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Organoleptic Evaluation, User Acceptability, and Cosmetic Safety of Physiorelax Forte Plus Formulations in a Pediatric Population

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Abstract

Massage relieves stress and anxiety, but also helps to reduce musculoskeletal problems, decreasing tension, in all stages of life. For pediatric use, organoleptic properties, cosmetic safety and user acceptability of topical products are important given the higher frequency of irritative or allergic episodes in young skin. We evaluate for the first time the comprehensive cosmetic performance of Physiorelax Forte Plus natural formulation in cream, spray and roll-on applied regularly in healthy and active children/adolescents. 210 healthy volunteers were included (150 adults with sensitive skin and 60 children and adolescents [6–16 years]). This three-part, sequential, observational, non-comparative pilot design monitored user experience under real-world conditions: (I) Open-label testing to assess skin compatibility in adults (N = 60); (II) In-use testing in adults for cosmetic acceptability and safety over 14 days (N = 90); (III) In-use testing in children/adolescents for 14 days (N = 60). Outcomes were dermatological assessments for tolerability and user (and/or parents/caregiver(s)-reported) satisfaction/acceptability and perceived benefits. No control group or objective efficacy measures were included. Among pediatric participants, no cutaneous reactions were observed at application sites after 14 days of use. Proxy reporting about consumer satisfaction and acceptability for the range were generally high. Principal component analysis revealed a clear three-cluster structure (sensory, functional, practicality), with roll-on driving the strongest differentiation across items and spray aligning most closely with sensory attributes, while cream showed an intermediate functional profile. The Physiorelax Forte Plus range demonstrated a favorable cosmetic safety profile and consumer acceptability in pediatric use under real-world conditions. Findings are limited by the observational, unblinded design, absence of a control group, and reliance on subjectively reported outcomes; no clinical or pharmaceutical claims are implied. Future controlled studies incorporating objective dermatologic endpoints, benchmark products, and direct child/adolescent reporting are warranted.

Keywords: child and adolescent health; massage; musculoskeletal system; cosmetic safety; self-care; topical administration; user acceptability

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Academic Editor: Enzo Berardesca

Received: 22 January 2026
Revised: 4 March 2026
Accepted: 27 March 2026
Published: 1 April 2026

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1. Introduction

Self-care is increasingly embraced in today's era. Adopting health-related and self-care behaviors is always a challenge, but this challenge is not just for adults, but for all ages. While it is true that there are conceptual models of self-care in children and young

adolescents with chronic conditions [1–4], these models of self-care should be leveraged not only for the management and recovery of various conditions, but also for prevention of potential problems and maintain mental and physical balance from early ages.

Physical activity is part of the definition of childhood, part of their daily life [5], and the presence of minor injuries, muscle soreness and fatigue, bruises and contusions is common. Accordingly, maintaining musculoskeletal health has become a recognized component of pediatric wellness [6]. Regular maintenance of musculoskeletal health should be done not only when a problem appears, but also for prevention. Pediatric massage can offer a very good approach to preserve musculoskeletal health as a care routine during exercise and daily activity and to address potential minor bodily related discomforts [7]. Establishing routine locomotor care can foster a proactive attitude towards preventing and relieving musculoskeletal discomfort while maintaining everyday well-being [8,9].

Within this context, the choice of natural products must account as a key element especially in pediatric populations, not only because this population presents more frequently with skin conditions [10], but because their vulnerability of developing skin. Pediatric skin exhibits a more permeable barrier that matures with age [11,12], making formulation quality and pH compatibility essential to avoid disrupting the barrier. In this context, natural-based cosmetic products are often preferred for routine care.

Topical products used during massage range from pharmacological analgesic gels to cosmetic preparations intended to condition the skin and facilitate massage. Physiorelax Forte Plus (Almirall S.A., Barcelona, Spain) range appears as a care product for global wellness and musculoskeletal personal health based on natural products, benefiting both the user and the person providing the massage, as they contain skin-friendly ingredients suitable for all ages. This range of formulations contains adaptogenic ingredients, described by the manufacturer as natural bioregulators, intended to help maintain the skin's balance and homeostasis [13]. Physiorelax Forte Plus range is available in three different formats (cream, spray and roll-on) (https://www.physiorelaxforte.com/productos [accessed on 4 March 2026]).

A recent study on the Physiorelax Forte Plus cream conducted an organoleptic assessment (cosmetic and application characteristics) by an expert panel, comparing it with another topical product intended for similar use. The results indicated a preference for Physiorelax Forte Plus Cream over Fisiocrem, based on its cosmetic characteristics [13], supporting its use in adults. In this sense, despite the widespread use of topical products for massage, pediatric-specific data on cosmetic performance, organoleptic attributes, short-term tolerability, and caregiver/child acceptability are very scarce, with most studies restricted to adults. Also, comparative information across formulation formats (e.g., cream, spray, roll-on) that could inform product selection is also limited. This research gap in early ages is particularly relevant given the higher vulnerability and permeability of pediatric skin during its maturation process.

The present study addresses this gap by providing the first evidence on the organoleptic attributes, cosmetic safety, and user satisfaction of the three different Physiorelax Forte Plus formulations in a pediatric population when applied regularly under normal conditions of use. A second objective was the evaluation of unexpected reactions reported by parents/caregiver(s), as well as possible reactions observed by the pediatrician. The results of this study will provide data for the first time on the real-world cosmetic use of this range of formulations on pediatric skin, which will help parents/caregiver(s), massage practitioners and/or health care professionals to decide and recommend a possible choice for their use.

2. Materials and Methods

2.1. Topical Formulations for Evaluation

The Physiorelax Forte Plus range (cream, spray and roll-on; Almirall S.A., Barcelona, Spain: https://www.physiorelaxforte.com/ [accessed on 4 March 2026]) is composed of massage formulations for muscles and ligaments, based on natural ingredients. Physiorelax Forte Plus formulations contain extracts of arnica (*Arnica montana*) [14,15], devil's claw (*Harpagophytum procumbens*) [16], St John's wort (*Hypericum perforatum*) [17], marigold (*Calendula officinalis*) [18,19], beeswax [20,21], mint (*Mentha piperita*) [22–24], menthol [25], eucalyptus oil [26,27], camphor [28,29], sunflower extract (*Helianthus annuus*) [30,31], limonene and citric acid [32–35], glycine soybean oil [36,37], Asiatic pennywort extract [38,39] and rosehip/*rosa moschata* seed oil [40–42] to nourish the skin, among its ingredients.

Study Design

This pilot study aimed to evaluate skin acceptability [43] and cosmetic safety [44,45] in an active pediatric population of the three formulations of the Physiorelax Forte Plus range, following a sequential methodological approach. The design sequence was based on three parts, with open tests [46] and in-use tests (under normal conditions), with the inclusion of adult volunteers in the first two parts, and children/adolescent volunteers in the subsequent Part III. Part I consisted of 3-day open tests designed as an initial compatibility screen to detect early, immediate-type irritation or intolerance in adults before proceeding to the "longer" in-use phases. Short open tests of 24–72 h are widely used in cosmetic tolerability assessments as a preliminary safeguard step [47]. Delayed hypersensitivity or cumulative irritation were expected to emerge, if present, during the subsequent 14-day in-use phases (Parts II and III) [48], which were specifically designed to capture subacute reactions under routine conditions of use. The sequential design therefore ensured that no early compatibility concerns were detected before progressing to the pediatric phase [45]. (Figure 1).

