



Ergonomic School Chair Design Requirements for Children with Special Needs: Focus Group Interview

Özel Gereksinimli Çocuklar için Ergonomik Okul Sandalyesi Tasarım Gereksinimleri: Odak Grup Görüşmesi

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Abstract

Introduction: This study aimed to determine ergonomic school chair design requirements for children with special needs between the ages of 6–12 while studying in a pilot school.

Methods: School chair design requirements were obtained through focus group discussions by ensuring the participation of experts in the field. An expert group consisting of physicians, teachers, physiotherapists, occupational therapists, and academicians working in the field of design participated in the study. The opinions of experts who agreed to participate in the study were obtained during a semi-structured interview consisting of four questions.

Results: Four themes emerged from the responses. In the adjustability theme, it was stated that the chair's length and tilt angle, seat width and depth, material, armrests, and foot supports should be adjustable according to the size of the child. In the add-on supports theme, the need for attachable materials for the child's head, trunk, back, arms, and legs was emphasized. In the suitability for school use theme, it was stated that chairs should be clean, take up little space, and be accessible. In the benefits of proper design theme, it was stated that child development can be supported in many areas.

Discussion and Conclusion: In future studies, school chair production can be carried out in the short term by considering the relevant requirements. In the long term, the expected benefits for the child can be investigated using objective measurements.

Keywords: Chair; Ergonomics; Pupil; Students

In children with special needs, impaired postural control mechanisms are a key problem that prevents participation in daily living activities.^[1,2] School activities constitute a

large part of the daily life activities of school-aged children with special needs.^[3] Postural control and stability must be ensured so that children can participate in many school

Cite this article as: Alataş DM, Cemali M, Tunç AR, Karaduman AA. Ergonomic School Chair Design Requirements for Children with Special Needs: Focus Group Interview. Lokman Hekim Health Sci 2024;4(3):157–165.

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Table 1. Semi-structured interview questions

Question	Content
1	What do you think about the sitting postures of children at the pilot school?
2	What do you think about the classroom chairs used by children in the pilot school?
3	What modifications would you recommend for the chairs of children with special needs to ensure an appropriate sitting posture in the classroom environment?
4	What would you like us to add?

activities, such as writing.^[4,5] Therapists can support children's participation by evaluating the situation of children with special needs, the requirements of school activities, and the school environment.^[6,7]

It seems that ergonomic chairs for school-aged students have not been adequately researched.^[8] On the one hand, it can be seen that the chairs designed are mostly standard chairs produced for use when eating, working, and resting.^[9] On the other hand, although children with special needs need to be supported with appropriate seating arrangements, it is known that same size chairs are used for all of these children in the school environment.^[10] While there are studies in the literature that include the design of ergonomic school chairs for children without any diagnosed health problems,^[11,12] one study states that the comfort level of a university student with scoliosis increased as a result of adjusting the back of his chair;^[13] another case study for a junior high school student with special needs states that the height and inclination of an ergonomic chair should be adjustable.^[14] However, the relevant studies did not comprehensively address the features required to produce ergonomic school chairs. Therefore, the aim of this study was to obtain expert opinions on the design requirements of ergonomic school chairs for children with special needs (mostly diagnosed with Cerebral Palsy and Down Syndrome) between the ages of 6–12 while studying in a pilot school through a focus group meeting and provide a broad perspective on the features of ergonomic school chairs.

Materials and Methods

Study Design

A pilot school in Ankara, where children with special needs are educated, applied to the Department of Occupational Therapy at Lokman Hekim University, Faculty of Health Sciences, with the need to evaluate the current situation of children's use of standard school chairs. Children with special needs in the pilot school were observed in their own school environment. It was later decided that a focus group discussion was needed to determine ergonomic school

chair requirements. This study was planned according to the phenomenology pattern, which is one of the qualitative research methods.^[15] Artificial intelligence-supported technologies were not used in the study.

