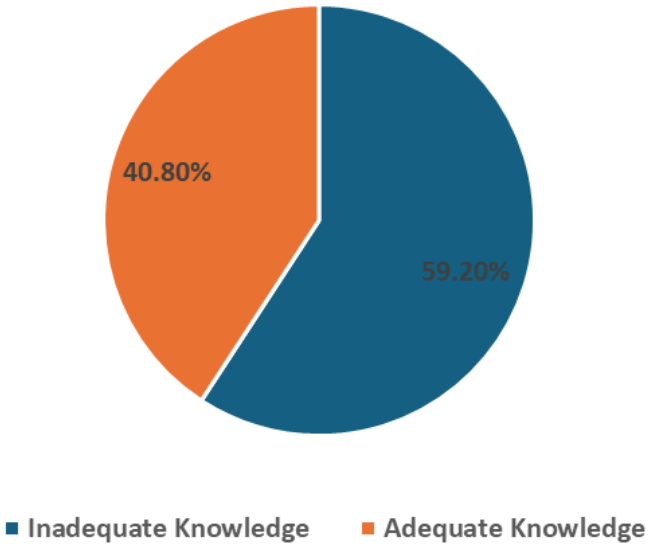

Figure 2. Overall Level of Knowledge of Parents Regarding Backpack Usage

Factors Influencing Musculoskeletal Discomfort in Children from Schoolbag Usage

Children carrying shoulder bags had a significantly higher rate of discomfort (79.4%) compared to those carrying bags with wheels (61.4%) (p=0.001. Additionally, children who carried their school bag for more than 15 minutes had a significantly higher rate of discomfort (84.1%) than those who carried it for less than 15 minutes (68.2%) (p<0.001). Regarding mode of transportation, children who walked to school had the highest rate of discomfort (86.3%), followed by those who took the bus (79.7%) and private car (73.4%) (p=0.008), as presented in Table 5.

Table 5: Factors Influencing Musculoskeletal Discomfort in Children from Schoolbag Usage.

Items		**Have you noticed any musculoskeletal discomfort or pain in your child related to carrying a backpack during the integration of textbooks for three consecutive semesters?**				
		NO		**YES**		**P-value**
		n	**%**	**n**	**%**	
Age		10.7427	4.32141	11.2192	3.68525	0.158
Gender	Male	98	24.8	297	75.2	0.549
	Female	73	22.9	246	77.1	
School type	Governmental	124	22.3	431	77.7	0.060
	Private	47	29.6	112	70.4	
Type of school bag carried by the child	Shoulder bag	120	20.6	462	79.4	0.001
	Bag with wheels	51	38.6	81	61.4	
Who chooses the schoolbag?	Parents	67	22.3	233	77.7	0.389
	The child	104	25.1	310	74.9	
Time spent carrying the school bag	Less than 15 minutes	115	31.8	247	68.2	<0.001
	More than 15 minutes	56	15.9	296	84.1	

Mode of transportation to the school	Walking	11	13.8	69	86.3	0.008
	Bus	28	20.3	110	79.7	
	Private car	132	26.6	364	73.4	
	Yes	100	19.4	415	80.6	

Factors Influencing the Perception of Parents Regarding Backpack Usage

Mothers had a higher level of adequate knowledge (45.0%) compared to fathers (30.2%) and other family members (42.4%) (p=0.008), and married parents had a higher level of adequate knowledge (43.4%) compared to divorced (21.9%) and widowed (26.7%) parents (p<0.001). Fathers working in the governmental sector had a higher level of adequate knowledge (45.2%) compared to those not working (36.4%) and those working in the private sector (32.5%) (p=0.041), while Mothers not working had a higher level of adequate knowledge (43.4%) compared to those working in the governmental (42.5%) and private sectors (26.5%) (p=0.029). Parents whose children complained about backpack-related heaviness or burden had a higher level of adequate knowledge (43.6%) compared to those whose children did not complain (28.7%) (p=0.001), and parents of children attending governmental schools had a higher level of adequate knowledge (42.9%) compared to those attending private schools (33.3%) (p=0.031), as presented in Table 6.