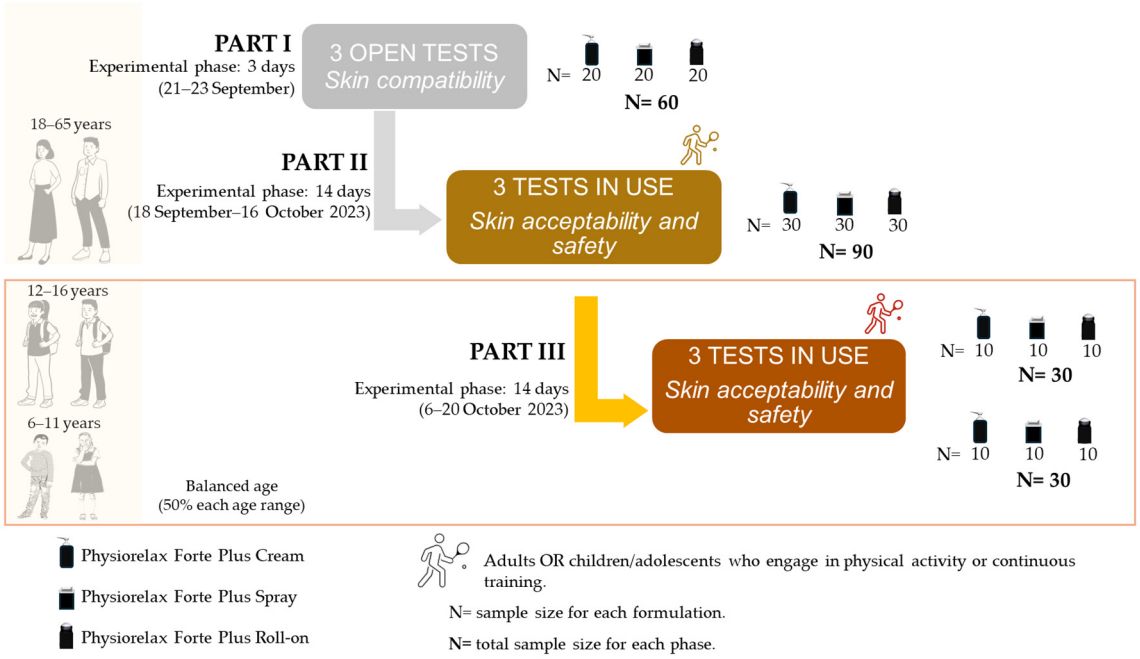


Figure 1. Sequential study chart.

The final sample for all parts involved a total of 210 healthy volunteers (150 adults and 60 children/adolescents). Signed informed consent and/or assent (as applicable)

were obtained from all participants and/or from parents/caregiver(s) at enrollment. The following sections describe the characteristics of each part, the volunteers included, and the experimental design of each part.

2.2. Parts I and II: Testing in Healthy Adult Volunteers

2.2.1. Part I: Open Skin Compatibility Tests

This first part was carried out in 60 healthy adult volunteers (men and women between 18 and 65 years old) with sensitive skin [49–51] and Fitzpatrick phototype I to IV [52]. The main exclusion criteria were having a chronic or acute illness at the time of study initiation or during the 3 weeks prior to the study; having skin pathologies during the 3 weeks prior to the start of the study; being under pharmacological treatment; pregnant or breastfeeding women; and subjects with an allergy to any of the components of the formulations under study.

Open testing of the formulations was performed to verify the dermatological compatibility (absence of irritation) of each of the three formulations, followed by a macroscopic examination on a numerical scale. All compatibility tests were conducted at the research center, where volunteers attended to receive the product and undergo evaluation. Twenty participants were assigned to each of the three formulations.

The experimental part consisted of three consecutive days, during which the dermatologist applied the product under study under normal conditions of use to the right leg (calf) at the clinic. After 30 min of a single application of the product, any adverse reactions were recorded each day to rule out any signs of contact urticaria. A safety test was carried out by the dermatologist in the application zones after repeated open applications (without occlusion) on the right leg (leaving the left leg as the control zone [without product]).

In case of reactivity, the main observable signs were evaluated across different dimensions (erythema, edema, vesicle/blister/papule/pustule, and dryness/peeling) on a 5-point scale (0 = absence of a specific sign, 4 = significant presence of a specific sign). The occurrence of erythema had to be specified as diffuse or localized. The main sensations of discomfort (heat, stinging, itching, tightness and burning), if any, were evaluated on a 3-point ordinal scale: slight, moderate, severe. This inspection by clinicians is consistent with common cosmetic in-use testing practice. The main objective of Part I was to verify the short-term dermatological compatibility of the formulations after repeated applications.

2.2.2. Part II: In-Use Skin Acceptability and Cosmetic Safety Testing

This part was carried out with 90 healthy adult volunteers with the same inclusion criteria and instructions as in Part I, with the addition that they had to be volunteers who practiced sports daily and were regular users of products similar to the one tested. Also, in this case, the participants should not have any skin marks in the experimental area that could interfere with the evaluation of skin reactions (pigmentation disorders, scars, overdeveloped hairiness, ephelides and nevi in quantity, sunburn, etc.).

During the in-use Tests, product applications were performed before and after sport and/or physical activity, for 14 days, so Part II lasted two weeks. During the experimental phase, the first application of the product was carried out during the first visit with the dermatologist to explain how to apply it. The dermatologist then handed the formulation containers to the adult volunteers and explained the recommendations to be followed during the following two weeks of application outside the center. On the last day (day 14), the product was also applied at the medical center.

To ensure optimal experience during the study, recommendations for use for the three formulations coincided with the usual use of the product, focusing on the area of the body to be exercised. It was recommended to apply the product twice on training days, before

and after physical exercise, and once on non-training days. The application should be with a gentle massage covering the area to exercise adequately until it is completely absorbed; this flexibility in the amount allows us to use it according to individual needs. Precautions were not to apply the cream/spray/roll-on on irritated or injured skin and to avoid contact with eyes and mucous membranes.

On the first and last day of the study, a clinical examination of the volunteers was performed at the center. The dermatologist also collected any information regarding adverse events (AEs) on the last day. In addition, on this last visit, a13-item questionnaire on the user acceptability and the perceived benefit of the formulations (a questionnaire for each formulation) was completed by the volunteers (see Table 1).

Table 1. User questionnaire on formulations' acceptability and perceived benefit.

Item	Question
1	After using the product, do you feel that it provides a pleasant sensation on the skin?
2	Do you consider that using the product acts in a localized way in the area?
3	Do you find that the product is absorbed quickly?
4	Do you consider that the use of the product provides a feeling of relief and comfort in the area?
5	Do you consider that the use of the product provides a toning sensation after its application?
6	Do you consider applying the product before physical activity helps to activate the area?
7	Do you consider applying the product before physical activity, does it reactivate the area during physical activity?
8	Do you consider that applying the product after physical activity helps the area to recover?
9	Do you consider that when applying for the product, it takes effect immediately?
10	Do you consider that the effect of the product lasts on the skin, creating a long-lasting sensation?
11	Do you think that after using the product it helps to minimize muscle fatigue?
12	After physical overexertion, do you think it helps to restore the exercised area?
13	Do you consider that the type of packaging facilitates the application of the product?

