

INVESTIGACIÓN APLICADA EN SALUD Y BIENESTAR: DE LA EVIDENCIA A LA INTERVENCIÓN

Comps.

María del Mar Simón Márquez
Ana Belén Barragán Martín
Pablo Molina Moreno
Elena Martínez Casanova

Editorial ASUNIVEP

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Design, Implementation, and Evaluation of a Scalable School-Based Postural Hygiene Project to Prevent Low Back Pain in Primary School Children

Francisco José Vera Serrano* & Carlos Manuel Pérez Pérez**

**Servicio Andaluz de Salud; **Universidad de Cádiz*

Introduction

Project Description

Current State of the Issue (State of the Art)

Low back pain (LBP) is no longer regarded as a condition confined to adulthood. Epidemiological evidence indicates that spinal pain is highly prevalent among children and adolescents, with pooled prevalence estimates rising steadily throughout the school years and tracking into adult musculoskeletal disorders (Calvo-Muñoz et al., 2013; Jones & Macfarlane, 2005). Modifiable risk factors identified in this population include prolonged sitting time, poor postural habits during classroom and homework activities, insufficient physical activity, and inappropriate backpack loading and carriage, with several studies reporting a significant association between excessive backpack weight and the presence of LBP in schoolchildren (Sheir-Neiss et al., 2003; Skoffler & Foldspang, 2008).

In response to this evidence, school-based back care educational programmes, commonly referred to as "back schools," have been implemented internationally with the general aim of increasing children's and adolescents' knowledge of spinal anatomy, ergonomics, and safe postural behaviour, while promoting healthier habits at school and at home (Cardon et al., 2002). Several controlled studies have demonstrated that structured, multi-session postural education programmes produce sustained improvements in theoretical and practical ergonomic knowledge, together with reductions in self-reported LBP at one-year follow-up, particularly when programmes combine theoretical content with practical, hands-on training rather than a single lecture-based session (Minghelli et al., 2021). Comparable improvements in postural habits, knowledge, and trunk muscle endurance have been reported following short-term educational interventions in secondary school students, reinforcing the feasibility of embedding back care content within ordinary school activity (Ritter & de Souza, 2015).

Nevertheless, the evidence base remains heterogeneous and, according to recent systematic reviews, inconclusive with regard to sustained behavioural change, with considerable variability in programme duration, content, delivery format, and outcome measurement across studies. Backpack-focused educational interventions, for instance, have shown improvements in specific carrying habits without necessarily translating into a measurable reduction in pain prevalence over the following months, suggesting that knowledge transmission alone may be insufficient without continued reinforcement and family involvement. More recent digital adaptations of back care education, including web-based preventive programmes, have similarly increased back-related knowledge without producing significant changes in posture, pain prevalence, or trunk muscle endurance, highlighting persistent challenges in translating educational content into durable behavioural and physical outcomes among young children.

Within this context, our research team implemented a pilot postural hygiene intervention, "Tu espalda es salud" ("Your back is health"), delivered as an interactive workshop at a state primary school in the Bahía de Cádiz area, combining theoretical content on spinal anatomy and ergonomics with practical postural correction activities for schoolchildren, under the institutional authorization of the Andalusian Health Service. This pilot experience confirmed the feasibility of delivering physiotherapist-led postural education within the ordinary school schedule and the receptiveness of teaching staff and pupils to this

format, while also revealing the same limitation identified throughout the literature: a single-session or short-format intervention, without structured follow-up, family involvement, or objective postural assessment, is unlikely to produce measurable and sustained reductions in back pain prevalence. This chapter proposes the scale-up of this pilot experience into a structured, multi-session, family-inclusive project evaluated through a cluster-randomized controlled design.

Detailed Description of the Project and Objectives

"Tu Espalda Es Salud 2.0" is a proposed school-based, physiotherapist-led postural hygiene project designed to prevent and reduce low back pain among primary school children through a structured, multi-session educational and practical intervention, combined with family engagement and objective postural assessment. Building directly on the format piloted by the research team, the project scales the original single-workshop model into a six-week programme integrated into the ordinary school timetable.

