ONLINE POSTURAL EDUCATION PROGRAM: APPROACH FOR SCHOLARS

PROGRAMA DE EDUCAÇÃO POSTURAL ONLINE: ABORDAGEM PARA ESCOLARES

Gabriella Lavarda do Nascimento
ORCID 0000-0002-8133-252X

Laboratory of Development and Postural Control, LADESCOP
Post-graduate Program in Human Movement Sciences, UDESC, CEFID
Florianópolis, Brazil
gabilavarda@gmail.com

Luciana Sayuri Sanada
ORCID 0000-0002-6530-6831

Laboratory of Development and Postural Control, LADESCOP
Post-graduate Program in Physiotherapy, UDESC, CEFID
Florianópolis, Brazil
luciana.sanada@udesc.br

Anelise Sonza
ORCID 0000-0003-0056-4984

Laboratory of Development and Postural Control, LADESCOP
Post-graduate Program in Physiotherapy, UDESC, CEFID
Post-graduate Program in Human Movement Sciences, UDESC, CEFID
Florianópolis, Brazil
anelise.sonza@udesc.br

Abstract. Introduction: Postural Education programs involving students, teachers, and family members to improve posture and postural habits should provide integrated knowledge acquisition and improve the quality of life of those involved. Objective: To evaluate the theoretical knowledge on posture and education in health, dynamic posture, physical self-perception in postural habits, and the quality of life of adolescents, before and after the application of an Online Postural Education Program. Method: Longitudinal interventional study with quantitative and qualitative approach. The sample comprised adolescents, teachers, and parents from the participating school. Anamnesis, analysis of dynamic postures was performed for the adolescents. Questionnaires were applied to adolescents, teachers, and parents. The program was conducted over five weeks, encompassing five remote, synchronous meetings, interactive educational intervention, and physical exercises. An online course was given to Teachers. Results: The interventions for 54 schoolchildren aged 11–16 years provided a significant improvement in the theoretical knowledge ($p<0.001$), dynamic postures of tying shoelaces ($p<0.001$), lifting and dropping objects to the ground ($p<0.001$), carrying backpacks ($p<0.001$), sitting at a desk to write ($p<0.001$), talking ($p<0.001$), using a computer ($p=0.001$), physical self-perception ($p<0.001$) and quality of life ($p=0.008$). Teachers and parents expressed learning with the program. Conclusion: This study provided a significant improvement in knowledge, dynamic posture, postural habits, physical self-perception, and quality of life of the adolescents. The interventions associated with the use of technology provided a teaching-learning process for the participating students.

Keywords: Posture; adolescents; postural habits; postural education; technology.

Resumo. Introdução: Programas de Educação Postural envolvendo escolares, professores e familiares para melhorar a postura e os hábitos posturais podem proporcionar aquisição integrada de conhecimento e melhorar a qualidade de vida dos envolvidos. Objetivo: Avaliar o conhecimento teórico sobre postura e educação em saúde, postura dinâmica, autopercepção física nos hábitos posturais e qualidade de vida de adolescentes, antes e após a aplicação de um Programa Online de Educação Postural. Método: Estudo de intervenção longitudinal com abordagem quantitativa e qualitativa. A amostra foi composta por adolescentes, professores e pais da escola participante. Foi realizada anamnese, análise das posturas dinâmicas dos adolescentes. Foram aplicados questionários a adolescentes, professores e pais. O programa foi realizado em cinco semanas, abrangendo cinco encontros remotos e síncronos, intervenção educacional interativa e exercícios físicos. Foi ministrado um curso online para Professores. Resultados: As intervenções com 54 escolares de 11 a 16 anos proporcionaram melhora significativa no

conhecimento teórico *(p<0,001)*, posturas dinâmicas de amarrar cadarços *(p<0,001)*, levantar e deixar cair objetos no chão *(p<0,001)*, carregar mochilas (p<0,001), sentar em uma mesa para escrever *(p<0,001)*, conversar *(p<0,001)*, usar computador *(p=0,001)*, autopercepção física *(p<0,001)* e qualidade de vida *(p=0,008)*. Professores e pais expressaram aprendizado com o programa. Conclusão: Este estudo proporcionou melhora significativa no conhecimento, postura dinâmica, hábitos posturais, autopercepção física e qualidade de vida dos adolescentes. As intervenções associadas ao uso da tecnologia proporcionaram um processo de ensino-aprendizagem aos escolares participantes.

Palavras-chave: Postura; adolescentes; hábitos posturais; educação postural; tecnologia.

1. INTRODUTION

The World Health Organization (WHO) defines *adolescence* as the phase that comprises 10–19 years, starting with the processes of body transformations from puberty to the growth and social development of the individual, being the transition period from childhood to adulthood (BRASIL, 2017; Gonçalves et al., 2020; Junior et al., 2021). This period encompasses biopsychosocial changes, in which postural deviations and bad postural habits are commonly correlated with the increased probability of musculoskeletal pain that may persist in adulthood (Faria et al., 2021; Franco et al., 2020; Kamper & Williams, 2017).