Participants

The criterion for inclusion in the study was to observe children with special needs in the pilot school while using the existing standard chairs in the school; the exclusion criterion was not having experience in pediatrics and/or ergonomics. The focus group meeting consisted of a physical medicine and rehabilitation physician working on spine health, four physiotherapists and two occupational therapists with publications and experience in the field of ergonomics and pediatrics, three teachers from the pilot school, and two academicians working in the field of design. Two focus group discussions were held in total, and the average number of participants was six. To ensure the confidentiality of personal data, participants were named using the initials of their professions (for example: doctors are indicated with D, physiotherapists with P, occupational therapists with O, academicians working in the field of design with A, and teachers with T). Informed consent was obtained from the participating experts before the interviews. The study was conducted in accordance with the Declaration of Helsinki.

Data Collection

This study was initiated after receiving approval from the Scientific Research Ethics Committee of Lokman Hekim University on (approval number: 2024/30, date: 30.01.2024). The professions of the experts were recorded as sociodemographic information. A semi-structured interview form was used to obtain the opinions of relevant experts. The questions included in the semi-structured interview form were created based on the focus group interview study in the literature about the suitability of tables and chairs for normally developing children^[11] and the authors' experience in the field of pediatrics and ergonomics.^[16] Relevant questions are included in Table 1.

Table 2. Features of the adjustability theme

Theme 1	Features
Adjustability	Chair size
	Chair tilt angle
	Seating surface depth and width
	Seat surface material
	Independent movement of the right and left seating surfaces
	Armrest
	Independent foot support

After the participants were contacted by telephone by the pilot school where children with special needs were educated and informed about the research, the experts who agreed to participate in the study specified a suitable date and time for focus group discussions. The focus group interview lasted 2 h, and the entire interview was audio recorded. The audio recordings were transcribed and prepared for content analysis. In addition to audio recordings, the assistant moderator took notes during the interviews.

Data Analysis

Phenomenological data analysis was used to analyze the data from the focus group interviews, during which expert opinions were obtained.^[15] The audio recordings were transcribed by two researchers (DMA and MC). Significant phrases that were repeated were identified. Themes emerged in this direction and were reviewed by other researchers (AK and ART), and a consensus was reached. The opinions of the experts who participated in the interviews were obtained.

Reliability/Transferability/Confirmability

The reliability of the research was ensured by obtaining approval from the participating expert group and by audio recording and transcribing the interviews. The transferability of the research was ensured through observation in a pilot school where children with different disabilities were educated. The confirmability of the study was achieved through consistent interaction and information sharing by the research team during data collection and analysis.^[17] Confirmability was also ensured using the Consolidated Criteria for Reporting Qualitative Research checklist.^[18]

Results

In the focus group meeting held to determine the chair requirements of school-aged children with special needs,

Table 3. Features of the add-on supports theme

Theme 2	Features
Add-on supports	Head and neck support
	Head pod connection module
	Right and left trunk support
	H belt
	Lordosis support
	Back support
	Crotch apparatus
	Foot support
	Material bar

questions were directed to experts in the pediatrics and ergonomics fields. Four themes emerged in line with the answers to the relevant questions.

Theme 1: Adjustability

The experts stated that instead of all parts of the chair being fixed, the parts of the chair should be editable. Theme features are included in Table 2 and Figure 1.

Considering that the child will grow over time, the chair to be designed should be age-adaptable. Considering that children may have spine problems, the depth and width of the seating surface and the height of the back support should be adjustable in the top-down and mediolateral directions. It is important that the height of the right and left pelvis, the length of the chair, and the tilt angle are specifically adjustable for the child (P2).

The chair height should be adjustable; additionally, the chair should include armrests and a belt. The chair armrest should be able to be raised and lowered. With the tilt angle of the chair, the child's posture can be supported, and the visual field can be expanded. Adjustable foot support is also required according to the foot structure; standard productions do not provide adequate support. However, we do not see chairs that can be modified according to the needs of children in pilot schools. The chairs do not have any supporting parts for the waist, body, head, or arms (P1).

When the pilot school was opening, chairs of the same height and width were ordered for production. For this reason, our students use the same fixed chairs; the chair features cannot be adjusted for each child. It is problematic for children to transfer from one school chair to another. Getting up from a chair, going to the toilet, and getting into a car can be challenging (T).

The seat surface material of the chair should be non-sweating and breathable (A).