The project targets children aged 8 to 12 years attending state primary schools within the Bahía de Cádiz-La Janda Health District catchment area. It comprises three complementary components: (1) a structured classroom curriculum of six weekly sessions covering spinal anatomy, ergonomics, safe backpack use, and correct postures for sitting, lifting, and screen use, delivered by physiotherapists in coordination with classroom teachers; (2) a practical postural correction component, including guided exercises and hands-on correction of sitting and lifting technique during each session; and (3) a family engagement component consisting of an information leaflet and a simple home-checklist enabling parents to reinforce correct postural habits and monitor backpack weight at home.

The intervention will be implemented over one school term (approximately 12 weeks, including baseline and follow-up assessments) and evaluated through a cluster-randomized controlled trial in which entire school classes, rather than individual children, are allocated to the intervention or a wait-list control condition, thereby minimizing contamination between groups within the same school environment. Outcomes will include both back-care knowledge and postural habits, consistent with previous back school literature, but will additionally incorporate self-reported LBP prevalence and objective backpack weight measurement, directly addressing the gap between knowledge acquisition and measurable behavioural and clinical change repeatedly identified in prior school-based programmes.

Project Objectives. Justification of the Interest and Feasibility

General Objective

To design, implement, and evaluate the effectiveness of a structured, multi-session, family-inclusive school-based postural hygiene project, compared with a wait-list control condition, in improving back-care knowledge, postural habits, and self-reported low back pain among primary school children, through a cluster-randomized controlled trial.

Justification of the Interest and Feasibility of the Project

The scientific interest of "Tu Espalda Es Salud 2.0" lies in its direct response to a limitation repeatedly identified in the school-based back care literature: educational interventions frequently improve knowledge without producing sustained changes in postural behaviour or pain prevalence (Minghelli et al., 2021). By extending the pilot single-session workshop into a structured multi-session format with practical correction and family involvement, and by evaluating outcomes with a cluster-randomized design that includes objective backpack weight measurement alongside self-reported pain, the project is positioned to generate more conclusive evidence regarding what programme components are necessary to translate knowledge into durable behavioural and clinical change.

From a feasibility perspective, the project builds directly on the operational experience, institutional authorization pathway, and school partnership already established through the pilot workshop delivered at a state primary school in the Bahía de Cádiz area. The proposed format requires no substantial

infrastructure beyond ordinary classroom space and can be delivered within existing curricular time allocated to health education, minimizing disruption to academic schedules and reducing the financial and organizational barriers that often limit the scalability of school health interventions.

Finally, by incorporating a family-based reinforcement component, addressing a component largely absent from the pilot format and only partially present in previous back school programmes, the project responds to recommendations in the literature suggesting that sustained behavioural change requires reinforcement beyond the school environment, thereby increasing the plausibility of achieving durable reductions in childhood low back pain prevalence.

Methodology

Description of Materials and Methodology. Planned Activities

"Tu Espalda Es Salud 2.0" will adopt a two-arm, cluster-randomized controlled trial design, with entire school classes as the unit of randomization, allocated 1:1 to the intervention or wait-list control condition using a computer-generated randomization sequence stratified by school and grade level. Participants will be children aged 8 to 12 years attending participating state primary schools within the Bahía de Cádiz–La Janda Health District catchment area, with parental informed consent obtained prior to enrolment.

The intervention will consist of six weekly 45-minute classroom sessions delivered by physiotherapists in coordination with classroom teachers. Each session will combine approximately 20 minutes of theoretical content, addressing spinal anatomy, ergonomics, correct sitting and lifting technique, safe backpack use, and screen-related postural habits, with approximately 25 minutes of practical activity, including guided postural correction exercises, backpack-fitting practice, and interactive games reinforcing key postural concepts. A structured home component will accompany the classroom sessions, consisting of an illustrated family leaflet and a simple weekly checklist enabling parents to reinforce correct habits and monitor their child's backpack weight. The control classes will continue their ordinary curriculum during the intervention period and will receive the same programme, in compressed format, after the follow-up assessment has been completed.