During the development and body growth phase of adolescents, postural problems are common because they are exposed to increasing overloads, adaptations to body changes, and psychosocial demand, in which the anatomical structures of the spine can be submitted to endogenous and exogenous factors harmful to postural structuring (Akbari-Chehrehbargh et al., 2020; Gomes et al., 2021; Menotti et al., 2018). Some of the risk factors identified in the literature are growth spurt, high body mass index (BMI), female gender, sedentary lifestyle, psychosomatic diseases, family history, socioeconomic level, and inadequate acquired daily habits, especially in the school environment (Dullien et al., 2018; Vieira et al., 2015; Winik et al., 2019).

During the school phase, the adolescent's posture adapts to the activity being developed, with a greater propensity to develop some type of postural deviation due to incorrect postural habits practiced for an extended period. These include sitting with incorrect positioning, furniture with inappropriate ergonomics, use of backpacks with excessive load, and asymmetrical transportation (Minghelli et al., 2021; Viçosa et al., 2020). Accordingly, it is important to include postural education programs in schools, intending to develop learning and physical self-perception and potentiating the inclusion of postural care in school and daily life activities (Kasten et al., 2017; Miñana-Signes et al., 2021).

The considerable technological growth and popularization of the use of electronic devices in increasingly young audiences can aid the teaching-learning process (Bruzzi, 2016; Fonseca & Alves, 2018; Kendra et al., 2020). Moreover, the use of strategies integrating technology in teaching practices can present advantages in the ability to learn, improving the levels of concentration, organization, motivation, and participation, besides enabling autonomy in activity management (Bruzzi, 2016; Fonseca & Alves, 2018; Kendra et al., 2020).

Digital interventions and health practice through technology have brought new opportunities to the health area, reducing barriers to care provision (Mbada et al., 2019; Toelle & Utpadel-fischler, 2019). Thus, the application of an Online Postural Education Program for adolescents, up to the moment of this study, is unprecedented and innovative. This is because it reaches the target population regardless of physical barriers and bridges the gap between the student and technology. Furthermore, online educational activities involving students, teachers,

and family members close the cycle of stimulating experiences to improve posture and postural habits as a joint action, justifying the relevance of the current study.

Thus, the current study aimed to evaluate the theoretical knowledge about posture and health education, dynamic posture, physical self-perception in postural habits in the school environment and activities of daily living, and the quality of life of elementary school students in a public school in southern Brazil, before and after the application of an Online Postural Education Program. This study hypothesizes that a postural education intervention associated with technology will improve the participating students' knowledge, dynamic posture, postural habits, physical self-perception, and quality of life.

2. METHODS

This was a longitudinal interventional study, with evaluations before and after applying an Online Postural Education Program, with a quantitative and qualitative approach. This study followed the recommendations for non-randomized studies TREND Statement Checklist (Morais et al., 2020). The study included adolescents aged between 11–16 years enrolled in a public school in southern Brazil, who understood the evaluations and interventions performed. The study also included teachers of both sexes from different disciplines from the 6th to 9th grades of the participating elementary school and parents and/or legal guardians who filled out a weekly questionnaire. The exclusion criteria were: adolescents with diagnosed motor and/or cognitive disabilities, previously acquired physical disabilities, congenital and/or neurological alterations, and who did not attend two-third of the program's online interventions; teachers who did not attend online course; illiterate parents and/or guardians.

The research participants signed informed consent (teachers and guardians) or assent forms (adolescents) for the Google® Forms digital platform (Google®, United States). This study was approved by a Brazilian Ethics Committee on Research Involving Human Beings (CAAE: 46019921.3.0000.0118).

Initially, a telephone call was made with the secretary of the education and school boards of a municipality in southern Brazil, to present the project and invite them to participate in the study. The participating school was selected for convenience, and a schedule of activities was established with the managers. The participating students could be in face-to-face, hybrid, or remote teaching because the application of the Postural Online Education Program did not depend on the option of the type of teaching.

Between four and two weeks prior to the beginning of the interventions for each class, teachers, guardians, and students were invited through videos recorded by the researchers, containing the study goals and benefits of the program, which were presented in the classroom to each class and sent via Whatsapp® (Whatsapp LLC, United States) in the school's parent-school group. These were also contacted individually by telephone. After their acceptance, the ethical consent forms were filled out. The schedules for the individual online evaluations and reassessments were made via telephone contact and/or WhatsApp® (WhatsApp LLC, United States) of the family members and/or schoolchildren.

Data collection before and after intervention and application of interventions were performed through the digital platform Google® Meet (Google, United States) at the school board's request. The same researcher applied the data collection instruments for the evaluations and reassessments.

Pre-intervention evaluation through the digital platform Google® Meet was performed individually in the adolescents' homes, in which anamnesis was performed, with the

application of the Theoretical Knowledge Questionnaire and analysis of dynamic postures. The researchers elaborated the anamnesis, in which questions about current and previous history, presence of musculoskeletal pain complaints (using a Visual Analog Scale for pain), regular physical activity, and type of teaching were placed.

The researchers elaborated the Theoretical Knowledge Questionnaire on posture and health education which was applied through the online form of Google® Forms. The purpose was to verify the evolution of the theoretical knowledge of the students about the themes addressed in the program. It comprised twelve questions of true, false, or unsure of how to answer and five multiple-choice questions. This was answered with online supervision of a researcher who allowed five to ten minutes to complete the questionnaire to minimize a search in the literature and Internet. The answers marked as "I don't know" were considered incorrect answers, while each correct answer was scored with 1 point and incorrect answers with 0 points, totaling a score of 17 points. At the end, the proportion of correct answers in each question was verified.