"Product" wording inside the items is understood as referring to each of the formulations in the range.

The primary endpoint of Part II was the cosmetic safety of the formulations after continuous use for 14 consecutive days, including the presence/absence of undesirable reactions as assessed by the dermatologist, and the assessment of discomfort reactions observed by the participants. Secondary endpoints included an organoleptic evaluation and subjective satisfaction and perceived benefit of the study formulations by the adult volunteers.

In order to proceed to the testing of the pediatric part, the results of Parts I and II in adults had to be satisfactory.

2.3. Part III: Testing in a Healthy Pediatric Volunteer Population

Part III: In-Use Skin Acceptability and Cosmetic Safety Testing

In this part of the study, the same inclusion and exclusion criteria as in Part II in adults were applied to a pediatric population aged 6–16 years. In this case, the pediatric population was not required to have sensitive skin. The included pediatric sample was intentionally age-balanced: 50% were children aged 6–11 years old and 50% were children aged 12–16 years, to avoid over-representation of one developmental stage and ensure that overall results were representative of the full pediatric population [53] (preventing unintentional bias related to product exposure conditions, skin characteristics, developmental stage, or activity patterns), even though age-stratified analyses were not conducted because satisfaction questionnaires were completed by caregivers rather than minors. Age stratification was not expected to influence the results and would not yield meaningful or interpretable differences.

For the in-use tests of Parts II and III, only one questionnaire was prepared, since in the case of the pediatric population (Part III) the parents/caregiver(s) responded to the

subjective questionnaire. Unexpected reactions reported by the parents/caregiver(s), as well as possible reactions observed by the pediatrician, were also collected. Possible AEs reported by the parents/caregiver(s) were collected through a non-leading, open question ("Has your child/adolescent experienced any skin reaction or any change you have observed during the study period?"). This approach is commonly used in in-use product evaluations to avoid suggestion bias and ensure that only spontaneously observed events are reported. Parents/caregiver(s) were encouraged to mention any reaction, whether or not they believed it to be related to the product. This methodology about AE reporting based on user-reported spontaneous observation mirrors regulatory cosmetovigilance principles, which explicitly rely on spontaneous consumer reports rather than directed symptom checklists [54–56]. All reported events, if any, were documented by the investigator. Applications of the formulations were performed under dermatological and pediatric control, before and after sports and/or physical activity, for 14 days. The recommendations were the same as in Part II for adults. On the first day of the study, a pediatric evaluation was performed to check the suitability criteria. Also, the first application of the product was performed so that the parents/caregiver(s) could see how the product was applied and at that moment it was also evaluated if there was any reaction. On day 14, parents/caregiver(s) filled out the subjective questionnaire on user acceptability and perceived benefit of the formulations. A pediatric evaluation in terms of cosmetic safety was also performed. The primary and secondary endpoints were the same as those for Part II in adults.

All participants across all parts, including adults and children/adolescents, were required to refrain from applying cosmetic products other than the one being tested in the experimental area; to avoid extensive exposure to solar radiation for one week before and throughout the testing period; and to refrain from receiving any vaccination within 3 weeks preceding the study or during its conduct.

2.4. Definition of Sensitive Skin and Rationale for Adult Pre-Screening

In this study, the sequential design intentionally began with adult participants with "sensitive skin" [51,57] (Parts I and II). In accordance with the Scientific Committee on Consumer Safety (SCCS) Notes of Guidance [45], ingredients and products intended for infants and children require a conservative approach due to age-related sensitivities; therefore, we structured the evaluation program in phases, starting with adults and only moving on to the pediatric population after there were no signs of risk. This adult-to-child approach is widely used in cosmetic safety assessments to maximize the likelihood of identifying early tolerability issues before proceeding to the pediatric phase [45]. Evaluating skin compatibility in a more reactive adult subgroup before progressing to pediatric participants served as an additional ethical safeguard, ensuring that no preliminary safety signals appeared before involving children. In contrast, the pediatric phase included a general-use population without requiring sensitive skin, as the objective was to characterize real-world acceptability and tolerability in the broad group of children for whom these formulations are intended. This distinction between phases was therefore deliberate and methodologically aligned with standard cosmetic testing practice.

2.5. Compliance Assessment During the In-Use Tests

In this consumer use cosmetic study, compliance was assessed following the standard approach used in in-use evaluations: at the final visit, adult participants (Part II) and parents/caregiver(s) (Part III) were asked whether they had followed the investigator's recommendations for formulations' use throughout the 14-day period. This method is consistent with common practice in for consumer use studies, where recognize "consumer

use tests" and "self-assessments" are valid methods. Then compliance is self-reported and not monitored through application logs or product-weight measurements [54–56,58].

2.6. Ethical and Regulatory Compliance

The study, including all its parts, was conducted in accordance with the following standards: the general principles of medical ethics in clinical research of the Declaration of Helsinki Declaration (June 1964) and its subsequent modifications; the international recommendations on Good Clinical Practice for the conduct of clinical trials of medicinal products ICH E6 (R1) of 10/06/1996 (CPMP/ICH/135/95); Directive 2001/20/EC of the European Parliament and of the Council on the harmonization of the laws, regulations, and administrative provisions of the Member States relating to the application of good clinical practice in the conduct of clinical trials on medicinal products for human use-OJ/EC of 01/05/2001; and the COLIPA recommendations-August 1997: "guidelines for the assessment of human skin compatibility".

In accordance with current Spanish regulatory frameworks (Royal Decree 85/2018 and Royal Decree 1090/2015), research involving cosmetic products does not require evaluation by an Institutional Review Board, as such studies are not classified as clinical investigations of medicinal products and are instead governed by specific quality-control and oversight mechanisms under the authority of the Spanish Agency of Medicines and Medical Devices (AEMPS).

2.7. Statistical Analysis

Statistical analysis was primarily descriptive, as the study was not designed to test comparative hypotheses between products or populations. Frequencies, percentages, and summary statistics were used to characterize skin tolerability outcomes and questionnaire-based satisfaction results. No inferential statistical tests were applied, since the objectives focused on documenting cosmetic acceptability and user experience rather than establishing differences between groups. This analytical approach is consistent with non-interventional cosmetic evaluations; however, it inherently limits the ability to make comparative or causal interpretations.