Table 1. Eligibility Criteria (Schools, Classes and Children)

Inclusion criteria	Exclusion criteria
State primary schools within the Bahía de Cádiz–La Janda Health District catchment area	Schools already implementing a structured back-care educational programme
Children aged 8–12 years enrolled in participating classes	Children with a diagnosed spinal pathology requiring active specialist follow-up (e.g., scoliosis under treatment, spondylolisthesis)
Written informed consent from parents/legal guardians	Absence of parental informed consent
Willingness of school management and teachers to integrate the 6-week curriculum into the ordinary timetable	Schools unable to commit to the full 6-week session schedule

Table 2. Weekly Curriculum Content of the Six-Session Classroom Programme

Session	Theoretical content (≈20 min)	Practical content (≈25 min)
1	Basic spinal anatomy and function	Postural self-awareness activities
2	Correct sitting posture at the desk	Guided seated posture correction
3	Safe backpack use and loading	Backpack-fitting practice with sample backpacks
4	Correct lifting and carrying technique	Guided lifting practice
5	Screen use and postural habits at home	Postural correction games
6	Review and integration of concepts	Family checklist introduction and role-play

Justification of the Methodology According to the Objectives

The proposed methodology is grounded in evidence that structured, multi-session, hands-on postural education programmes produce more consistent improvements in ergonomic knowledge and postural habits than single lecture-based sessions (Minghelli et al., 2021), and that combining theoretical content with guided practical correction enhances the durability of learned postural behaviour (Ritter & de Souza,

2015). The addition of a family engagement component is justified by evidence and repeated recommendations in the school-based back care literature suggesting that reinforcement beyond the classroom is necessary to translate acquired knowledge into sustained behavioural change, particularly regarding backpack carriage and home postural habits (Cardon et al., 2002).

The cluster-randomized design, allocating entire classes rather than individual children, is methodologically appropriate given the classroom-based delivery format and minimizes contamination between intervention and control participants who share the same physical and social environment, a consideration of particular importance in school-based trials evaluating knowledge-transmission interventions.

Suitability of Materials and Methodology to Each Type of Activity

Materials have been designed to fit the different activities comprised within the programme. For the theoretical sessions, physiotherapists will use an age-appropriate illustrated slide set and anatomical models adapted from the format piloted in "Tu espalda es salud," simplifying anatomical and ergonomic concepts for children aged 8 to 12 years. For the practical sessions, materials will include correctly and incorrectly loaded sample backpacks for hands-on fitting practice, floor markers for postural correction exercises, and a simple observational checklist enabling physiotherapists to record each child's baseline postural habits during guided activities. For the family component, an illustrated leaflet, written in accessible language, and a one-page weekly home-checklist will be distributed through the school, requiring no digital access and thereby maximizing reach across families with differing resources.

Assessment materials will include a validated back-care knowledge questionnaire adapted to primary-school reading level, a simple LBP prevalence questionnaire completed with parental assistance, and a portable digital scale for objective backpack weight measurement conducted at school.

Available Resources and Their Suitability for the Project

The project will be coordinated by the Physiotherapy Department of the Faculty of Nursing and Physiotherapy of the University of Cádiz, in partnership with the Bahía de Cádiz–La Janda Health District (Andalusian Health Service), building on the institutional authorization pathway already established for the pilot "Tu espalda es salud" workshop. Participating state primary schools will provide classroom space and curricular time for the six weekly sessions, and school management teams will facilitate communication with families for the home-based component.

Additional resources include portable digital scales for backpack weight assessment, printed educational and assessment materials produced with departmental support, and access to institutional statistical software for the planned cluster-adjusted analyses. Collaboration with school health coordinators and the district's community health promotion team will support recruitment, scheduling, and the institutional authorization process required for implementation within the public school system.

