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Normative data of the teacher self-efficacy scale in Chilean elementary school teachers

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Self-efficacy is crucial to teaching performance; it enables teachers to establish positive relation-ships with students, cope with work challenges, and promote academic success. Assessing perceived self-efficacy is vital because it directly impacts daily pedagogical practices. This study sought to establish normative data for interpreting the Teachers' Sense of Efficacy Scale (TSES) scores among Chilean elementary school teachers. The sample included 1,426 first- to eighth-grade teachers, with an average age of 41.4 years (SD = 10.8), from public and subsidized private schools. No significant differences (d = 0.09) were found in self-efficacy scores between men (M = 98.8; SD = 15.1) and women (M = 97.4; SD = 15.7), so the full sample was analyzed. The reliability coefficient was excellent (α = 0.971). The average TSES score was 97.7 (SD = 15.6), exceeding the theoretical midpoint ($M_{theoretical}$ = 72). Most teachers were in the average range of the scale (T = 40−60). These normative data enable accurate interpretation of teacher self-efficacy, facilitating targeted interventions to improve teachers' wellbeing and professional effectiveness.

KEYWORDS

self-efficacy, teachers, elementary school, normative data, measurement

1 Introduction

There is ongoing interest in studying teachers' characteristics and how these are reflected in their pedagogical practices. Teacher self-efficacy is crucial for elementary school student learning (Almonacid et al., 2023; Gülsün et al., 2023; Leavy et al., 2023; Naimanova et al., 2023), given the high workload and dynamic and demanding context in which teachers operate (Skaalvik and Skaalvik, 2023). Self-efficacy refers to judgments about one's cognitive, social, and behavioral abilities, allowing individuals to face various situations effectively for positive outcomes (Bandura, 1981, 1984).

Self-efficacy beliefs are significant in shaping an individual's thoughts and emotions, thus reflecting their performance contexts and effort levels (Bandura, 1981, 1982, 1984). In a teaching context, teacher self-efficacy relates to beliefs about one's abilities in specific performance areas, developing skills to perform professional duties, i.e., teaching and learning activities that achieve set objectives (Dellinger et al., 2008; Downes et al., 2021; Hoang and Wyatt, 2021; Tschannen-Moran and Woolfolk Hoy, 2001). Tschannen-Moran and Woolfolk Hoy (2001) note that teacher self-efficacy encompasses instructional practices, classroom management, and student engagement, motivating students to participate in classes and school activities.

Teacher self-efficacy impacts behavior and personal experiences positively in students, fostering proper student-teacher relationships, reducing conflicts, and increasing closeness (Granziera and Perera, 2019; Hajovsky et al., 2020; Shu, 2022; Wettstein et al., 2021). Teacher self-efficacy perception is associated with a reduction in both externalizing and internalizing behavior in children, and this association remains consistent over time (Finch et al., 2023). Teachers with higher self-efficacy focus on student success and being accessible to students, while those with lower self-efficacy concentrate on behavior management (Pressley and Ha, 2021; Woodcock et al., 2022). Higher teacher self-efficacy enhances job commitment and satisfaction (Cayupe et al., 2023; Ispir and Yildiz, 2023; Liu et al., 2022; Mokhtar et al., 2023), contributing to better student academic performance (Mahmoodi et al., 2022; Murillo et al., 2018).

Classroom management is a concern for teachers, aiding appropriate student learning and performance (González-Mayorga and Rodríguez-Esteban, 2023). Teacher self-efficacy in promoting student engagement predicts the wellbeing of the educators (Reppa et al., 2023). Improving teacher self-efficacy in classroom management, instructional strategies, and student engagement impacts relationships positively and reduces behavioral issues (Rivas et al., 2023). Effective instructional practices are related to learning, supporting student writing development (Wang and Troia, 2023), and mathematics teaching (Bosica, 2022). Teacher self-efficacy perception is essential, given student diversity, linked to successful teaching strategies (Chunta and DuPaul, 2022; Gülsün et al., 2023; Opoku et al., 2022; Woodcock et al., 2022; Yada et al., 2018). High self-efficacy teachers adapt instructions to student needs, ensuring relevant and interesting learning experiences (Woodcock et al., 2022).