In the evaluation of dynamic postures, postures and support materials were selected to perform simple and common postures in the home environment to minimize the risks of environmental variation and lack of adequate furniture to perform the desired posture. Accordingly, the following dynamic postures were assessed: posture when picking up and dropping objects to the ground (standardized objects were a ball or shoe box with a shoe inside); posture when tying the shoelaces; posture when carrying a backpack/school bag in which the students had to organize the backpack/school bag according to the highest weight of school materials. The adolescents performed the tasks as they do in everyday life and without specific instructions, being filmed in the frontal and sagittal planes during the virtual meeting.

The analysis of dynamic postures was performed later through observation of the footage, and the dynamic postures were scored using a Likert scale. It has emphasized that this analysis was performed by the same trained evaluator, and the biomechanical criteria were in accordance with the literature (Noll, Candotti, et al., 2013; Noll et al., 2016).

The following questionnaires were also sent through Google® Forms: Body Awareness of Postural Habits in Young People (BAPHY-Q); Back Pain and Body Posture Evaluation Instrument (BackPEI); Quality of Life Questionnaire for Children and Adolescents (KIDSCREEN-27). All these instruments are validated in the Portuguese language (Brazil), intended for adolescents, and were applied according to a schedule, with a maximum of 1 questionnaire per day, in a randomized way.

The BackPEI comprises 21 closed questions referring to postural habits adopted in the school environment and activities of daily living (ADLs). It addresses issues related to back pain in the last three months, demographic, socioeconomic, and hereditary data, and behavioral and postural habits, containing a specific version for females and males (Noll, Tarragô Candotti, et al., 2013).

The BAPHY-Q questionnaire comprises 35 closed questions to identify the students' self-perception about their postural habits in the classroom and at home and related to the teacher's attitude in the classroom. The Likert scale for this questionnaire is bipolar. Positive scores indicate that the participant describes an appropriate body perception of the postural habit, while the negative ones indicate that the perception is inadequate (Schwertner et al., 2018).

The KIDSCREEN-27 has 27 closed questions to verify the quality of life of adolescents. It is assessed using a Likert scale, in which a total score above 80 points is considered a good quality of life (De Farias Júnior et al., 2017).

To optimize the teaching-learning process of schoolchildren, teachers and family members participated in the study. An online course about postural education was offered to the teachers. The teachers were also invited to fill in the "Questionnaire of Self-Perception of Teachers and Perception of Posture and Postural Habits of their Students" (P&Hscreen – Posture and Habits Screen). The P&Hscreen was developed by the researchers and validated with Content Validation indexes greater than 0.81 (according to Halek Holle and Bartholomeyczik (2017) (Halek et al., 2017), values ≥0.78 are considered valid) and Test-retest Reliability with means of 0.94 for intraclass correlation coefficient (ICC) and 0.91 for Kappa Coefficient (KC) (Cicchetti, 1994), ICC between 0.75 and 1.00 is excellent (Gadotti et al., 2006), KC between 0.81 and 1.00 is considered almost perfect). The objective is to evaluate the postural self-perception of teachers and their perception of postural habits that their students perform in different situations in the school environment. It was applied through the Google® Forms platform one week before the remote training of teachers and at the end of the program.

The parents and/or guardians of the students were sent an online questionnaire prepared by the researchers through Google® Forms. The purpose was to verify their attendance as stimulators and protagonists in the proper development in physical exercises and changes in postural habits oriented in the Online Postural Education Program.

3. POSTURAL ONLINE EDUCATION PROGRAM

Approach with adolescents

The Online Postural Education Program was conducted over five weeks, comprising five remote meetings with an online evaluation and reassessment in the home environment and three online interventions at school through the Google® Meet platform. The three theoretical-practical interventions online occurred once a week, lasting 120 minutes for each class, at a date and schedule made available by the school.

On the first day of the online intervention, topics such as program objectives, general notions about the human skeleton, scapular and pelvic girdles, and postural muscles were addressed, together with the mechanism of postural compensation, body awareness, proprioception, the importance of physical activity, and kinesiophobia.

On the second day of the online intervention, ergonomics and adequate posture orientations were presented in the school environment and ADLs, such as the following: an appropriate way to use electronic devices, mobile phones, tablets, computers, and Notebooks when sitting at the school/home desk and in front of the computer, sitting and lifting properly, picking up and dropping objects to the floor.

On the third day, topics such as proper posture when tying shoelaces, standing, and walking properly, transportation of school materials, ideal weight of the school backpack, more suitable posture when sleeping, and pillow height were addressed.

At the beginning of the second and third online interventions, the students held games with questions related to the topics addressed in the program, using the program Mentimeter®: Interactive Presentation Software (Mentimeter, Sweden) through their mobile phones or electronic devices at their disposal. The scores of the adolescents were recorded with each appropriate response, computing a list of score records, awakening the students with the desire to overcome their scores and practice the contents addressed.

After each theoretical meeting, physical exercise practices were performed through online and synchronous practical classes of stretching, joint mobilization, balance, muscle strengthening, respiratory control, and relaxation, focusing on important musculoskeletal

structures to maintain more suitable posture. Wrong postures and executions of the proposed exercises were corrected online, live by a researcher physiotherapist.