Table 6. Factors Influencing the Perception of Parents Regarding Backpack Usage

Items		**Overall Level of Knowledge of Parents Regarding Backpack Usage**				
		Inadequate knowledge		**Adequate knowledge**		**P-value**
		n	**%**	**n**	**%**	
Respondent	Mother	251	55.0%	205	45.0%	0.008
	Father	134	69.8%	58	30.2%	
	Others (Sister, Brother, etc..)	38	57.6%	28	42.4	
Marital status	Married	351	56.6%	269	43.4	<0.001
	Divorced	50	78.1%	14	21.9	
	Widow	22	73.3%	8	26.7	
Father education	Illiterate	15	71.4%	6	28.6	0.288
	Secondary / below	123	60.9%	79	39.1	
	University / above	285	58.0%	206	42.0	
Mother education	Illiterate	10	58.8%	7	41.2	0.274
	Secondary / below	144	62.3%	87	37.7	
Mother education	University / above	269	57.7%	197	42.3	
Father work	Not working	42	63.6%	24	36.4	0.041
	Governmental sector	242	54.8%	200	45.2	
	Private sector	139	67.5%	67	32.5	
Mother work	Not working	205	56.6%	157	43.4	0.029
	Governmental sector	146	57.5%	108	42.5	
	Private sector	72	73.5%	26	26.5	

Income status	Less than 5000 SAR	31	55.4%	25	44.6	0.068
	From 5000 to 10,000 SAR	128	67.4%	62	32.6	
	From 10,000 to 15,000 SAR	112	57.7%	82	42.3	
	More than 15,000 SAR	152	55.5%	122	44.5	
Number of Children		3.83	3.28	3.43	2	0.064
Has your child complained about experiencing a sense of heaviness or burden associated with their backpack?	No	97	71.3%	39	28.7	0.001
	Yes	326	56.4%	252	43.6	
School type	Governmental	317	57.1%	238	42.9	0.031
	Private	106	66.7%	53	33.3	

Discussion

The study explores parental perceptions regarding the impact of backpack use on children's musculoskeletal health in Saudi schools over three semesters, particularly during the integration of textbooks. A significant majority of parents (81.0%) reported that their children experienced discomfort related to backpack weight, with 76.1% noting musculoskeletal pain, predominantly in the shoulders, neck, and back. Despite a substantial number of parents having received education on proper backpack usage, knowledge of effective carrying techniques was less widespread.

The use of backpacks by schoolchildren has long been a subject of concern among parents, educators, and healthcare professionals (Perrone et al., 2018). Schoolbag weight has been identified as a significant factor that can affect the musculoskeletal health of growing children, potentially leading to issues such as back pain, poor posture, and reduced oxygen saturation levels (Adeyemi et al., 2014). As students progress through their education, the integration of textbooks and other academic materials often results in an increase in the weight of their school supplies, further exacerbating these concerns. Moreover, most students do not carry their backpacks properly, which may lead to future musculoskeletal disorders (Alami et al., 2018). In particular, during the integration of textbooks over three consecutive semesters, this study aimed to investigate parents' perceptions and experiences regarding their children's backpack usage and the possible impact on musculoskeletal health.

The sociodemographic data of Saudi families with school-age children obtained in this study are largely in line with findings from earlier extensive research conducted in Saudi Arabia by Alamer et al. and Alsiddiky et al. (Alamer et al., 2022; Alsiddiky et al., 2019). Important commonalities include the majority of respondents being mothers, who make up 63.9% of the current sample Alamer et al. reported 74.9% mothers. The vast majority of participants were married, ranging from 84.1% to 94.1% (Alamer et al., 2022; Alsiddiky et al., 2019), with the current study reporting 86.8% married. Regarding educational attainment, the current study found 68.8% of fathers and 65.3% of mothers had a university education or above, which is slightly higher than the 57.9% of fathers and 61.9% of mothers reported by Alamer et al (Alamer et al., 2022). Employment patterns also aligned, with most fathers working in the government sector

(61.9% in the current study; 62.8% in Alamer et al.), while a significant portion of mothers were homemakers (50.7% in the current study; 51% in Alamer et al.).(Alamer et al., 2022) .The current study's sample also appears to be of relatively high socioeconomic status, with 38.4% of families reporting monthly incomes over 15,000 SAR. This is aligned with the Alsiddiky et al. study, which found most participants had incomes between 5,000 and 20,000 SAR(Alsiddiky et al., 2019).