In Ghana, teachers reported moderate to high self-efficacy in student engagement, instructional strategies, and classroom management, highlighting the importance of experience and training workshops (Agormedah et al., 2022). Teacher self-efficacy is affected by contextual changes, impacting practices (Pressley and Ha, 2021). High self-efficacy teachers possess a deeper understanding of student needs, demonstrate a higher level of commitment to their colleagues, employ inclusive teaching methods, and effectively handle student behavior (Charles et al., 2023; Devi and Ganguly, 2022). Low self-efficacy influences less emotional support and collaboration among teachers, which is vital for inclusive education (Mudhar et al., 2023).

Research has shown that teacher self-efficacy levels can be improved (Gómez-Marí et al., 2023); implementing teacher training programs that address the specific needs and requirements of various contexts is essential to enhancing pedagogical outcomes (Devi and Ganguly, 2022; Waswa and Celik, 2021). Teacher self-efficacy is linked to experience and further training (Altay, 2023; Reyes-Cruz, 2020; Segarra Escandón et al., 2022; Thomson et al., 2022). Teachers are part of an educational community where support from other members and administrative backing facilitate classroom management (Pressley and Rangel, 2023). Teacher self-efficacy is important to consider due to the substantial effort educators must make in their everyday activities; therefore, it is vital to provide support for teachers and their teaching (Ryan and Hendry, 2023).

Teacher self-efficacy perception should be evaluated to take actions supporting teachers in their work. The Teachers' Sense of Efficacy Scale (TSES) by Tschannen-Moran and Woolfolk Hoy (2001) focuses on three areas of teacher activities linked to their self-efficacy perception: efficacy for instructional strategies, classroom management, and student engagement. The efficacy for instructional strategies dimension concerns the teacher's perception of effectiveness in implementing various classroom strategies; efficacy for classroom management addresses the ability to manage student behavior, adhering to classroom norms; efficacy for student engagement focuses on the teacher's perception of engaging students in activities effectively (Tschannen-Moran and Woolfolk Hoy, 2001).

The scale includes psychometric studies of Chilean teachers. Covarrubias-Apablaza and Mendoza-Lira (2016) found a four-dimensional factor structure with 17 items, proposing a fourth factor, efficacy in attending to student uniqueness and assessing teacher capacity to teach diverse students. The scale has validity and reliability evidence. Gálvez-Nieto et al. (2023) reported that the bifactor exploratory structural equation modeling (B-ESEM) for 24 items, with one general factor and three residual factors, fit the data best, suggesting using a global score.

The TSES has been used in various studies in Chile, showing lower self-efficacy in public school teachers (Covarrubias-Apablaza and Mendoza-Lira, 2016). Physical education teachers in public schools showed higher general self-efficacy but lower classroom management scores (Pérez et al., 2023). Teacher self-efficacy perception was associated with more years of experience and postgraduate training, providing tools to cope with daily challenges (Covarrubias-Apablaza and Mendoza-Lira, 2016; Pérez et al., 2023). No gender differences were found in self-efficacy perception (Covarrubias-Apablaza and Mendoza-Lira, 2015; Pérez et al., 2023), consistent with some studies but contrasting others reporting gender differences (Sirmaci and Taş, 2016; Tárraga-Mínguez et al., 2022).

Given the empirical knowledge of various constructs, the TSES lacks normative data for classifying teachers by self-efficacy levels. It is important to note that normative data for various self-efficacy scales have been presented in research conducted in different countries. For example, normative data for the General Self-Efficacy Scale have been provided for Spanish university students (Suárez et al., 2000) and Spanish adolescents (Espada et al., 2012). Additionally, Dominguez-Lara (2016) conducted research with Peruvian university students and presented normative values for the academic self-efficacy scale with the aim of identifying university students with low self-efficacy. Furthermore, normative data have been reported for the Academic Life Self-Efficacy Scale in Mexican university students (García-Méndez and Rivera-Ledesma, 2021) and for children's self-efficacy (Oros, 2017). However, these contributions have not been made for Chilean teachers, despite the potential significance for the school community, given the numerous challenges faced by teachers, such as the high segregation of the educational system (Murillo et al., 2023; Murillo and Garrido, 2017) and other adverse conditions that reduce the likelihood of students reaching their full potential (Espinoza et al., 2022; Vargas Diaz and Matus Correa, 2022).