As an educational reinforcement strategy, a site was developed on the platform Google® Sites (Google, United States), in which digital teaching materials presented in each theoretical intervention were available. It also included animated folders with orientations and demonstrations of the exercises to be performed at home during the week. These educational materials were developed using the software Genially® Applications and Websites (Genially WEB SL, Spain) and the digital design platform, Canva® (Canva Pty Ltd, Australia). The access link was available weekly to schoolchildren and family members via the group on the WhatsApp® platform. Care was taken to recommend physical exercises that students could do safely and with minimal equipment without supervision, and the researchers were available for online support if necessary.

Approach with teachers

Online training was initially conducted in a single session to teachers from the sixth to ninth grades of the participating elementary school, lasting 120 minutes, through the platform Google® Meet. The main subjects explained throughout the program were presented, as well as postural education themes directed to teachers, such as an appropriate posture when using the school board. Teachers were also invited to participate in online interventions with students and encouraged to perform postural education work after the intervention, continuing this theme in school activities.

Data analysis

The data were processed and analyzed in the Statistical Package for the Social Sciences (SPSS®) program, version 20.0. Dispersion measures such as arithmetic mean, standard deviation or median and interquartile interval, or absolute and relative frequency were applied to the variables. The normality of the distribution of the data was assessed through the Kolmogorov-Smirnov test. The paired student t-test (normal distribution) and Wilcoxon test (non-normal distribution) were applied to compare the quantitative variables before and after the intervention, as well as the McNemar test for nominal and Wilcoxon test for ordinal categorical variables. A significance level of 5% ($p \leq 0.05$) was adopted.

4. RESULTS

Of the 85 adolescents in the sixth to ninth grades enrolled in a public Elementary School, 54 were included in the Online Postural Education Program (Figure 1). The characterization of the student group is presented in Table 1.

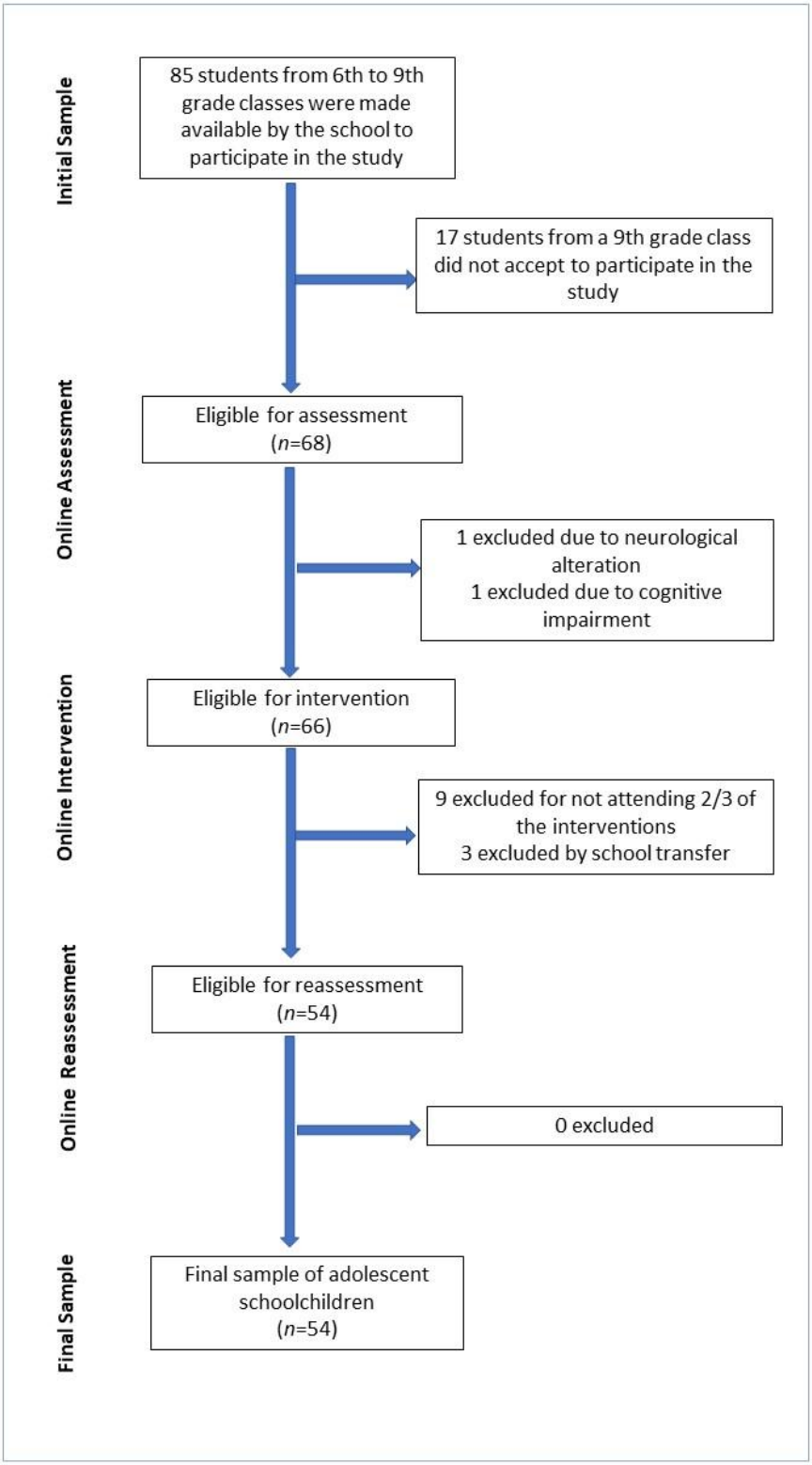

Figure 1. Flowchart of the sample selection adolescents

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Table 1. Characterization of adolescents