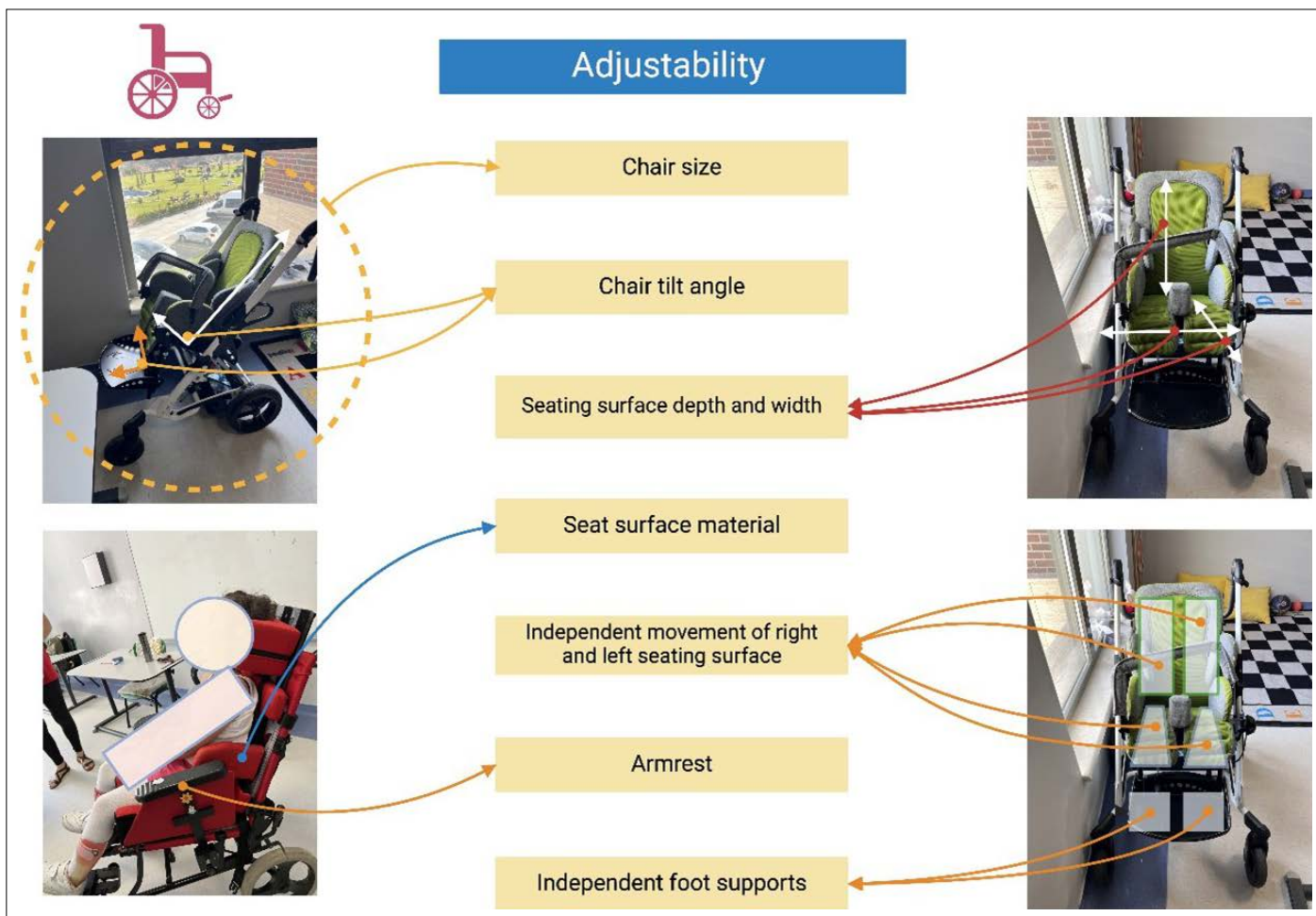


Figure 1. Features of adjustability theme (BioRender was used for the production of this figure).

Theme 2: Add-on Support

The experts stated that since the needs of children in the pilot school are different, attachable and removable devices on the chair are required. Theme features are included in Table 3 and Figure 2.