Normative data are essential for interpreting individual TSES scores compared to an appropriate reference group, providing a clear framework for assessing self-efficacy levels. These data assist in identifying teachers who require training to improve their classroom management and teaching strategies. They facilitate effective educational interventions, contribute to teacher wellbeing by reducing burnout risk, and promote educational equity by considering contextual and demographic differences. In summary, normative data provide precise assessment and remediation aimed at enhancing

teacher wellbeing and professional efficacy, which in turn benefit the entire school community.

Therefore, it is essential to develop normative data for interpreting TSES scores among Chilean elementary school teachers, supporting teachers in areas with lower scores through targeted interventions, consistent with research highlighting the importance of training to increase self-efficacy in their work (Altay, 2023; Devi and Ganguly, 2022; Reyes-Cruz, 2020; Segarra Escandón et al., 2022; Thomson et al., 2022; Waswa and Celik, 2021). This approach represents a significant contribution to research and planning interventions in schools, enabling the evaluation of teacher self-efficacy perception and creating opportunities to improve weak areas, activating necessary resources at the personal, social, school, and community levels. Consequently, the goal is to establish normative data for interpreting the Teachers' Sense of Efficacy Scale (TSES) scores among Chilean elementary school teachers.

2 Materials and methods

2.1 Design

This research used a non-experimental, cross-sectional, descriptive design, allowing data collection at a single point in time without manipulating independent variables (Toro Jaramillo and Parra Ramírez, 2010), describing the variables studied regarding their normative data.

2.2 Participants

The population consisted of all public school teachers in Chile from 1st to 8th grade ($N = 85,298$), teaching students aged approximately 6–13 years. A stratified random sample was estimated based on region, habitat (urban and rural), type of funding (public and subsidized schools), and gender. The sampling was probabilistic, stratified, and multistage with 95% confidence, 2.5% sampling error, and variance $p = q = 0.5$ (Scheaffer et al., 1987). The expected sample was 1,576 teachers, representing 1.85% of the population.

A total of 1,426 teachers (22.7% men, 77.3% women) with an average age of 41.5 years (SD = 10.8) from 250 public (65.1%) and subsidized (34.9%) schools participated in this research. Experience ranged from less than 1 to 48 years, with an average of 14.3 years (SD = 10.1). Geographically, 10.9% of teachers worked in rural schools and 89.1% in urban schools.

It should be noted that this dataset was collected for a large-scale national study; therefore, previous articles have published these data, such as, Salvo-Garrido et al. (2023, 2024) and Gálvez-Nieto et al. (2023). It is important to highlight that the proposed objectives are different.

2.3 Instruments

Sociodemographic Questionnaire: Data on age, gender, region, commune, school name, school type (public or subsidized), residence (urban or rural), professional title, years of experience, and ethnic group membership were collected.

Teachers' Sense of Efficacy Scale (TSES): The TSES evaluates teacher efficacy perception (Tschannen-Moran and Woolfolk Hoy, 2001), consisting of 24 items responded on a five-point ordinal scale (1 = none, 5 = a lot), covering three correlated factors: Efficacy for instructional strategies, Efficacy for classroom management, and Efficacy for student engagement. National and international evidence shows appropriate psychometric properties (Covarrubias-Apablaza and Mendoza-Lira, 2016; Dominguez-Lara et al., 2019; Gálvez-Nieto et al., 2023; Tschannen-Moran and Woolfolk Hoy, 2001), indicating the scale can be used with Chilean teachers as a unidimensional measure.

2.4 Procedure

The schools were randomly selected, and with this information, contact was made with the chosen institutions. Meetings were requested with school principals or relevant authorities to present the research and invite participation.

Subsequently, a list of primary school teachers from the educational institution was requested, and those who were invited to participate in the research were randomly selected. The school administrators sent an email to the selected teachers containing the link to complete the survey.

Teachers who agreed accessed a link to the informed consent, explaining the study's objective and ethical principles, including voluntary participation, risks, and benefits. After reviewing the information, teachers could participate or exit the website.

Data were collected via the online platform Question Pro. This study was approved by the Scientific Ethics Committee of the Universidad de La Frontera, Chile (Evaluation File No. 053_21; Study Protocol Sheet No. 019/21).