Variables	n=54
Age (years old)	12 ± 1
Sex	
Female	30 (55.60)
Male	24 (44.40)
Mass (kg)	54.58 ± 14.70
Stature (cm)	155 ± 22
IMC (kg/m²)	21.62 ± 4.39
Type of teaching	
Remote	4 (7.40)
Presential	50 (92.59)
Regular physical activity**	
Yes	21 (38.88)
No	33 (61.11)

Legend: Values presented as mean ± standard deviation or absolute (relative) frequency.
Abbreviations kg: Kilogram; cm: centimeters; IMC: Body Mass Index; kg/m²: kilogram per square meter; ** Physical education not included.

In the initial anamnesis, 23 (42.59%) adolescents reported having musculoskeletal pain complaints in the last three months. Of these, 15 (65.21%) were female, and 8 (34.75%) were male. Regarding the body region with a higher level of pain, 8 (34.80%) mentioned the lower back region, 6 (26.10 %) cervical spine, 5 (21.70%) shoulders, and 4 (17.40%) knees, with a score ranging from 4 to 6 (moderate pain) in the self-reported pain scale.

The results of the mean general score of the Theoretical Knowledge Questionnaire demonstrated significant improvement (7±2 vs. 13±3, $p<0.001$) in the teaching-learning process of adolescents regarding postural education after the application of the program (Figure 2). Of the 17 questions in the instrument, a statistical difference was verified in 15 questions in the proportion in which the students correctly answered each question related to the following subjects: anatomy of the human body ($p=0.39$; $p<0.001$; $p=0.05$; $p<0.001$; $p=0.38$; $p<0.001$; $p<0.001$); body awareness ($p=0.013$); kinesiophobia ($p<0.001$); postural habits in the school and home environments ($p<0.001$; $p<0.001$; $p<0.001$; $p< 0.001$; $p<0.001$; $p<0.001$).

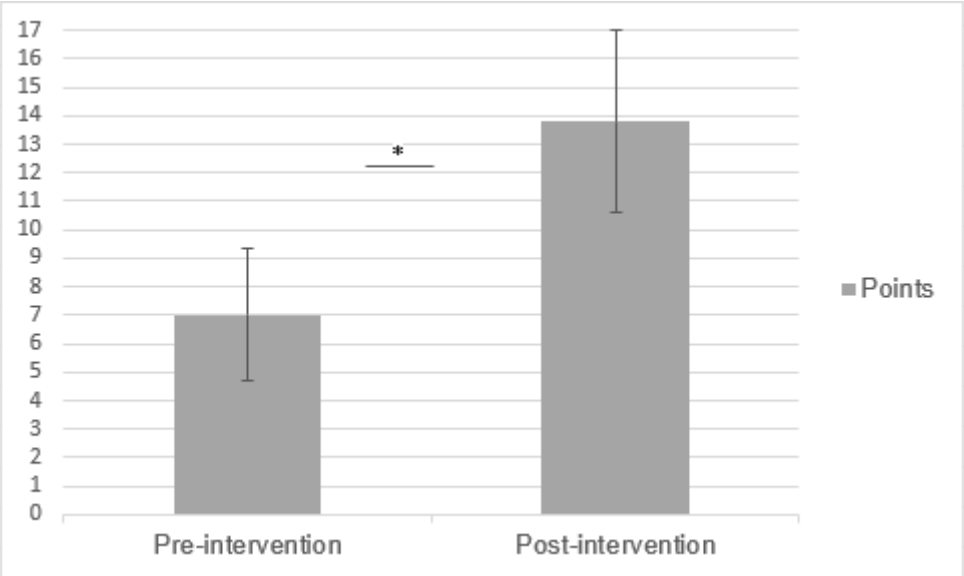

Figure 2. Result of the Theoretical Questionnaire before and after the application of the Online Postural Education Program (*Wilcoxon test*, n=54)
*statistically significant difference, $p \leq 0,05$.

Regarding the analysis of the students' dynamic postures, there was an improvement in execution and post-intervention learning in all postural habits analyzed: posture when tying their shoelaces (p<0.001); lifting and dropping heavy objects to the ground (p<0.001); transporting the school backpack (p<0.001) (Wilcoxon test for ordinal categorical variables).

The results of the BackPEI questionnaire assessed by the McNemar analysis revealed a significant improvement in the proportion of correct execution of postural habits in school environments and activities of daily living, such as the following: posture when lifting and dropping objects to the floor (p<0.001); transporting school backpacks (p<0.001); posture when sitting at a school desk to write (p<0.001); sitting in a chair to talk (p<0.001); sitting when using a computer (p=0.001).