The current study provides a detailed profile of the children of the participating parents. On average, the children had 2.08 (SD=1.91) siblings, with slightly more male (2.12, SD=1.77) than female (2.0, SD=1.91) siblings. This aligns with the findings from the Alamer et al. study, which reported that the majority of families (67.3%) had three or more children (Alamer et al., 2022). The children in this study were 11.10 years old on average (SD=3.84). This age range is in line with the findings of the Alamer et al. study, which focused on children between the ages of 7 and 14 and found a mean child age of 8.9 ± 1.6 years (Alamer et al., 2022). An interesting similarity across the studies is the high percentage of children attending governmental schools - 77.7% in the current study and 77.7% in the Alamer et al. study. This suggests a widespread reliance on the public education system among Saudi families. S. Aburizaizah et al., on the other hand, noted that private middle schools in Saudi Arabia provide better instruction to more privileged students than government-run institutions (Aburizaizah et al., 2016). The majority of children (81.5%) who used school bags did so with shoulder bags, which were mostly chosen by the children (58.0%), according to the current study.

This is comparable to the Alamer et al. study, which reported that 81% of children used backpacks, with over half (51.7%) selected by the parents (Alamer et al., 2022). In terms of transport to school, half of the children in the current study spent under 15 minutes commuting, primarily using private cars (69.5%), followed by buses (19.3%) and walking (11.2%). These findings are again in line with the Alamer et al. study, which reported that 77.8% of children spent less than 15 minutes commuting, and 79.6% traveled by private car (Alamer et al., 2022). Our study's conclusions are consistent with the body of knowledge regarding the negative effects of heavy backpacks on school-age children's musculoskeletal health. Eighty-one percent of parents stated that their child had felt heavy or burdened by their backpack, and more than seventy-six percent reported that their child had experienced musculoskeletal pain or discomfort from carrying a backpack for three semesters in a row. Like S. Negrini et al., who reported that 46.1% of children reported having back pain and that 79.1% of children felt that school backpacks were heavy and that they caused fatigue, 65.7% of children felt that way (Negrini & Carabalona, 2002).

The most commonly reported issues were shoulder pain (60.3%), fatigue (54.1%), neck pain (38.6%), upper back pain (39.5%), and low back pain (29.2%). These results are in line with those of other studies, including one conducted by Abdullah Assiri et al. (Assiri et al., 2019), which reported that back pain was prevalent overall at 39.4%, with upper back pain, middle back pain, and lower back pain making up 14.5%, 13.4%, and 11.5% of cases, respectively. According to Samia Ali El-Nagar's research, the shoulder was the most commonly affected area in school-aged children with back pain, and nearly one-quarter (24.4%) said that the pain made it difficult for them to go about their daily lives (Ali El-Nagar, 2017). In terms of severity, half of the parents (50.6%) rated the discomfort or pain as moderate, with over a quarter (26.3%) rating it as severe. The frequency of these issues was also

concerning, with 31.5% of children experiencing them once a week and 15.8% more than once a week. These findings align with the study by Rawan S. Alghamdi et al. (Alghamdi et al., 2018), Also, study by K. Spiteri et al., which highlighted the need for weight reduction in schoolbags due to the link between excessive schoolbag weight and self-reported back pain in children aged 8–13 years (Spiteri et al., 2017). which found that school bag weight is significantly related to shoulder and neck pain in female students. Additionally, the study conducted by Alsiddiky et al. discovered that a sizable majority of parents knew that carrying heavy schoolbags can result in back problems—87.3% of fathers and 90.9% of mothers. This recognizes that the issue of heavy backpacks and their impact on children's health is well-recognized, but more needs to be done to address this problem effectively (Alsiddiky et al., 2019). Most parents (59.3%) said they had learned something about using backpacks properly, mostly from social media (38.7%). This is consistent with research by Alamer et al., which found that 57.6% of Saudi Arabian parents said they had received instruction regarding school bags, with schools providing 70.8% of the instruction and awareness campaigns providing 18.6% (Alamer et al., 2022).

The overall level of knowledge of parents regarding backpack usage was specifically, 59.2% of parents exhibited inadequate knowledge, while only 40.8% had adequate knowledge. While Alamer et al found that 78.1% of parents exhibited inadequate knowledge (Alamer et al., 2022). Of the parents in this study, 47.6% were aware that the recommended weight for a backpack should not exceed 10% of the child's body weight. This information is essential because studies by Dianat et al. and Alsiddiky et al. have demonstrated a link between a lower prevalence of musculoskeletal problems in children and higher parental awareness of schoolbag weight limits and appropriate carrying techniques (Alsiddiky et al., 2019; Dianat & Karimi, 2014). Alrasheed et al. also discovered that the majority of parents in Al-Ahsa, Saudi Arabia, are aware of the potential effects of school backpacks on musculoskeletal disorders as well as the right size, weight, and carrying techniques (Alrasheed et al., 2022). In this study, the majority of parents (63.3%) actively assisted in getting their child's backpack ready, with 72.1% inspecting and purging items that weren't needed and 64.6% looking up the latest information on backpack safety. Nonetheless, Alsiddiky et al.'s study revealed that a sizable percentage of parents (42.8% of mothers and 49.6% of fathers) did not empty their kids' schoolbags of unnecessary items, indicating that more needs to be done to involve parents in this important duty (Alsiddiky et al., 2019).