2.5 Data analysis

Preliminary analysis compared teacher self-efficacy scores between men and women to determine the relevance of separate normative data (Dominguez-Lara et al., 2018), using Cohen's d magnitude: < 0.41 insignificant; 0.41–1.15 low; 1.15–2.70 moderate; > 2.70 high (Ferguson, 2009). Descriptive (mean, standard deviation) and distributional (skewness, kurtosis) analyses were performed. Univariate normality of teacher self-efficacy was evaluated with skewness (< 2) and kurtosis (< 7) (Finney and DiStefano, 2013).

Normative data were determined using the percentile rank (PR) interval range and T score. PR represents the percentage of participants with a similar or lower score than the evaluated subject (Crocker and Algina, 2006). The T score (M = 50; SD = 10) assesses if the score is below, above, or within the normative sample mean. Values one standard deviation (SD) below and above the mean ($T = 40$–60) represent two-thirds of all participants, considered average teacher self-efficacy (Table 1) (Kelley, 1939). The JAMOVI software (The Jamovi Project, 2023) was used for the descriptive analyses, and a script created in SPSS (IBM Corp, 2015) by the authors was employed for the normative scores.

Finally, the K2 coefficient (>0.7) (Livingston, 1972) was calculated to assess the reliability of each cutoff point, determining the levels presented (Table 1) for precise classification (Dominguez-Lara et al.,

TABLE 1 Interpretation of *T*-values.

T-value	Interpretation
<30	Level of self-efficacy well below average
30–39	Level of self-efficacy below average
40–60	Level of self-efficacy within the average
61–70	Level of self-efficacy above average
>70	Level of self-efficacy well above average

TABLE 2 Normative values for the TSES.

Direct score	n	Z	T	PR	K2
24	2	−4.7198	18.1	0.1	0.999
48	1	−3.1823	20.8	0.2	0.997
51	2	−2.9901	22.3	0.3	0.997
53	2	−2.8620	23.7	0.4	0.997
54	2	−2.7979	24.6	0.6	0.997
57	2	−2.6058	25.4	0.7	0.996
58	2	−2.5417	26.1	0.8	0.996
59	2	−2.4776	26.7	1.0	0.996
61	3	−2.3495	27.3	1.2	0.996
62	6	−2.2854	28.2	1.5	0.995
63	3	−2.2214	29.0	1.8	0.995
64	4	−2.1573	29.5	2.0	0.995
65	6	−2.0933	30.2	2.4	0.995
66	7	−2.0292	31.0	2.8	0.994
67	2	−1.9651	31.4	3.2	0.994
68	10	−1.9011	32.0	3.6	0.994
69	9	−1.8370	32.8	4.2	0.993
70	11	−1.7729	33.5	4.9	0.993
71	20	−1.7089	34.5	6.0	0.993
72	32	−1.6448	35.9	7.9	0.992
73	16	−1.5808	36.9	9.5	0.992
74	12	−1.5167	37.5	10.5	0.991
75	11	−1.4526	37.9	11.3	0.991
76	10	−1.3886	38.3	12.1	0.990
77	10	−1.3245	38.6	12.8	0.990
78	18	−1.2604	39.1	13.7	0.989
79	14	−1.19634	39.6	14.9	0.989
80	7	−1.1323	39.9	15.6	0.987
81	12	−1.0683	40.2	16.3	0.987
82	12	−1.0042	40.5	17.1	0.986
83	14	−0.9401	40.9	18.0	0.985
84	16	−0.8761	41.2	19.1	0.984
85	21	−0.8120	41.7	20.4	0.983
86	17	−0.7479	42.2	21.7	0.982
87	20	−0.6839	42.6	23.0	0.980
88	17	−0.6198	43.0	24.3	0.979
89	17	−0.5558	43.4	25.5	0.978
90	20	−0.4917	43.8	26.8	0.977
91	23	−0.4276	44.3	28.3	0.976
92	31	−0.3636	44.8	30.2	0.974
93	34	−0.2995	45.5	32.5	0.973
94	37	−0.2355	46.1	35.0	0.973
95	25	−0.1714	46.7	37.1	0.972

(Continued)

2018; Fernández Arata et al., 2014). This coefficient is suitable as distributional characteristics (e.g., high kurtosis) do not significantly affect it, allowing use even without the normality assumption (Gempp and Saiz, 2014). The α coefficient was previously calculated to estimate reliability (>0.8) (Ponterotto and Charter, 2009).