Table 2 shows the students' self-perception regarding behavioral variables and postural habits performed in the school and home environment. After the intervention, a significant improvement was observed in the total BAPHY-Q score (10.11 ± 18.82 vs. 29.04 ± 14.90, p< 0.001).

Table 2. Results of the Questionnaire on Body Awareness of Postural Habits in Young People before and after on the Online Postural Education Program (*Paired Student t-test*, n=54)

BAPHY-Q	Pre-intervention	Post-intervention	p value
Total Score	10.11 ± 18.82	29.04 ± 14.90	<0.001*
Positive Scores (%)	51.38	73.82	
Negative Scores (%)	48.62	26.28	
Classroom	4.35 ± 7.21	11.37 ± 5.72	<0.001*
Positive Scores (%)	53.87	81.65	
Negative Scores (%)	46.13	18.35	
At home	4.37 ± 10.19	14.50± 9.56	<0.001*
Positive Scores (%)	50.56	74.51	
Negative Scores (%)	49.35	25.51	
Carrying objects	2.85 ± 3.27	5.15 ± 2.21	<0.001*
Positive Scores (%)	66.67	86.11	
Negative Scores (%)	33.33	13.89	
Teachers	-1.46 ± 2.51	-1.98 ± 2.52	0.345
Positive Scores (%)	27.16	24.69	
Negative Scores (%)	72.84	75.30	

Values presented as mean ± standard deviation; Relative frequency (%); Positive Scores correspond to the perception of adequate postural habits; Negative Scores correspond to the perception of inadequate postural habits. *statistically significant difference, $p \leq 0,05$.

The responses to the KIDSCREEN-27 quality of life questionnaire indicated an improvement in the means after the program's application (93.50 [82.75-103.25] vs. 99.50 [94.00-104.00], p=0.008), according to the total score shown in Table 3.

Table 3. Results of the Quality-of-Life Questionnaire for Children and Adolescents before and after on the Online Postural Education Program (*Wilcoxon test*, n=54)

KIDSCREEN-27	Pre-intervention	Post-intervention	p value
Total Score	93.50 [82.75-103.25]	99.50 [94.00-104.00]	0.008*
Physical activity and health	15.50 [14.00-18.00]	18.00 [15.00-19.00]	0.030*
Psychological well-being	22.00 [20.00-23.00]	22.00 [20.00-24.00]	0.706
Autonomy and relationship with parents	25.50 [20.00-29.00]	26.50 [22.00-29.00]	0.786
Social support and peer group	16.00 [11.75-19.25]	18.00 [16.00-19.25]	0.007*
School environment	15.00 [14.00- 17.00]	17.00 [14.75-19.00]	0.011*

Values presented as median [interquartile range 25-75%]. *statistically significant difference, $p \leq 0,05$.

Concerning the faculty from the sixth to ninth grades of a total of 12 teachers, 4 accepted to participate in the study, all of whom were female, with an average age of 40 ± 9.70 years, who have taught between 10 and 20 years, and 2 (50%) have higher education level (bachelor's degree) and 2 (50%) specialization. The total sample teaches classes in elementary school, and only one teaches in high school too. The teachers teach several disciplines of the curricular component of elementary school, highlighting that the four teachers are currently responsible for the discipline "Literary Reflection and Practice of Health and Food Hygiene" in different scholar years. The online theoretical-practical interventions with the students were conducted in classes where these teachers were responsible for the discipline of health promotion, which was available by the school.

The teachers reported that permanent education actions are rarely performed for teachers in the school participating in this study, in which the theme of postural education had never been addressed. Further, 3 (75%) of the teachers classified their knowledge about posture and proper postural habits in the school and home environment as considerably good after training. This provided the perception of being sufficiently able to develop and establish activities for students about postural education in which they previously declared they were not fit.

The analysis of the P&Hscreen questionnaire revealed that the perception of inappropriate habits prevailed in the physical self-perception of teachers in school activities before training. However, after training and termination of the program, good postural habits became more frequent. For example, concerning the posture during the transport of school material, previously, 3 (75%) of the sample had the perception that they poorly performed this habit, evolving to adequate, in which they acquired the habit of frequently using the backpack with both straps on the shoulders. Nevertheless, they continued carrying much weight (above 10% of body weight).

They also noticed an improvement in posture when using classroom and/or home furniture such as tables and chairs, in which the view of performing inadequate posture when sitting with the trunk tilted forward, away from the back of the chair, changed from frequent to rarely in 3 (75%) of the teachers. The teachers' self-perception regarding posture in the use of the blackboard and/or school slate remained the same, scored as adequate before and after the program. However, they sometimes reported writing with an elevation of the upper limbs above the shoulder line, which may be related to the main pain complaints mentioned by the majority of the sample—regions of the shoulders, cervical spine, elbows, wrists, and hands.

Regarding the teachers' perception of the posture and postural habits of their students in school activities, they noticed that the students began to carry school material properly after the theoretical-practical approaches of the program. They began to use the backpack with two straps over the shoulders, whereas before, it was more common to use the backpack over one shoulder only. Further, 3 (75%) of the sample found that there was an improvement in the students' posture when sitting at school, sitting more often with the trunk supported on the back of the school chair, keeping the knees at 90 degrees, and feet flat on the floor, considerably reducing the posture of slumping in the school chair.