Back and head support should be provided when necessary. Right-left trunk support is important for children with scoliosis; it must have an H belt or a 5-point belt and provide support under the foot. Again, lordosis should be supported. It must have a crotch device; this device can prevent the child from slipping from the chair and developing an abnormal lower extremity posture (P1).

A material bar can be added for manual skills. The material bar must have a surface that allows materials of different textures and equipment to support fine motor skills (O).

Additional materials required for the chair should allow for attachment and removal. While teachers support their manual skills on the material bar, the bar should be removable when students want to work at their desk (T).

Table 4. Features of the suitability for school use theme

Theme 3	Features
Suitability for school use	Lightness Cleanability Chemical free No sharp corners Transition between fixed and wheeled systems It occupies little space Portability Affordable and accessible

The head support should be addable and removable. If the child's attention level is good and they are not tired yet, they hold their head and their visual field is not affected for learning. Therefore, the lesson can be continued without head support. However, teachers can add a head apparatus when they observe that the child is distracted and tired. It would also be valuable to include the Head Pod module. If there are

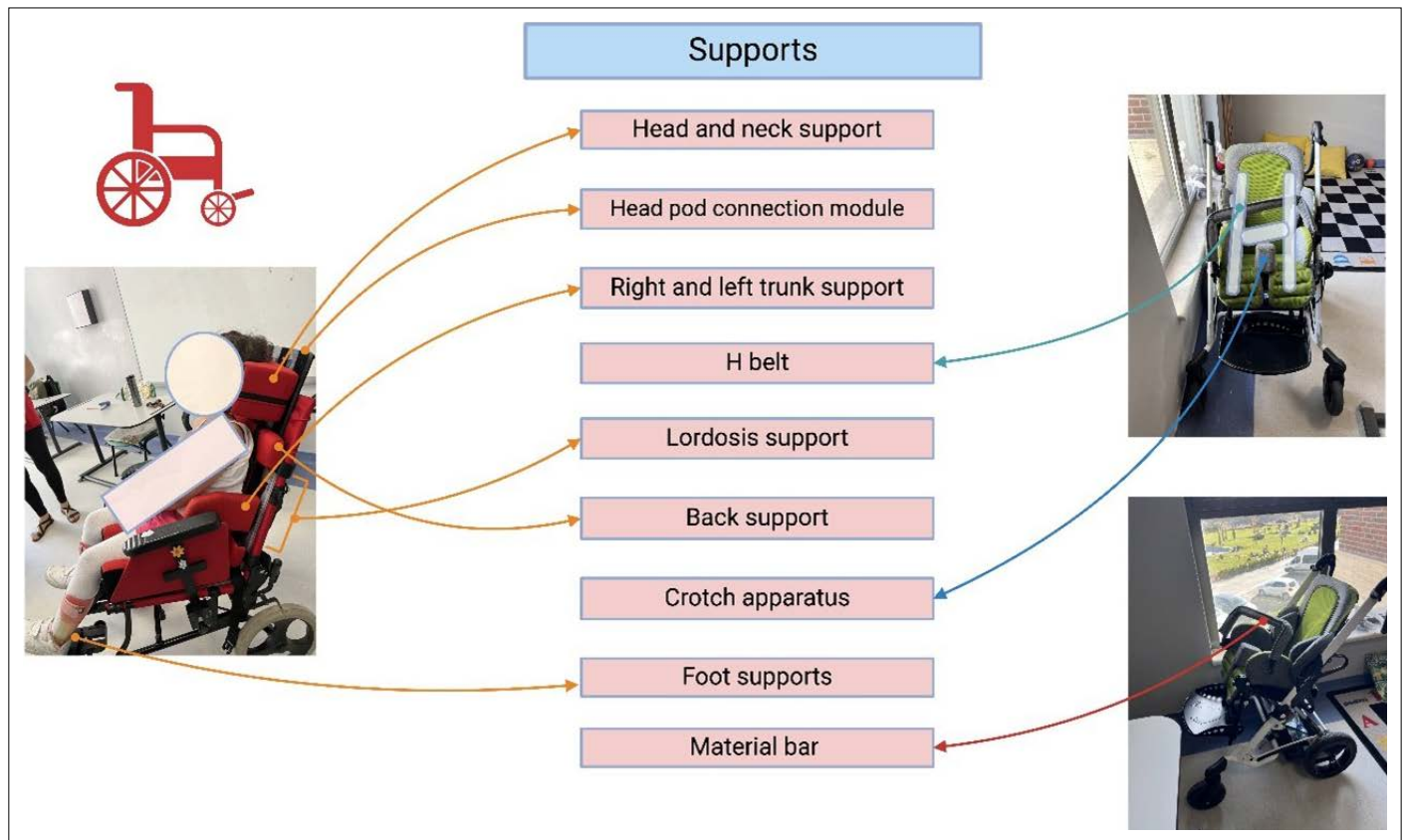


Figure 2. Features of the add-on supports theme (BioRender was used for the production of this figure).

armrests, the upper body weight can be supported. Having foot support is necessary for proper posture (P2).

Theme 3: Suitability for School Use

The experts expressed their opinion that the chairs were not suitable for school use. Theme features are included in Table 4 and Figure 3.