The 13-item questionnaire used to assess cosmetic acceptability, user satisfaction and perceived benefits was developed specifically for this pilot study and has not undergone formal psychometric validation. The choice of a non-validated instrument reflects the exploratory, non-comparative, real-world design, in which the primary aim was to descriptively capture caregiver-reported and adult experience and short-term cosmetic tolerability rather than to generate clinical efficacy data or inferential comparisons. The questionnaire was evaluated using a 4-point scale: 1 = completely disagree, 2 = disagree, 3 = agree, 4 = completely agree. The results were expressed as percentages of adult volunteers (or parents/caregiver(s)) satisfied with the formulation. For the pediatric sample, these answers were aggregated as follows: those who answered 3 or 4 were parents/caregiver(s) considered satisfied for an item, and those who answered 1 or 2 were parents/caregiver(s) considered not satisfied. These dichotomous results are represented as percentages by a radial graph (or network plot) to visually compare the percentage of parents/caregiver(s) satisfied (scores of 3–4) and dissatisfied (scores of 1–2) with each characteristic of the formulations. A principal component analysis (PCA) was performed in Python (v.3.11) to explore multivariate patterns in the perception of the three product formulations (cream, spray and roll-on) across the 13 evaluated attributes. The analysis was conducted on a matrix of 13 observations (attributes) $\times$ 3 variables (formulations). Each cell contained the mean Likert score for that attribute–formulation combination, calculated by weighting the percentage distribution of responses. Responses were numerically coded as follows:

1 = completely disagree, 2 = disagree, 3 = agree, and 4 = completely agree. This produced a continuous metric ranging from 1 (lowest agreement) to 4 (highest agreement) for each attribute. For each formulation and each item, a weighted mean score was calculated based on the observed percentage distribution of responses. This procedure yielded a 13 × 3 matrix containing one continuous score per item and formulation. Before multivariate analysis, all three formulation variables (cream, spray, roll-on) were standardized (z-scoring) to remove differences in scale and to ensure equal contribution to the subsequent components. A PCA was performed on the standardized matrix. Components were extracted using eigenvalue decomposition of the covariance matrix. The first two principal components (PC1 and PC2) were retained for visualization, together explaining >98% of the variance in the data. Component loadings were used to interpret the contribution and directionality of each formulation within the PCA space.

Rather than applying an unsupervised clustering algorithm, items were assigned to three thematic clusters based on their semantic content: sensory (items describing perceptual and hedonic sensations), functional (items referring to perceived physiological or performance-related effects), and use/practicality (items related to application context, ease of use, or packaging). These clusters were used purely as interpretative categories, not as inputs to the PCA model.

Statistical analyses were descriptive in nature. Summary statistics were calculated using Microsoft Excel (Microsoft Corporation, Redmond, WA, USA). Figures were generated using Microsoft Excel. One figure was created using the Python programming language in a supported computational environment (Microsoft Corporation, Redmond, WA, USA).

Sample Size Justification

This study was designed as an exploratory, non-comparative safety and acceptability evaluation of cosmetic products, and not as a hypothesis-driven clinical efficacy trial. Therefore, no formal sample size calculation based on statistical power was performed. Sample sizes were determined according to standard practices for cosmetic open and in-use safety studies, aiming to ensure sufficient exposure to detect common adverse skin reactions and to assess subjective acceptability under real conditions of use. A sample size of approximately 20 participants per product/formulation is commonly considered adequate in cosmetic safety and tolerability assessments. The pediatric sample size (N = 60; 20 per formulation) was considered sufficient to identify frequent tolerability issues and unexpected reactions, while minimizing unnecessary exposure of children and adolescents, while the adult phases (N = 150) provided preliminary safety assurance prior to pediatric testing. Importantly, the sequential approach (adult compatibility → adult acceptability → pediatric evaluation [user acceptability and cosmetic safety]) was chosen for ethical reasons and is consistent with exploratory tolerability studies [45,55,59].

3. Results

3.1. Part I: Open Skin Compatibility Tests in Adult Volunteers

A total of 60 healthy adult volunteers with sensitive skin were included for the Open Tests. The basic demographic and clinical characteristics of each group according to the formulation to be tested can be found in Table 2. No AEs or signs of irritation were detected in any of the volunteers after single and/or repeated applications (3) of the three formulations.

Table 2. Demographic and clinical characteristics of participants by test type and formulation.

	Open Skin Compatibility Tests in Adults Total N = 60	**In-Use Skin Acceptability Tests in Adults Total N = 90**	**In-Use Skin Acceptability Tests in a Pediatric Population Total N = 60**
Cream	N = 20	N = 30	N = 20
Age, years Mean (SD) Median (IQR)	 38.5 (8.4) 39.5 (10.5)	 38.3 (12.0) 39.5 (21.3)	 11.5 (3.0) 11.5 (5.0)
Sex, male/female N (%)	10/10 (50%, 50%)	19/11 (63.3%, 36.7%)	11/9 (55%, 45%)
Fitzpatrick phototypes N (%)	I: 0 II: 6 III: 14	I: 0 II: 2 III: 28	I: 0 II: 8 III: 11 IV: 1
Spray	N = 20	N = 30	N = 20
Age, years Mean, SD Median (IQR)	 37.1 (11.2) 37.5 (16.0)	 35.8 (12.7) 36.0 (18.8)	 11.3 (3.0) 11.5 (5.3)
Sex, male/female N (%)	11/9 (55%, 45%)	12/18 (40%, 60%)	7/13 (35%, 65%)
Fitzpatrick phototypes N (%)	I: 1 II: 4 III: 15	I: 0 II: 2 III: 28	I: 0 II: 9 III: 11
Roll-on	N = 20	N = 30	N = 20
Age, years Mean, SD Median (IQR)	 37.6 (10.9) 39.0 (18.5)	 37.9 (12.0) 38.5 (17.8)	 10.9 (3.1) 11.5 (4.3)
Sex, male/female N (%)	9/11 (45%, 55%)	15/15 (50%, 50%)	10/10 (50%, 50%)
Fitzpatrick phototypes N (%)	I: 1 II: 4 III: 15	I: 0 II: 1 III: 29	I: 0 II: 5 III: 13 IV: 2

IQR: interquartile range; SD, standard deviation.

3.2. Part II: In-Use Skin Acceptability and Cosmetic Safety Testing in Adult Volunteers

For Part II, a total of 90 healthy adult volunteers with sensitive skin who practiced sports daily and were regular users of products similar to the tested one were included (see Table 2). None of the volunteers reported or presented skin reactions in the area of application of the product according to the dermatologist evaluation at the final visit. No volunteer reported discomfort after continued use of the formulations.

The results of the subjective questionnaire on formulations' satisfaction and perceived benefit in healthy adult volunteers are shown in Figure 2. Overall, in almost all cases the volunteers were at least satisfied with all formulations' characteristics. Both the cream and the roll-on showed the highest rates of subjective satisfaction, especially the cream, with percentages of volunteers completely satisfied with the characteristics of the formulation exceeding 80% in at least 7 out of the 13 items evaluated.

3.3. Part III: In-Use Skin Acceptability and Cosmetic Safety Testing in a Pediatric Population

For Part III, a total of 60 healthy pediatric volunteers (range 6–16 years) who practiced sports were included (see Table 2).

None of the pediatric volunteers presented skin reactions in the area of application of the formulations as assessed by the pediatrician at the final visit. One parent/caregiver reported a single episode of transient discomfort in his daughter during continued use of the cream. According to the caregiver, during application on the legs, the spreading of the cream generated a sensation ("vaho", as literally described by the caregiver) that caused the child to cry for 2–3 min until the product was fully absorbed or covered by leggings. No visible skin changes were observed at any time by the study clinician. No additional cases of discomfort or dermatologic reactions were reported among the remaining participants.