3 Results

The initial comparative analysis of teacher self-efficacy scores between men (M = 98.8; SD = 15.1) and women (M = 97.4; SD = 15.7) indicated no significant differences (*d* = 0.09), so the full sample was analyzed. The reliability coefficient was excellent (α = 0.971), reflecting low measurement error. The average teacher self-efficacy score was 97.7 (SD = 15.6), well above the theoretical midpoint (Theoretical Range = 24–120; $M_{theoretical}$ = 72), with acceptable skewness −0.621 (SE = 0.13) and kurtosis 0.151 (SE = 0.13), suggesting a reasonable approach to univariate normality. Table 2 presents the typical scores corresponding to the direct scores of the scale, thus providing normative data for the Chilean population. Normative values for the TSES showed that central values (average level) predominate compared to the lower scale values. The theoretical mid-point (Theoretical Mean = 72) represented a low PR (<16), below the observed mean (*T* < 40). Cutoff reliability was optimal in all cases (> 0.95), indicating low measurement error around scores defining the established levels (Tables 2, 3).

Table 3 shows the normative values by interval range, based on the interpretation ranges of the T score.

Most teachers have high scores. Teachers with low scores (<65) are around the lowest 2% of the distribution, while higher scores (>115) are above the 85th percentile. Regarding the T score, most participants were between 40 and 60, indicating average teacher self-efficacy. These normative data provide precise information about the self-efficacy levels expressed by participating teachers, allowing for appropriate interventions.

4 Discussion

The results indicate that perceived self-efficacy among Chilean elementary school teachers is generally high, with most participants falling within the average and high ranges on the TSES. These findings align with previous studies suggesting that teacher self-efficacy is closely related to experience and continuous training, as noted by Covarrubias-Apablaza and Mendoza-Lira (2016) as well as Pérez et al. (2023).

The high reliability of the established cutoff points (>0.95) reinforces the precision of the obtained normative data, allowing for

TABLE 2 (Continued)

Direct score	n	Z	T	PR	K2
96	99	−0.1073	47.8	41.5	0.971
97	43	−0.0433	49.1	46.5	0.971
98	31	0.0208	49.8	49.1	0.971
99	31	0.0849	50.3	51.2	0.971
100	35	0.1489	50.9	53.5	0.972
101	32	0.2130	51.5	55.9	0.972
102	30	0.2771	52.0	58.1	0.973
103	23	0.3411	52.5	59.9	0.974
104	37	0.4052	53.1	62.0	0.975
105	30	0.4692	53.7	64.4	0.976
106	21	0.5333	54.2	66.2	0.977
107	34	0.5974	54.7	68.1	0.979
108	37	0.6614	55.4	70.6	0.980
109	34	0.7255	56.1	73.1	0.981
110	29	0.7896	56.8	75.3	0.982
111	31	0.8536	57.5	77.4	0.983
112	18	0.9177	58.1	79.1	0.984
113	27	0.9817	58.7	80.7	0.985
114	33	1.0458	59.5	82.8	0.986
115	30	1.1099	60.4	85.0	0.987
116	22	1.1739	61.2	86.8	0.988
117	26	1.2379	62.0	88.5	0.989
118	26	1.3020	63.0	90.3	0.989
119	34	1.3661	64.3	92.4	0.990
120	91	1.4302	68.5	96.8	0.991

TABLE 3 Normative values by range for the TSES.

DS	PR	T	K2
< 65	< 2.4	< 30	0.995
65–80	2.4–15.6	30–39	0.995–0.987
81–115	16.3–85	40–60	0.987–0.987
116–120	86.8–96.8	61–70	0.988–0.991

DS, Direct Score; PR, Percentile Rank; T, T-value; K2, Livingston's K2 coefficient.

an accurate interpretation of teacher self-efficacy levels with a low margin of error. High teacher self-efficacy is associated with greater job satisfaction and professional commitment (Cayupe et al., 2023; Ispir and Yildiz, 2023; Liu et al., 2022; Mokhtar et al., 2023), positively influencing student academic performance (Mahmoodi et al., 2022; Murillo et al., 2018).

The analyses show no significant differences in self-efficacy levels between men and women, consistent with some previous studies (Covarrubias-Apablaza and Mendoza-Lira, 2015; Pérez et al., 2023), though contrasting with others reporting gender differences (Sirmaci and Taş, 2016; Tárraga-Mínguez et al., 2022). This finding suggests that in the Chilean context, teacher self-efficacy might be independent of gender, which is good news for educational equity.