The school chairs should be clean and lightweight. The corners of the chairs should not be sharp and should not cause injury. It must have a brake system and seat belt that cannot be opened by a child (T).

The chairs can be produced in two types: fixed and braked. The brake system will be suitable for the ergonomics of school servants. In this way, the risk of musculoskeletal injuries when pushing and pulling chairs can be reduced (O).

There should be a material bar on the table for manual skills. The bar should be stable so that it can be laid with materials of different textures. Considering the classroom size, chairs should allow room to move if they take up little space in the classroom (T).

The chair must be made of durable but not heavy material, must not contain chemicals, and must be able to be cleaned (A).

Table 5. Features of the benefits of proper design theme

Theme 4	Features
Benefits of proper design	Ensuring a proper sitting posture Preventing the risk of trunk and extremity deformity Increasing the interaction with the environment Increasing performance in desk activities Supporting participation

Theme 4: Benefits of Proper Design

The experts emphasized that if a design for a child with special needs is provided, the child's development can be supported in many areas. Theme features are included in Table 5 and Figure 4.

Students at a special education school use uniform chairs. Scoliosis can be viewed as a spine problem that develops secondary to the special needs of these children, and hip dislocations can be seen as a hip problem. Therefore, the progression or formation of the relevant deformities can be prevented or delayed by determining and implementing the chair requirements necessary for the health of children (D).