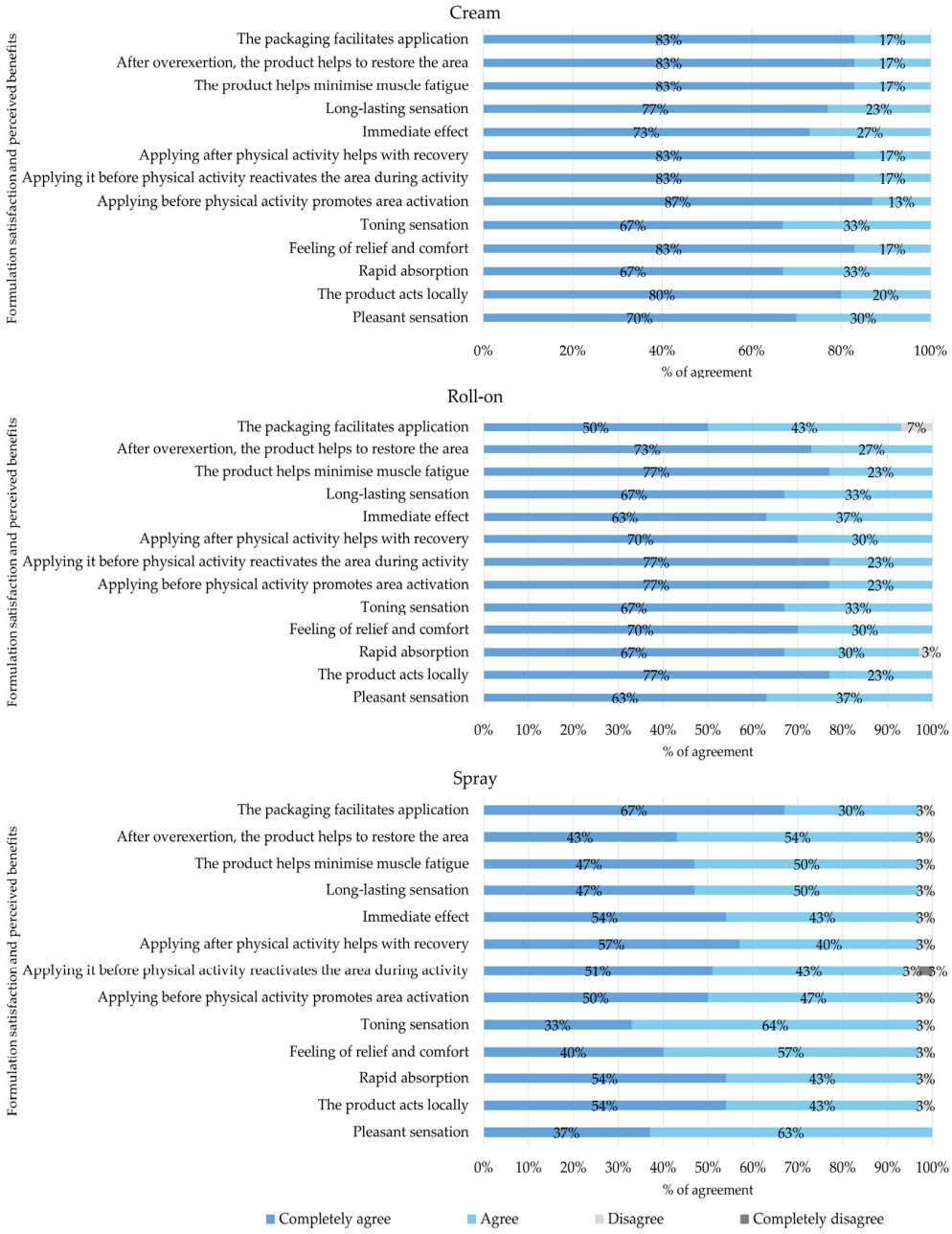


Figure 2. User acceptability and perceived benefits of the formulations in healthy adult volunteers (Part II).

The results of the questionnaire on formulations' acceptability and perceived benefit in the pediatric healthy volunteers are shown in Figure 3. The percentages of complete satisfaction (by parents/caregiver(s)) with the three formulations were slightly lower in the pediatric population compared to the adult one. However, overall, most parents/caregiver(s) (>90%) were completely satisfied/satisfied with most characteristics of all three formulations. Some items stood out slightly because few parents/caregiver(s) disagreed with the toning sensation item for all three formulations. Figure 4 compares how satisfied and dissatisfied parents/caregiver(s) were with each formulation-related subjective questionnaire item. Twenty-five percent of parents/caregiver(s) were dissatisfied with the spray packaging. Overall, the charts reveal that the global opinion about formulations is very positive. The skin acceptability of the three formulations was very good according to the user results (Figure 4) and the pediatrician's opinion.