When it came to desirable backpack features, most parents (54.8%) said that having two shoulder straps was preferable to having just one, as were being lightweight (48.3%) and having multiple compartments for distributing weight (38.7%). Other notable features included padded shoulder straps (42.0%) and a size that fits the child's age and weight (46.8%). These results are in line with research conducted by Alamer et al., which discovered that most parents (95.1%) were aware that a backpack with two shoulder straps is ideal and that lightweight (92.2%) and wide (87.7%) backpacks are also important (Alamer et al., 2022). On the other hand, there was less awareness of appropriate carrying techniques, such as using both shoulders (77.3%) and other suggested approaches. According to Alamer et al., 69.7% of parents knew that the shoulder strap should be tight to keep the load closer to the back, 73.4% knew that it is preferable to carry the backpack in the middle, and 93.3% of parents knew that the

schoolbag should be carried on two shoulders rather than one (Alamer et al., 2022). Parents were more aware of the risks to their necks (59.9%), shoulders (63.7%), and bodies (51.0%) than they were of the risks to their lower backs, posture, and other musculoskeletal systems. This is consistent with research by Alsiddiky et al. (Alsiddiky et al., 2019; Lai & Jones, 2001). that found only 36.9% of fathers and 37.6% of mothers were aware that improper schoolbag weight and insufficient carrying techniques could obstruct healthy spinal alignment and growth. Additionally, the study by Lai and Jones emphasizes the possible effects of heavy backpacks because they discovered that children who carry backpacks that are heavier than 10% of their body weight develop kyphotic postures, which in turn reduce lung capacity (Lai & Jones, 2001).

The results show that children who carried shoulder bags reported feeling much more uncomfortable (79.4%) than children who carried bags on wheels (61.4%) (p=0.001). This is consistent with a study by T. Puckree et al. that discovered a significant relationship between students' pain levels and the kind of school bag they carry, with a higher proportion of female students reporting pain. The unequal distribution of weight and the strain on the shoulders and upper back may be the cause of the increased discomfort related to shoulder bags (Puckree et al., 2004). Furthermore, 84.1 percent of kids who carried their school bag for more than 15 minutes reported feeling uncomfortable, compared to 68.2% of kids who carried it for less than 15 minutes (p<0.001). When it came to their mode of transportation, kids who walked (86.3%) reported feeling the most uncomfortable, followed by kids who rode the bus (73.7%) and kids who drove themselves (73.4%) (p=0.008). This research emphasizes how children's musculoskeletal health may be impacted by the length and distance of their commutes, with longer walks to school being associated with more discomfort. The findings of the study by H. Khan et al., which also revealed that shoulder pain was the most commonly reported complaint (67.3%) among elementary school students carrying heavy school bags, and that there was a significant correlation between pain and perceived backpack weight, further corroborate these findings (Humaira Khan et al., 2021). According to the current study, children who carried shoulder bags reported being significantly more uncomfortable (79.4%) than children who carried bags with wheels (61.4%) (p=0.001). Furthermore, 84.1 percent of kids who carried their school bag for more than 15 minutes reported feeling uncomfortable, compared to 68.2% of kids who carried it for less than 15 minutes (p<0.001). When it came to their mode of transportation, kids who walked (86.3%) reported feeling the most uncomfortable, followed by kids who rode the bus (73.7%) and kids who drove themselves (73.4%) (p=0.008). Additional context regarding the significance of parental education and awareness in addressing the problem of heavy backpacks and their impact on children's health is provided by the Alamer et al. study. According to the study, 81.9% of moms reported having a good awareness level, which was considerably higher than the statistically significant (P=.001) 66.8% of parents. Furthermore, 81.2% of children whose parents chose the school bag had a good awareness level compared to 74.8% of those who let the child choose (P=.001), and good awareness was found in 78.3% of mothers who had graduated from university compared to 65.2% of illiterate mothers (P=.001). The Alamer et al. study also demonstrated the value of parental education, as evidenced by the fact that 89.3% of parents who learned about school bags had good awareness, compared to only 62.9% of parents who did not (P=.001) (Alamer et al., 2022).