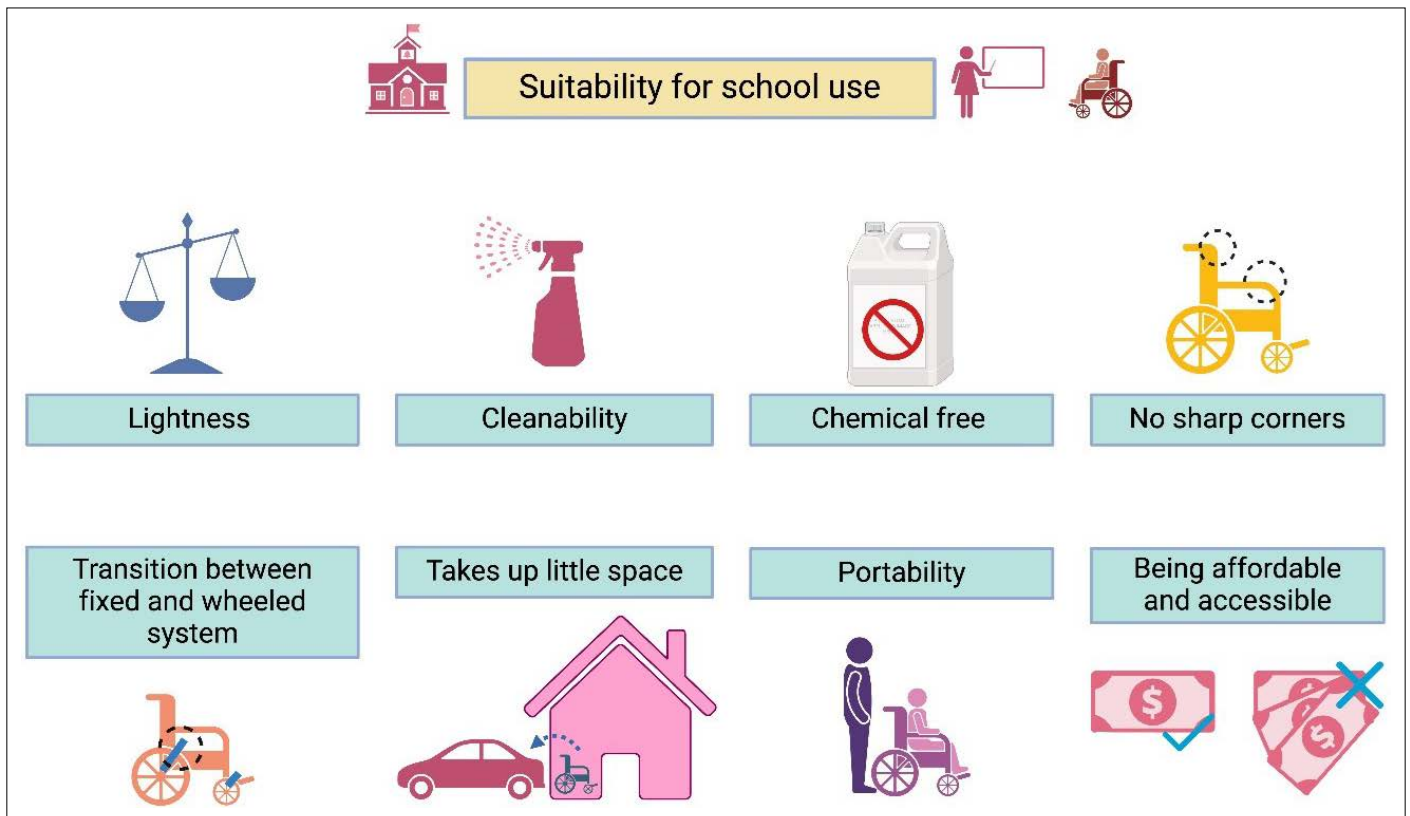


Figure 3. Features of suitability for school use theme (BioRender was used for the production of this figure).