Moreover, most teachers reported that they perceived those students previously performed cervical flexion frequently when using electronic devices and that after orientation, they more often kept their necks aligned when using electronic devices. Additionally, when picking up and dropping heavy objects to the ground, in the pre-intervention, they rarely kept the object close to their body, keeping the spine erect, while after the intervention, they progressed to frequently performing this daily activity with knee flexion.

The teachers reported that they performed school activities after the training of the Postural Education Program by reviewing the content with the classes that participated in the study. Further, they began the development of pedagogical strategies for postural promotion with all classes, although this was not associated with the school curriculum. They were also grateful for the training provided to them and the schoolchildren. For example: "I appreciate the attention. They loved it. I'm using the materials made available by the project to contextualize the theme with other classes." "Thank you so much for the affection; we learned a lot from the classes. The group was very excited about the activities conducted." "After the program classes, I performed activities to review the content covered and saw that they learned from the project. Thank you."

Regarding the participation of parents and family members as stimulators and protagonists in the proper development of physical exercises and changes in postural habits oriented in online theoretical-practical interventions, the results show a low attendance because only 20 (37.03%) answered the weekly online questionnaire. Of these, 16 (80%) reported that the teaching material available was read in the family, and 17 (85%) stated that their children performed the physical exercises at home proposed during the 3 weeks. Moreover, 16 parents (80%) noticed an improvement in postural habits such as posture when sitting, using electronic devices, and carrying the school backpack after applying the Online Postural Education Program.

Some family members were satisfied with the program: "My son really liked the classes; he's taking better care of how he sits. These days, he corrects his brother." "It was a pleasure; it's important to learn about posture." "It was very good for him, for his posture." "My daughter loved the classes and told me she wanted to have more." "We participated and talked about the project and what was done at school and home online with the student." "This activity conducted in school is very cool. I thank you for the initiative, congratulations to all."

5. DISCUSSION

This study led to significant benefits in the theoretical knowledge about postural education, dynamic postures, postural habits, physical self-perception, and quality of life of adolescents from a public school after the application of an Online Postural Education Program. The current study indicated that this online intervention provided positive results to the population of interest.

The prevalence of self-reported musculoskeletal pain in the last three months was present in 42.59% of the sample, and 34.75% were female. Kamper and Williams (2017), reported that the prevalence of musculoskeletal pain increases from childhood to adolescence, with a higher risk of chronic pain in adulthood, in those who report persistent pain. Thus, educational strategies on posture and reinforcement of good postural habits for adolescents are important.

The prevalence of low back pain in Brazilian schoolchildren varies between 13.4 and 46.70% (de Lemos et al., 2013; Meucci et al., 2018; Onofrio et al., 2012; Silva et al., 2016), being higher in girls, possibly related to their anatomy and differences in pubertal development (Rodríguez-Oviedo et al., 2018). In this study, the prevalence of low back pain in the total sample was 14.81%, corroborating studies in schoolchildren from southern Brazil (de Lemos et al., 2013; Onofrio et al., 2012). These findings may be due to the socio-cultural and economic similarities of the studied localities.

The significant improvement in the mean of the overall score and the proportion of correct answers of the Theoretical Knowledge Questionnaire after the interventions online demonstrate

that the approaches using education technology were effective in the teaching-learning process about posture and postural habits in the school context. According to Lozano-Lozano et al. (2020), the technology in education aims at expanding the reach of learning and teaching beyond physical space and distance and can offer continuous access to knowledge, information, and practice tools. Other studies (Dullien et al., 2018; Minghelli et al., 2021; Santos et al., 2017; Viçosa et al., 2020) found similar results with improved knowledge of students after postural intervention but performed a face-to-face approach. Improving knowledge on posture and postural habits can result in applying adequate static and dynamic postures when performing ADLs.

When analyzing the dynamic postures of adolescents, they were asked to adopt postures they perform daily and those that can be easily performed at home and observed by filming. Dynamic posture analysis can more accurately measure knowledge transfer to movement execution and be easily performed in different contexts (Dullien et al., 2018; Noll, Candotti, et al., 2013; Noll et al., 2016).

After the intervention, the adolescents significantly improved their postures when tying shoelaces, lifting and dropping heavy objects to the ground, and transporting their school backpacks, demonstrating that the knowledge acquired in online interventions was transferred to the correct execution of movements. Vieira, Treichel and Noll (2015), developed postural education strategies in a municipal school in southern Brazil and verified, through films, that the students displayed significant improvements in posture when lifting objects from the ground ($p=0.009$) and carrying their backpacks ($p=0.009$), in addition to other postures of ADL.

The task of lifting heavy objects from the ground is performed daily by adolescents. When performing the movement, flexing the spine instead of the lower limbs can cause pain due to overload in the muscles of the lumbar region and increased pressure of the intervertebral discs and may lead to their degeneration in the future (Vieira et al., 2015).