The project will be conducted in accordance with the ethical principles of the Declaration of Helsinki and the specific safeguards required for research involving minors, and will be submitted for approval to the Provincial Research Ethics Committee of Cádiz and to the relevant educational authorities prior to implementation. Written informed consent will be obtained from parents or legal guardians, together with the assent of participating children expressed in age-appropriate language. All data will be pseudonymised at the point of collection and managed in accordance with Spanish Organic Law 3/2018 on Data Protection and Guarantee of Digital Rights and Regulation (EU) 2016/679, with particular attention to the reinforced protection required for personal data concerning minors.

Indicators and Evaluation Procedures

The primary outcome will be change in back-care knowledge, measured with an age-adapted theoretical and practical questionnaire administered before the intervention, immediately after the six-week programme, and at three-month follow-up, consistent with instruments used in previous back school evaluations (Minghelli et al., 2021).

Secondary outcomes will include self-reported LBP prevalence and intensity over the preceding month, collected with parental assistance at the same three time points; objectively measured backpack weight, expressed as a percentage of each child's body weight, recorded by physiotherapists at school; and observed postural habits during a standardized seated task, rated using the same checklist applied at baseline.

Implementation outcomes will include session attendance, teacher-reported ease of curricular integration, and family engagement with the home-checklist, measured through checklist return rates, providing information on the feasibility of embedding the programme within routine school practice.

Table 3. Outcome Measures, Instruments and Assessment Time-Points

Domain	Instrument	Baseline	Post-intervention	3-month follow-up
Back-care knowledge (primary)	Age-adapted theoretical/practical questionnaire	X	X	X
Self-reported LBP prevalence/intensity	Parent-assisted questionnaire	X	X	X
Backpack weight	Portable digital scale (% body weight)	X	X	X
Observed postural habits	Standardized seated-task checklist	X	X	X
Implementation	Attendance register, checklist return rate	–	X	X

All outcomes will be analysed following the intention-to-treat principle, using multilevel mixed-effects models with pupils nested within classes and classes nested within schools, including group, time, and group-by-time interaction as fixed effects, and class and school as random effects, to appropriately account for the clustered data structure. Backpack weight will additionally be analysed as a binary variable (percentage of children exceeding the recommended threshold of 10–15% of body weight) using generalized linear mixed models with a logit link. Statistical significance will be set at $p < .05$, with effect sizes and 95% confidence intervals reported for all between-group comparisons.

Project Organization and Planning

The project will be organized into four sequential phases over an estimated 14-month period.

Phase 1: Preparation (Months 1–3). Institutional authorization procedures, school recruitment, cluster randomization, adaptation and printing of educational and assessment materials, and training of participating physiotherapists in standardized session delivery.

Phase 2: Baseline Assessment and Intervention Delivery (Months 3–6). Baseline knowledge, pain, and backpack-weight assessments, followed by delivery of the six-week classroom programme to intervention classes, with concurrent continuation of the ordinary curriculum in control classes.

Phase 3: Post-Intervention and Follow-up Assessment (Months 6–11). Immediate post-intervention assessment, delayed delivery of the compressed programme to control classes, and three-month follow-up assessment across all participating classes.

Phase 4: Analysis and Dissemination (Months 11–14). Cluster-adjusted statistical analysis, preparation of manuscripts and a practical implementation guide for participating schools, and dissemination of findings to school management teams and the district's community health promotion service.

Coordination will be maintained through a shared calendar with participating schools, monthly progress meetings with school health coordinators, and a single point of contact within each school to facilitate session scheduling and material distribution.

Dissemination activities will include the preparation of a practical implementation guide summarizing session content, materials, and scheduling recommendations, intended to facilitate adoption by additional schools within the health district without direct research team involvement. Findings will be disseminated to school management teams, the district's community health promotion service, and relevant educational authorities, and will be submitted for publication in peer-reviewed journals indexed in the Journal Citation Reports, following the CONSORT extension for cluster-randomized trials.