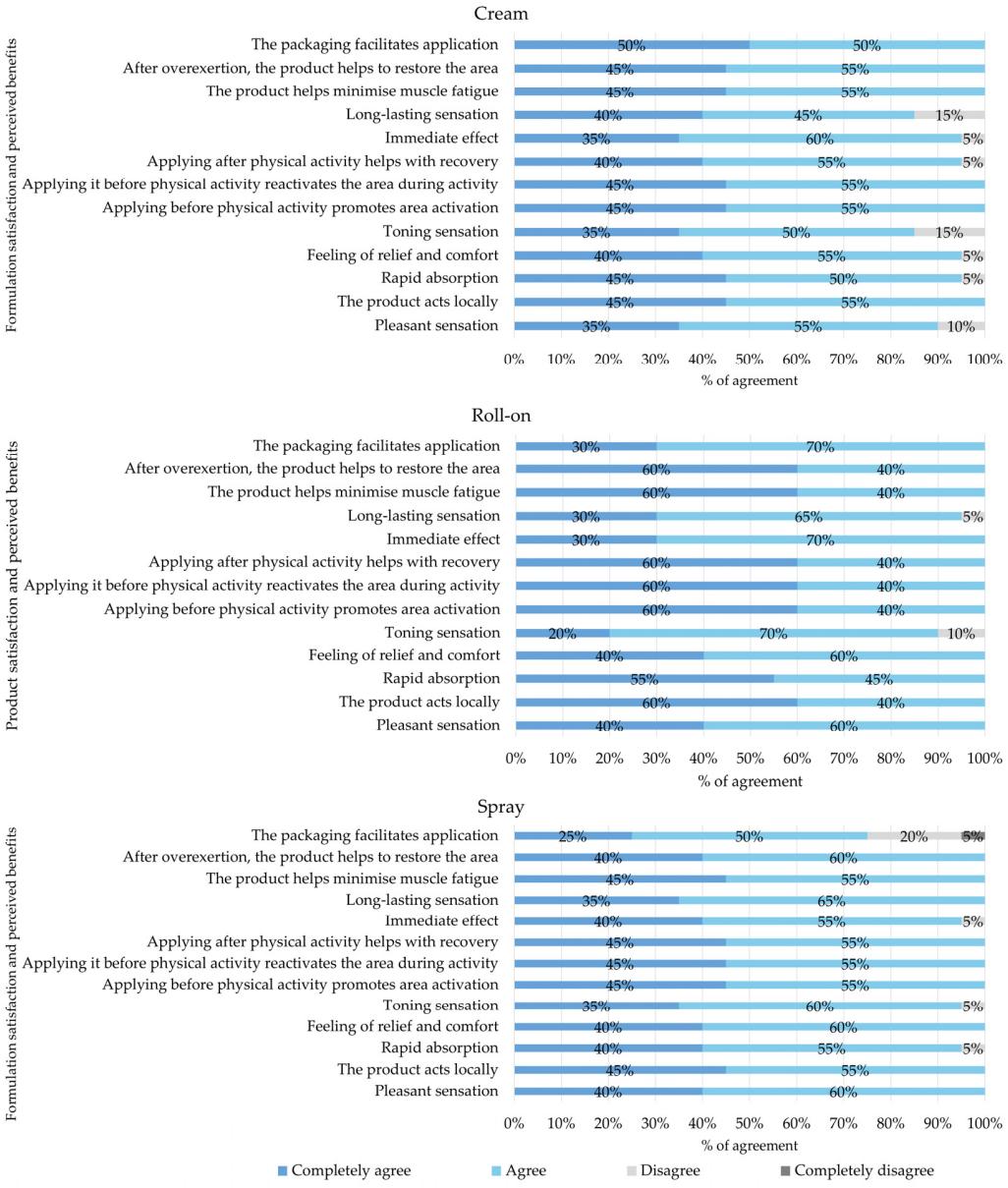


Figure 3. User acceptability and perceived benefits of the formulations in healthy child and adolescent volunteers (Part III).

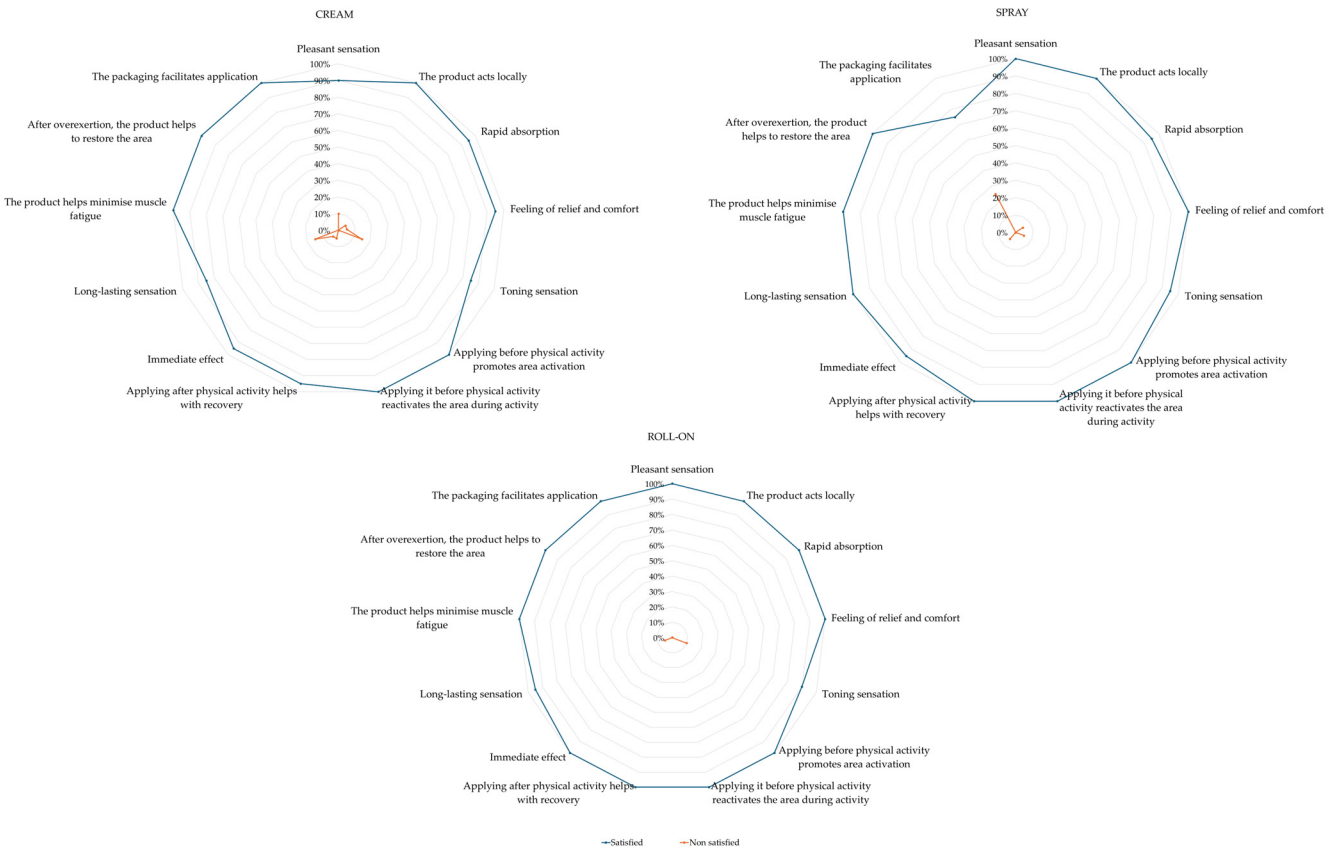


Figure 4. Radial graph comparing the percentage of parents/caregiver(s) satisfied and dissatisfied with the organoleptic characteristics for each formulation.

Overall, satisfaction greatly outweighed dissatisfaction for all attributes across all formats, indicating consistent positive user perception by parents/caregiver(s) (Figure 4). In any case, in the evaluation of sensory attributes one by one, some differences across formulations were observed.

For the cream, satisfaction rates approached the upper range across nearly all attributes, particularly for localized action, area activation, subjective feeling of relief and comfort and easy application. Satisfaction with the toning and the long-lasting sensation was slightly lower compared with other attributes of the formulation, with both attributes obtaining a score slightly below 90% satisfaction. For the roll-on, the high satisfaction profile was once again predominant across all attributes, with the proportion of non-satisfied users consistently low, reinforcing a broadly positive evaluation of this format. But, again, the toning sensation for the roll-on also showed comparatively lower satisfaction levels, reaching around 90% of positive opinions. Finally, the spray formulation also displayed a higher global satisfaction profile, with users consistently reporting high satisfaction on most attributes, except for ease of use as a spray, reaching approximately 70% of positive opinions, indicating generally good, though not maximal, acceptance of this characteristic.

Overall, the radar charts (Figure 4) demonstrate that all three formulations achieved very high satisfaction rates with minimal dissatisfaction, confirming good acceptability and user experience across sensory, comfort-related, and functional characteristics.

The complementary PCA analysis is shown in Figure 5. The PCA performed on the standardized 13 × 3 item–formulation matrix revealed a highly compact structure, with the first two principal components explaining 98.4% of the total variance (PC1: 61.5%; PC2: 36.9%). This indicates that nearly all meaningful variability in participants' eval-

uations of the three formulations (cream, spray, roll-on) can be represented in a two-dimensional latent space.