Recommendations

A number of recommendations are made in response to the study's findings regarding the problem of heavy backpacks and how they affect children's musculoskeletal health. First, schools and parents should be encouraged to promote the use of wheeled backpacks, as the study found that children using shoulder bags had a significantly higher rate of discomfort compared to those using wheeled bags. In addition, since the study found that kids who carried their backpacks for longer than fifteen minutes a day reported feeling more discomfort, schools should consider instituting rules or other measures to reduce the amount of time kids spend toting bulky backpacks. Some ideas include providing children with lockers or planning more frequent breaks.

Enhancing parental awareness and involvement is another key recommendation. The findings from the Alamer et al. study highlighted the importance of parental awareness and involvement in backpack selection and usage. Schools and health authorities should develop educational programs and resources to inform parents about the risks of heavy backpacks and the importance of proper backpack selection and usage. Furthermore, schools and parents should work closely with healthcare professionals, such as physical therapists and pediatricians, to develop evidence-based guidelines and interventions to address the issue of heavy backpacks and their impact on children's musculoskeletal health.

Limitations

It is important to consider the various limitations of this study when interpreting the results. The study's data collection method was self-reported by parents, which raises the possibility of recall or social desirability biases influencing the collected information's accuracy. Furthermore, the study's cross-sectional design makes it more difficult to determine a causal relationship between the use of backpacks and outcomes related to musculoskeletal health. The absence of objective measurements, such as backpack weight, posture, or physical exams, may compromise the validity of the results. Finally, the study did not account for all possible confounding factors, such as physical activity levels, body mass index, and pre-existing medical conditions, which may also contribute to musculoskeletal health outcomes

Conclusion

The study's conclusions demonstrate the serious harm that heavy backpacks can do to kids' musculoskeletal systems. The majority of parents said that their kids were in pain and uncomfortable, and shoulder pain, exhaustion, neck pain, upper back pain, and lower back pain were the most frequent complaints. Many children experienced these problems frequently, and parents rated their severity as moderate to severe. Despite the widespread prevalence of backpack-related discomfort, the overall level of parental knowledge regarding proper backpack usage and its impact on their children's health was inadequate. While a majority of parents had received some education on the topic, their understanding of recommended backpack weight, desirable features, and proper carrying techniques was limited. The study also identified several key factors that influence the likelihood of children experiencing musculoskeletal discomfort from backpack use. Children carrying shoulder bags, those who carried their backpacks for more than 15 minutes, and those who walked to school had significantly higher rates of discomfort compared to their counterparts. Additionally, the research revealed disparities in parental knowledge based on demographic factors. Mothers, married parents, and parents of children attending governmental schools exhibited higher levels of adequate knowledge compared to fathers,

divorced or widowed parents, and those with children in private schools. These results demonstrate the necessity of thorough educational programs aimed at parents and kids in order to encourage appropriate backpack use and reduce the likelihood of musculoskeletal problems. The load on children may also be lessened by employing techniques like streamlining the curriculum to require fewer textbooks, putting e-learning solutions into place, and redesigning schoolbags. We can contribute to ensuring students' long-term musculoskeletal health and wellbeing by addressing these issues.

Future Research

Future studies could improve upon this research by incorporating objective measurements, such as backpack weight and posture analysis, to provide more accurate data on the relationship between backpack usage and musculoskeletal health outcomes. Longitudinal studies could also be beneficial in establishing causal relationships by tracking changes in children's musculoskeletal health over time in relation to their backpack usage patterns. Additionally, expanding the demographic diversity of study participants could help generalize findings across different populations and settings.

Research could further explore the effectiveness of interventions, such as educational programs for parents and students about proper backpack use and ergonomics. Investigating the long-term effects of using different types of backpacks on musculoskeletal health could also yield valuable insights.

Author Contributions

All authors significantly contributed to the work reported, including conception, study design, execution, data acquisition, analysis, and interpretation. They actively participated in drafting, revising, or critically reviewing the manuscript, provided final approval of the version to be published, agreed on the journal submission, and accepted accountability for all aspects of the work.

Data Availability Statement

The authors will transparently provide the primary data underpinning the findings or conclusions of this article, without any unjustified reluctance. If need from editorial team.

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Conflicts of Interest

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