Results

Expected Results of the Project

Outcomes to Be Evaluated Upon Completion of the Project

The evaluation of "Tu Espalda Es Salud 2.0" will focus on determining whether extending the pilot postural hygiene workshop into a structured, multi-session, family-inclusive format produces measurable improvements in back-care knowledge, postural habits, objectively measured backpack weight, and self-reported low back pain prevalence among primary school children, relative to a wait-list control condition.

Implementation outcomes, including session attendance, ease of curricular integration, and family engagement with the home-checklist, will also be evaluated to determine the feasibility of scaling the programme across additional schools within the health district.

Description of Evaluation Procedures and Expected Results

Assessments are planned at three time points: baseline, immediately after the six-week programme, and at three-month follow-up, allowing analysis of both immediate and short-term sustained effects, an aspect that was not captured in the single-session pilot format.

Based on findings from comparable multi-session back school programmes combining theoretical and practical content (Minghelli et al., 2021; Ritter & de Souza, 2015), the intervention is expected to produce significant improvements in back-care knowledge, sustained at three-month follow-up, together with improvements in observed postural habits during seated tasks.

With regard to backpack weight, given the inclusion of hands-on fitting practice and a family-based monitoring checklist, addressing a risk factor consistently associated with childhood LBP (Sheir-Neiss et al., 2003), a measurable reduction in the proportion of children carrying backpacks exceeding recommended weight thresholds is anticipated in the intervention group relative to control.

Regarding self-reported LBP, while previous single-technique or short-format educational interventions have shown limited effects on pain prevalence, the combination of structured practical correction with family reinforcement is expected to produce a modest but measurable reduction in reported LBP episodes at follow-up, addressing the gap between knowledge acquisition and clinical outcome repeatedly reported in the school-based back care literature.

Finally, high rates of session attendance and positive teacher-reported feasibility of curricular integration are expected, building on the receptiveness already observed during the pilot workshop, supporting the programme's potential for scale-up across additional primary schools within the health district.

Several limitations are anticipated. First, self-reported LBP prevalence in young children, even when collected with parental assistance, may be subject to recall and reporting bias. Second, although cluster randomization minimizes contamination within the same school, informal exchange of information between intervention and control classes cannot be entirely excluded and will be monitored through teacher debriefing. Third, the delayed delivery of the compressed programme to control classes, while ethically appropriate, prevents a longer blinded follow-up comparison beyond three months.

Conclusions

Conclusions. Innovations Derived from the Implementation of the Project

"Tu Espalda Es Salud 2.0" represents a structured and evidence-informed evolution of a successful pilot postural hygiene workshop into a scalable, multi-session, family-inclusive school-based project for the prevention of childhood low back pain. Rather than relying on a single educational session, the project adopts a comprehensive format combining classroom-based theoretical content, hands-on postural correction, and family reinforcement, directly addressing the principal limitation identified throughout the school-based back care literature: the frequent disconnect between improved knowledge and sustained behavioural or clinical change (Minghelli et al., 2021).

One of the main innovations of the project lies in its cluster-randomized evaluation design, which minimizes contamination between intervention and control participants sharing the same school environment, together with the incorporation of objective backpack weight measurement alongside self-reported knowledge and pain outcomes, providing a more complete evaluation framework than that typically applied in previous single-outcome back school studies.

The family engagement component constitutes a further contribution, extending the reach of the intervention beyond the classroom through a low-cost, non-digital home-checklist accessible to families regardless of technological resources, in contrast to recent digital adaptations of back care education that have shown limited effects on posture and pain despite increasing theoretical knowledge.

From a practical standpoint, the project has been designed for direct scalability within the public school system, relying on existing curricular time, physiotherapist involvement already institutionally authorized through the pilot experience, and low-cost printed materials, minimizing the financial and organizational barriers that commonly limit the sustainability of school health interventions. If the expected outcomes are confirmed, the project has the potential to provide a replicable, low-cost model for reducing childhood low back pain within the Andalusian public health and education systems, while contributing evidence to the broader international literature on the translation of school-based back care education into measurable behavioural and clinical outcomes.

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