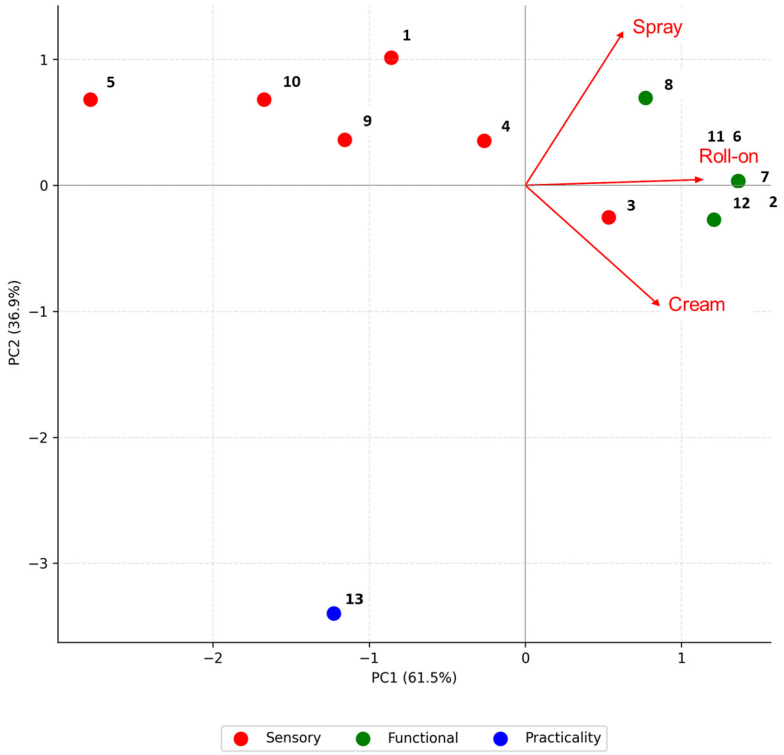


Figure 5. Multidimensional profile of product performance attributes by formulation (PCA Biplot) by parents/caregiver(s). PC, principal component; var, variance. Numbers (1–13) correspond to the 13 assessed attributes: 1, Pleasant sensation; 2, Acts locally; 3, Rapid absorption; 4, Relief and comfort; 5, Toning sensation; 6, Activation before physical activity; 7, Reactivation during activity; 8, Recovery after physical activity; 9, Immediate effect; 10, Long-lasting sensation; 11, Minimizes muscle fatigue; 12, Restores after overexertion; 13, Packaging facilitates application. The biplot shows the projection of all attributes onto the first two principal components (PC1 and PC2). Colors indicate attribute clusters: sensory (blue), functional recovery/activation (green), and packaging (orange). Red arrows represent formulation loadings (cream, spray, roll-on).

The PCA biplot showed a clear organization of the items into three content-driven thematic clusters: (a) sensory (items 1, 3, 4, 5, 9, 10): these items (related to pleasant sensation, rapid absorption, immediate effect, toning, long-lasting sensations and overall comfort) clustered together in the upper PC2 region. Their position showed closer alignment with the spray loading vector, suggesting that the spray format is the one most consistently associated with sensory attributes; (b) functional (items 2, 6, 7, 8, 11, 12): items describing physiological effects (local action, recovery, fatigue minimization) and activity-related functional use (before/after physical activity) grouped in the sector influenced by roll-on and, to a lesser extent, cream. This indicates that these formulations are perceived as more effective in terms of functional benefits and sports-related application contexts; (c) practicality (Item 13): the sole item related to ease of application and packaging usability positioned independently, with a clear directional alignment toward the roll-on vector, reflecting its perception as the most practical and convenient formulation. The loading vectors for the three formulations showed differentiated perceptual profiles: roll-on displayed the strongest discriminative contribution along PC1, aligning with functional and use-oriented attributes; spray loaded positively along PC2, reinforcing its association with sensory characteristics; cream presented an intermediate profile, closer to functional benefits than to sensory attributes.

Overall, the PCA structure demonstrates that participants' perception of the formulations is well differentiated across sensory, functional, and practical dimensions, with stable and coherent item groupings that reinforce the internal consistency of the evaluation patterns.

3.4. Compliance Assessment of All Participants During the In-Use Tests

All participants and parents/caregiver(s) reported full adherence to the recommended regimen; therefore, the calculated compliance rate was 100% (for all formulations). This value reflects the self-reported nature of the assessment and should be interpreted within the methodological context of observational consumer use studies.

4. Discussion

When examining the ingredients of creams that are applied for musculoskeletal care, we often find chemical substances that do not help skin care, such as blocking agents and/or preservatives. These components have the potential to block the skin pores, leading in some cases to redness, rashes, or allergic reactions. This is especially important in subjects with sensitive skin and/or infants and young populations [60,61]. It is well known that the cutaneous barrier and immune development from early life to adulthood undergo changes [12,62] with the skin being softer and smoother at early ages [11]. When skin products are used daily, this is especially relevant. Physiorelax Forte Plus range appears in three different formats (cream, spray and roll-on) as natural topical antalgics respecting the properties of the skin for musculoskeletal health care and massage use. This is the first study evaluating cosmetic safety, organoleptic characteristics, subjective satisfaction and perceived benefit of these three formulations in a pediatric population aged 6–16 years.

There are various definitions of the periods of child development, but there is agreement in separating newborns from infants/preschoolers from the age of 3 years [63]. Thus, for example, the World Health Organization (WHO) divides the stages of child development into newborn, early childhood (0–3 years), middle childhood (4–9 years) and adolescence (10–19 years) in the pediatric population [64]. By initially focusing on sports, the age range of the pediatric population in the current work was set to 6 years old, which is when this population starts practicing sports. However, in accordance with the WHO's conceptualization of childhood, we believe that our findings could be extended to the pediatric population from 3 years of age onwards. The current results show a very good cosmetic safety profile and dermatological compatibility of the three formulations applied regularly for 14 days in children and adolescents practicing sports. The entire range showed no skin reactions.

Many personal care products are often responsible for allergic contact dermatitis and irritant contact dermatitis in the general population [65]. Contact hypersensitivity is especially common in adolescents, and many ingredients in fragranced skin care products are true allergens that can cause skin reactions [66]. Our safety results stand in clear contrast to these findings. Interestingly, we found no differences between the three types of formulation application in terms of skin compatibility. In addition to a good cosmetic safety profile, the organoleptic characteristics, as well as the perceived benefit, of the formulations generally satisfied the parents/caregiver(s) of the pediatric volunteers. The formulations provided subjective relief and comfort, helped activate the area before, during and after activity, giving a personal sensation of reduced muscle fatigue and supporting recovery after overexertion. In this sense, compared with adults, the proportion of "complete satisfaction" was slightly lower in children and adolescents, a well-described pattern in pediatric research where parents/caregiver(s) proxy reports tend to be more conservative and less prone to extreme ratings. This is largely attributable to the nature of proxy

reporting, as parents/caregiver(s) base their evaluations on observable behaviors rather than on subjective sensory experiences directly perceived by the user. Consequently, proxy reports show lower concordance in less observable domains (such as immediate effect, long-lasting sensation, or perceived comfort) yielding more moderate ('agree') rather than maximal ('completely agree') responses [67–69]. Moreover, parents/caregiver(s) hold different evaluative expectations than adult users: while adults directly assess cosmetic and acceptability attributes during post-exercise recovery, parents/caregiver(s) evaluate these formulations within routine musculoskeletal well-being in their children, where subjective effects are naturally less evident. This shift in evaluative focus widens the distribution between "agree" and "completely agree" without altering the overall positive perception of the formulations [67–69]. Despite these expected differences in proxy-based ratings, overall satisfaction ("agree + completely agree") remained consistently high, supporting the good acceptability of the formulations in the pediatric population.