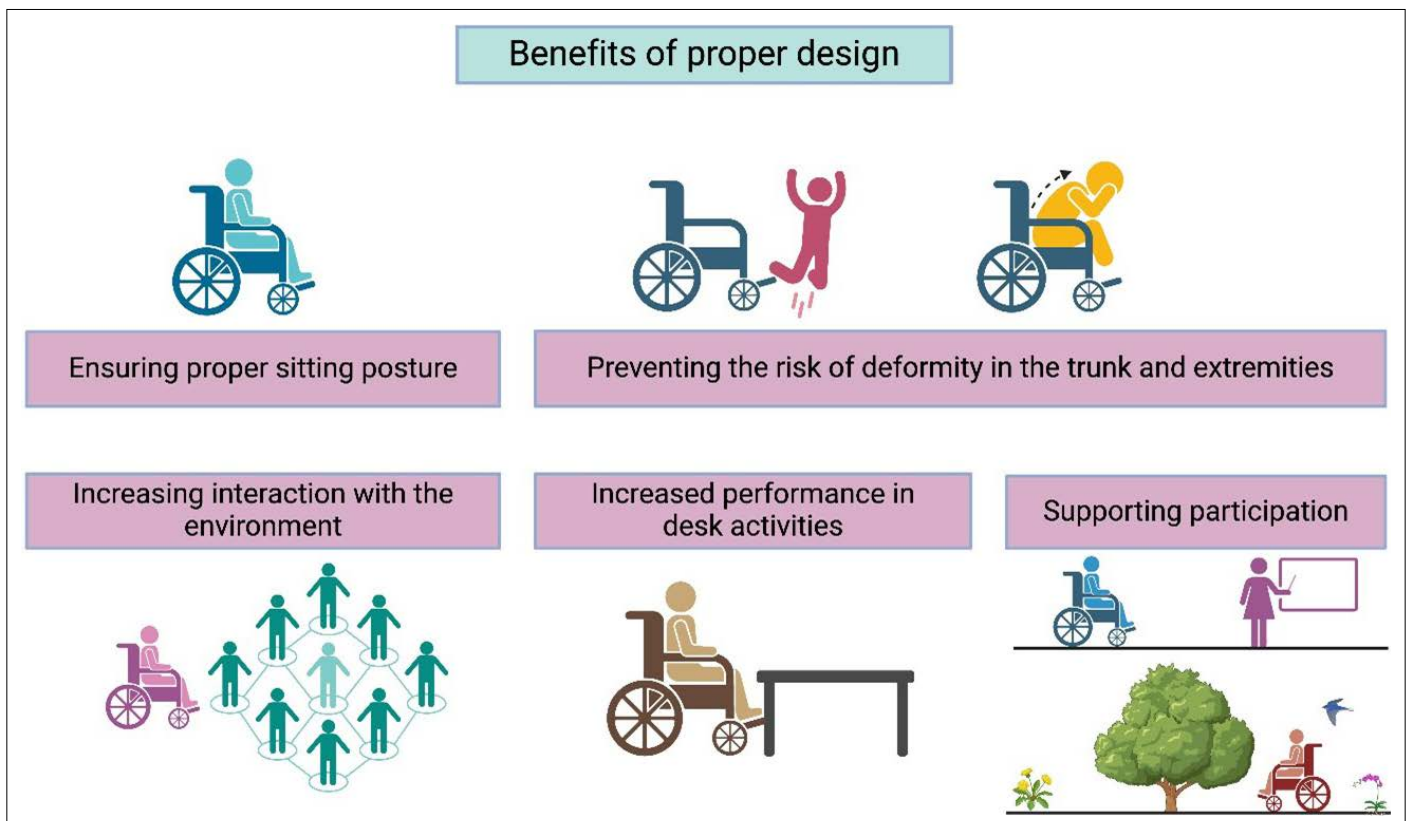


Figure 4. Features of benefits of proper design theme (BioRender was used for the production of this figure).

Students spend most of their day sitting in school. With appropriate chair designs, the load on the joints can be reduced, and perhaps the child's learning and interaction with the environment can improve positively (P1).

If chairs are affordable, children's participation in the school environment can be supported by an appropriate design; the child's performance in school activities may increase (O).

Discussion

The aim of this study was to obtain expert opinions on the design requirements of school chairs for children with special needs aged 6–12 years studying in a pilot school through a focus group meeting. Experts stated that because the anthropometric characteristics and needs of children with special needs differ from each other, the ergonomic school chair should be adjustable and have additional supports. The features that a chair should have to be suitable for school use are summarized. In addition, the experts expressed their expectations regarding the effects of an ergonomically designed school chair with a suitable design for children.

In a study conducted by Podrekar et al.,^[19] it was found that 90% of primary school students had an inappropriate height for the chairs they used at school. Akgül et al.^[20] stated that foot supports should be added to chairs for short students and that a seating option with support areas for the arms should be preferred. Cantin et al.^[21] stated that primary school students' elbows should be approximately 2–3 cm below the top of the table, and their feet and knees should be in contact with the ground at an angle of approximately 90°. They also emphasized the need for adjustments because children grow at different rates. Tuttle and colleagues stated that the height, depth, and width of the seat are the three most important dimensions in the design of ergonomic chairs for university students. It was emphasized that while most attention is paid to adjusting the seat height in the design, the depth of the seat, which causes pressure on the popliteal area and can affect circulation, is often ignored.^[22] In this study, under the theme of adjustability, it was stated that the height and tilt angle of the chair should be adjustable because the child's size changes as he grows older. Similarly, the experts emphasized the depth and width of the seating surface, the ability of the seating surface to move in two parts, and the material's adaptability. The authors also stated that the armrests and foot supports should be adjustable. Even if the relevant chair parts mentioned in the literature and emphasized by the experts are present in the design of a school chair, it will not provide sufficient support if it is not adjustable. Therefore, it is important that the relevant

chair parts are present and can be modified according to the child's body structure, size, and needs.