The concentration of high scores on the TSES suggests that teachers have a positive perception of their ability to manage classrooms, implement effective instructional strategies, and engage students. This aligns with research highlighting the importance of self-efficacy in classroom management and student engagement to promote a positive learning environment (Rivas et al., 2023; Woodcock et al., 2022).

However, some teachers were in the lower scale ranges despite generally high self-efficacy levels. These teachers could benefit from specific interventions to improve their self-efficacy, as suggested by studies emphasizing the need for institutional support and continuous professional development programs (Altay, 2023; Devi and Ganguly, 2022; Reyes-Cruz, 2020; Segarra Escandón et al., 2022; Thomson et al., 2022; Waswa and Celik, 2021). The TSES items focus on specific classroom situations, both in terms of capacity development (e.g., item 2 focuses on critical thinking) and handling challenging behaviors (e.g., item 3). Therefore, intervention programs that provide resources to improve teacher performance could be developed using the TSES for initial and final assessments and considering a prior longitudinal invariance analysis (Brown, 2015).

In conclusion, the normative data presented in this study provide a solid foundation for accurately classifying teacher self-efficacy levels in Chile. These findings enrich the literature on teacher self-efficacy and have significant practical implications. Educational institutions and policymakers can use these data to design and implement specific intervention programs to improve teacher self-efficacy, contributing to better professional performance and a more effective educational environment. Different teacher profiles can be established, grouped, and differentiated based on perceived self-efficacy levels, identifying teachers with similar demographic or professional characteristics and allowing for differentiated and pertinent interventions. From a methodological standpoint, this study is particularly relevant because teacher self-efficacy levels are sometimes determined based on arbitrary criteria and without empirical support, as observed in some studies (Agormedah et al., 2022; Savas et al., 2014). This practice could compromise research outcomes, especially when these results inform public policy or state-funded initiatives.

Despite the significant contributions of this study, some limitations must be considered. First, the sample consisted only of public and subsidized private school teachers, which may not fully represent the reality of private school teachers, given that teacher self-efficacy experiences often differ depending on the type of school management (Huang et al., 2023), and even in relation to the school's geographical location (Surana, 2021). Second, the high TSES scores may be influenced by social desirability bias or an overestimation of one's teaching abilities. Therefore, it is recommended to complement this evaluation with objective measures such as classroom observations, peer reports, or student assessments (Parola et al., 2022) to mitigate the potential effect of social desirability bias.

Future research should expand sample diversity to include private school teachers for broader generalization of findings. First, longitudinal studies are recommended to evaluate how teacher self-efficacy evolves over time and in response to different training interventions (Jiang et al., 2024). Second, multivariate analyses could be incorporated to examine the interaction of variables relevant to the Chilean educational context (e.g., school type, educational level, teaching experience, etc.) with teacher self-efficacy (Odanga et al., 2022), thereby providing additional information to

schools aiming to optimize their resources. Finally, another promising research area explores the relationship between teacher self-efficacy and contextual factors such as institutional support and working conditions that may influence teacher performance and wellbeing. Additionally, incorporating more objective evaluation methods like classroom observations and peer evaluations to complement teacher self-reports would provide a more comprehensive understanding of teacher self-efficacy and its determinants.

The normative data presented in this study can serve as a valuable tool for school administrators and educational psychologists. By using the cut-off points based on T-scores and percentiles, educational institutions can identify teachers whose self-efficacy levels fall below or above the average range. This allows for the development of targeted interventions such as professional development programs, peer mentoring, or individual coaching. Moreover, tracking changes in these scores over time can help monitor the effectiveness of institutional strategies aimed at improving teacher wellbeing, classroom performance, and student outcomes. The availability of empirical norms contributes to informed decision-making and fosters more equitable support across diverse teaching contexts.

Data availability statement

The data cannot be published due to restrictions from the scientific ethics committee, which considers sensitive data.

Ethics statement

The studies involving humans were approved by Scientific Ethics Committee of the Universidad de La Frontera, Chile (Evaluation File No. 053_21; Study Protocol Sheet No. 019/21). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The authors declare that no Gen AI was used in the creation of this manuscript.

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