Principal component analysis revealed a clear three-cluster structure (sensory, functional, practicality), with roll-on driving the strongest differentiation across items and spray aligning most closely with sensory attributes, while cream showed an intermediate functional profile.

Limitations

This study is not without limitations. Because this was a pilot, exploratory study with a predefined non-comparative design, the sample sizes were not based on power calculations and were not intended to detect rare AEs or to identify meaningful differences between formulations or products. The study is suited to capture frequent or early tolerability issues but cannot provide robust incidence estimates or comparative risk profiles.

The study did not control the level of exercise performed by the pediatric volunteers, either on the days of physical activity or on the presumed days of no physical activity, which may affect the results, although all trends are in the same direction, with no skin reactions and general satisfaction with the formulations. Also, considering that some of the age groups are already adolescents, it would be interesting to assess the subjective satisfaction and perceived benefit directly from them, as there may be a slight bias on the part of the parents/caregiver(s). So, future studies evaluating the perceptions directly reported by the volunteers receiving the formulations are warranted [70]. In this regard, this pilot exploratory study relied on a subjective non-validated questionnaire for adults and caregivers and on clinician visual inspection rather than on validated dermatologic scoring systems, objective imaging, or laboratory assessments. These methodological choices are appropriate for descriptive cosmetic in-use evaluations but limit the robustness and the precision of tolerability assessments and preclude any inference regarding clinical efficacy or detailed safety quantification.

The lack of randomization and blinding naturally restricts the extent to which comparative or causal interpretations can be made regarding product performance; however, as the purpose of this study was not to compare formulations or evaluate efficacy, but to characterize cosmetic skin acceptability, tolerability, and user-reported experience in real-life usage conditions, within the field of non-interventional cosmetic research, study designs that are observational, non-randomized, and unblinded are widely accepted and considered appropriate for documenting safety profiles and consumer use perceptions. In addition, because the formulations differed in format, texture, packaging, and mode of application (cream, spray, roll-on), blinding of participants, caregivers, or clinicians was not feasible, a constraint common to cosmetic in-use evaluations. As the study did not involve efficacy endpoints nor comparative hypotheses, the absence of blinding is less impactful. Nonetheless, knowledge of the applied product may influence subjective acceptability

ratings, and findings should therefore be interpreted as descriptive real-world tolerability and user experience rather than as blinded or inferential evidence.

The absence of a control group prevents establishing whether the lack of AEs is attributable to the formulations themselves or to other factors such as natural variability over time, placebo effects, caregiver expectations, or the benign nature of routine massage. Therefore, no causal inference can be made regarding skin tolerability.

Future controlled studies (including validated skin assessment tools, standardized dermatological scoring methods, comparator products, blinded assessments, and objective dermatologic efficacy endpoints) with larger samples are required to confirm these preliminary findings, evaluating product differences or rare skin events and differentiating product-related effects from external factors.

5. Conclusions

The Physiorelax Forte Plus range did not cause any undesirable skin reactions in the participant pediatric population after 14 days of use, with an observed incidence of 0% cutaneous AEs across the 60 evaluated children and adolescents. Our data suggests that the pediatric population in general may benefit from the daily use of Physiorelax Forte Plus range. The overall opinion on the formulations is very positive, with more than 90% of parents/caregiver(s) reporting satisfaction or complete satisfaction with most formulations' characteristics. Based on the cosmetic safety data and the user acceptability expressed, the product in its three formulations was well-tolerated in short-term use with high subjective satisfaction in an uncontrolled evaluation.

The PCA provided a clear and structured representation of how users differentiate between the three topical formulations across sensory, functional, and practicality dimensions. Sensory items consistently grouped together and aligned with the spray formulation, while functional and activity-related items clustered toward the roll-on and, to a lesser extent, the cream, reflecting users' perception of these formats as more effective for recovery and sport-related use. Practicality was captured as a distinct dimension, with the roll-on standing out as the most convenient format for application. Overall, the PCA indicates that participants' evaluations follow stable and coherent perceptual patterns, reinforcing the robustness of the acceptability profile across formulations. These insights can inform future formulation development and product positioning by clarifying the perceptual domains that drive user evaluations.

These preliminary observational tolerability and acceptability data obtained under normal use may help parents/caregiver(s) and health professionals consider these topical natural formulations as part of routine musculoskeletal care in children and adolescents.

Author Contributions: Conceptualization, J.B.N., D.A.-T. and S.P.-L.; writing—original draft preparation, M.G.; writing—review and editing, J.B.N., D.A.-T., S.P.-L. and M.G.; supervision, D.A.-T. and S.P.-L.; visualization, J.B.N., D.A.-T., S.P.-L. and M.G.; project administration, D.A.-T. and S.P.-L.; funding acquisition, D.A.-T. and S.P.-L. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Almirall HQ, market Company Iberia (Spain & Portugal) and the APC was funded by Almirall HQ, market Company Iberia (Spain & Portugal).

Institutional Review Board Statement: The study, including all its parts, was done in accordance with the following standards: the general principles of medical ethics in clinical research of the Declaration of Helsinki Declaration (June 1964) and its subsequent modifications; the international recommendations on Good Clinical Practice for the conduct of clinical trials of medicinal products ICH E6 (R1) of 10/06/1996 (CPMP/ICH/135/95); Directive 2001/20/EC of the European Parliament and of the Council on the harmonization of the laws, regulations and administrative provisions of the

Member States relating to the application of good clinical practice in the conduct of clinical trials on medicinal products for human use-OJ/EC of 01/05/2001; and the COLIPA recommendations-August 1997: "guidelines for the assessment of human skin compatibility". This study did not involve an interventional clinical trial. Therefore, registration in a public clinical trial registry was not required.

Informed Consent Statement: Signed informed consent and/or assent (as applicable) were obtained from all participants and/or from parents/caregiver(s) at enrollment.

Data Availability Statement: The data that supports the findings of this study are available from the authors upon reasonable request.

Acknowledgments: We would like to express our most sincere thanks to Paula Anglada Ribé for her outstanding contribution to the development and follow-up of the entire research project. Her dedication, knowledge and professionalism have been fundamental to the achievement of this article. Her commitment to excellence and her tireless support have left a significant mark on this work. We are deeply grateful for her valuable collaboration and for being an essential part of this team. We would also like to express our sincere thanks to COSMESERVICE, Cosmetrade S.L., for their dedication and professionalism in conducting this research project. Their commitment to excellence and their contribution have been fundamental to the success of this study. We value their expertise and effort and recognize the importance of their work in achieving our objectives.

Conflicts of Interest: David Asensio-Torres and Sonia Palenzuela-Larrarte are employers of Almirall S.A. Jordi Bertrán Novella. has made a presentation on Physiorelax in a national convention organized by Almirall. The remaining author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Abbreviations

The following abbreviations are used in this manuscript:

AEMPS	Spanish Agency of Medicines and Medical Devices
AEs	Adverse Events
COLIPA	European Cosmetic, Toiletry and Perfumery Association
CPMP	Committee for Proprietary Medicinal Products
EC	European Commission
E6	ICH guideline
ICH	International Council for Harmonisation
OJ/EC	Official Journal of the European Communities
PC	Principal Component
PCA	Principal Component Analysis
R1	Revision 1
SCCS	Scientific Committee on Consumer Safety
WHO	World Health Organization

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