The current literature recommends that the correct weight of the backpack should not exceed 10% of the schoolchildren's body mass, but other important issues, such as its proper use, should also be evaluated (Rodríguez-Oviedo et al., 2018). Özgül et al. (2012), analyzed the excess weight of the backpack and its unilateral transport. They compared the specific kinematic parameters of the hemibody gait cycle that carried the backpack with the load-free hemibody, evaluated by motion analysis camera and force platform. They verified that both hemibodies were biomechanically affected by asymmetric load. Furthermore, the asymmetric use of a school backpack can cause postural changes such as lumbar hyperlordosis and thoracic hyperkyphosis, pain and musculoskeletal injuries, balance changes, and distribution of plantar pressure (Arias et al., 2018; Kim et al., 2015; Pau et al., 2011; Suri et al., 2020).

Additionally, by analyzing the BackPEI questionnaire, it was possible to verify an improvement in the correct execution of other postural habits after the theoretical-practical interventions, such as sitting down to write at the school desk and using the computer. Ozdemir et al. (2021), assessed 2,221 adolescents and found that musculoskeletal pain was related to poor postures when sitting in school (38.1%, n = 847) and carrying school backpacks (84.1%, n = 1,713). Other studies (Faria et al., 2021; Sedrez et al., 2015) also found a correlation between musculoskeletal pain and inadequate habits of adolescents, using the BackPEI, suggesting the importance of implementing postural education programs in schools to reduce the prevalence of postural changes by reducing associated risk factors.

Regarding the evaluation of the students' self-perception of behavioral variables and postural habits performed in the school and home environment through the BAPHY-Q questionnaire, the application of the Online Postural Education Program resulted in adolescents expanding their knowledge on the subject and their body awareness. This provided them incentives to adopt correct postural habits, helping them become active and responsible agents in promoting their health.

In the current study, the students already presented good quality of life, as assessed by the KIDSCREEN-27 questionnaire. However, after the intervention, there was a significant improvement in quality of life, which emphasizes that the change in postural habits and the practice of physical exercises are beneficial to adolescents' kinetic-functional and mental health. In a sample of 1,565 adolescents from Germany, with a mean age of 14.37 years, Wunsch et al., (2021), verified through the KIDSCREEN-27 questionnaire that the practice of self-reported regular physical activity was correlated with the improvement of quality of life. However, adolescence is a transition period characterized by emotional demands, which can lead to anxiety, depressive symptoms, and stress. Thus, it is important to promote the health and well-being of adolescents (Freire & Ferreira, 2018; Wunsch et al., 2021).

Regarding the participation of teachers in the program, it is important to highlight that they did not have previous knowledge about issues related to posture, postural habits, and postural education. After participating in the training and monitoring of the Online Postural Education Program with their students, they became sufficiently empowered. Thus, they began the implementation of educational activities on posture in the school and home environment of their students. According to Menotti et al., (2018), it is important to train education professionals through theoretical and practical training on the importance of body stimulation and appropriate postural habits in the learning process. Therefore, when teachers can recognize incorrect postural habits, they may be able to contribute to the identification of postural deviations and correction of postural habits of their students (Dullien et al., 2018; Junior et al., 2021).

Notably, there are few studies with joint actions of teachers and family members to benefit schoolchildren's postural education. According Vieira, Treichel and Noll (2015), efficient performance within the classroom by teachers and in the home by parents, with monitoring and instruction of students about correct postural habits, can be one of the preventive measures of early postural changes. Although the family members' participation was low, the results were positive, possibly due to actions performed with teachers and classmates. If the experience is brought to the family environment, the likelihood of maintaining and adopting good postural habits for activities of daily living is higher for the adolescent and the family as a whole.

To date, no studies have been found in the literature that used a postural education approach in the online format, making this study unprecedented. The use of technology has been pointed out as a potential solution to increase the teaching offer, as it offers ample opportunity at low cost, such as geographical barriers and can provide better educational experiences, stimulating students' attention, participation, and learning (Dunleavy et al., 2019; Lozano-Lozano et al., 2020). Accordingly, new studies with educational tools using technologies and gamification are required, integrating the participation of teachers and family members to enable the construction of knowledge through the expansion of access to the information provided. This can be useful for health promotion and prevention of postural problems of schoolchildren.

As limitations of this study, it is highlighted the difficulty in telephone contact with family members and/or schoolchildren for scheduling online evaluations and reassessments, which

overloaded the study logistics, as well as the lack of internet access of some parents who could not participate in the study. Additionally, the participation of only one school, the wide age range of the adolescents, low participation of teachers and family members, and small complications with the internet connection of the participating school were other limitations. These were quickly resolved, and the execution of the program followed according to the established schedule.

This study presents strengths such as the use of technology to benefit postural education for adolescents, as an innovative and effective strategy, which overcomes physical barriers and expands the reach of health promotion interventions, making the educational process more dynamic and engaging. Furthermore, it is an approach that involves not only students, but also teachers and parents, creating a collective and collaborative learning environment, enhancing changes in postural habits and improving the community's quality of life.

6. CONCLUSION

Through the application of the Online Postural Education Program, it is concluded that this intervention was effective in significantly improving theoretical knowledge about postural education, in the execution of dynamic postures when tying shoelaces, lifting and dropping heavy objects to the floor, and transporting school materials, the correct execution of postural habits when sitting at the table to write and a chair to talk and use the computer, physical self-perception in school and home environment, and quality of life of the participating adolescents. The interventions associated with the use of technology provided students with a teaching-learning process through the interaction of theoretical and practical activities, together with teachers and family members. These can become multipliers of appropriate postural habits in the school environment and other environments where they are inserted.

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