In a study conducted by Mandal et al.,^[23] the presence of low back pain in students was associated with the absence of lumbar support while sitting. Cantin et al.^[21] stated that even healthy children may feel symptoms such as fatigue and pain when they are not adequately supported by their chairs and desks because they have to spend additional energy to maintain their sitting position, which may cause compensatory posture. Under the add-on supports theme, it was stated that standard chairs in the school needed head and neck support and even some modules. In addition, it was emphasized that the chair should have trunk support on the right and left sides, the presence of an H belt, and back and waist supports to support curvatures. The need for supports, such as a crotch apparatus, foot support, and material bar, was also stated. It can be considered that by providing these supports specified by experts, in addition to the supports specified in the current literature, it may be possible for children with special needs to create and maintain an appropriate posture by spending less energy.

Stotz and Walker^[24] emphasized that furniture should be esthetically pleasing, durable, lightweight, comfortable, and inexpensive. Domljan et al.^[25] set out some basic requirements that should be considered when purchasing furniture for primary schools; these were durability, security, portability, maintainability, and functional adjustability. Goddard et al.^[26] stated that chairs at schools should be used for at least 10 years and that these chairs should be easy to clean and repair. Over the years, materials such as wood and aluminum have been used to fabricate school chairs.^[27] In the current study, under the suitability for school use theme, it was stated that chairs for children with special needs should be clean and light and should not contain chemicals. It was also stated that for safety reasons, the corners should not be sharp, and the chair should have a brake system that cannot be opened by children. Small footprint and portability also came to the fore; it was expressed that if this chair was domestically produced, it would be more accessible to families in terms of cost. These features can be a guide for chair designs that children with special needs can use at school.

Dianat et al.,^[28] in their study where they evaluated the anthropometric characteristics and classroom furniture of university students studying in Iran, stated that maintaining appropriate posture is very important for general spine health, as students spend most of their waking hours sitting at school. Additionally, Wingrat et al.^[29] found that the incompatibility between child and furniture was a factor affecting children's performance and attention levels. In

this study, under the benefits of proper design theme, it was stated that if the school chair is designed to meet the needs of children with special needs, it will be possible to prevent the progression and formation of deformities in children with special needs at school. It was also stated that the child's interaction with the environment can be increased and their participation can be supported. In this regard, future studies should evaluate the effects of ergonomic chair designs on body structure and functions, the environment, and participation using objective methods.

As a result of the observations in the pilot school, the school chair features were mostly determined for children with physical disabilities. Therefore, the relevant school chair features may not be generalizable to the requirements for chairs used by children with mental disabilities. This situation constitutes the limitation of the study. In addition, another limitation of the study is that children with special needs who use standard school chairs were not invited to the focus group interview to obtain user opinions. Future studies may invite children with special needs who have sufficient cognitive function and expressive language as participants.

Conclusion

The study results emphasized the features of a chair suitable for school use. In addition, the parts of the school chair that should be adjustable for children with special needs were specified, and the supports that can be added were summarized. In the short term, after the production of a chair suitable for school use, each child with special needs can be evaluated by a health worker, and access to supports that can be adjusted and added specifically for the school chair can be provided. In the long term, the expectations stated under the main theme of the benefits of proper design can be measured using objective measurement tools and satisfaction surveys.

Ethics Committee Approval: The Lokman Hekim University Non-Interventional Clinical Research Ethics Committee granted approval for this study (date: 30.01.2024, number: 2024/30).

Authorship Contributions: Concept: AAK, DMA; Design: AAK, DMA; Supervision: AAK, DMA; Materials: AAK; Data Collection or Processing: DMA; Analysis or Interpretation: DMA, MC; Literature Search: DMA; Writing: DMA, ART, MC, AAK; Critical Review: DMA, AAK.

Conflict of Interest: None declared.

Use of AI for Writing Assistance: Artificial intelligence-supported technologies were not used in this study.

Financial Disclosure: The authors declared that this study received no financial support.

Peer-review: Externally peer-reviewed.

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