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IMPACT OF CENTERING IN PHYSICAL EDUCATION ON ADOLESCENTS: A TRANSDISCIPLINARY APPROACH TO WELL-BEING

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Abstract: This study explores the role of 'Centering' in physical education for adolescents, a crucial age for holistic development. Analyzing 191 female adolescent students, the authors investigated the impact of Centering, a neuromotor skill for the conscious management of intra-abdominal pressure (IAP), on respiratory mechanics and stress management. This technique, physical and seemingly simple, is part of the Synchrony training methodology for movement education (De Bernardi, 2008). It was originally developed to enhance athletic performance (Hrysomallis, 2017; Zemková, 2016; Granacher et al., 2013), but in its development has shown to bring health benefits (Brown & Pfeiffer, 2018; Green et al., 2021). Studies indeed suggest that Centering indirectly works on fundamental physical abilities often related to health, such as breathing or reducing excessive peripheral muscle tension (Hodges et al., 2013; Allard-Latour et al., 2022). In light of these emerging discoveries, the authors wanted to verify, with a simple educational protocol, whether its teaching could achieve stress reduction, offering a transdisciplinary and effective approach to improve the overall well-being of adolescents. The findings indicate that Centering could indeed be used transversally and, thanks to its didactic simplicity, inclusively in various educational contexts, enhancing physical education as a tool for general well-being.

Keywords: Physical Education; Innovative Techniques; Adolescents; Respiratory Mechanics; Stress.

1. Introduction

Physical education, essential in the school curriculum, plays a fundamental role in the healthy growth and integral development of adolescents. The effects of organized physical movement on the global development of students have been extensively studied and recognized for their impact not only on physical health but also on socio-emotional and cognitive development of students, as highlighted by McLennan & Thompson (2015), Smith et al. (2018), Rodriguez et al. (2017), and Tucker et al. (2020).

Respiratory mechanics, influenced by trunk and spinal stability, is a key aspect in this context. Elements such as the diaphragm, pelvic floor, and abdominal muscles

play a vital role in effective breathing and regulation of intra-abdominal pressure (IAP), an important factor for physical support during physical activity and that can also affect general health and stress management (Hodges et al., 2013; Allard-Latour et al., 2022).

In this scenario, the concept of Centering emerges as a promising methodology. Originally adopted in the sports context by De Bernardi, to optimize athletic performance (Hrysomallis, 2017; Zemková, 2016; Granacher et al., 2013), Centering has found, especially in recent years, new applications in physical education (De Bernardi, 2008; Fogliata et al., 2023), showing benefits in preventing injuries and improving overall health. Centering can also help mitigate common, but absolutely relevant disorders, such as back pain (Hagins and Lamberg, 2011; Hodge, 2000; Kobesova et al., 2015; Saeterbakken et al., 2021; Hlaing et al., 2021; Tsai et al., 2020) and could positively impact self-perception and stress management, especially important for adolescents (Brown & Pfeiffer, 2018; Green et al., 2021; Malwanage & Sterling, 2022; Russell et al., 2013; Smith, 2017).

This study, therefore, aims to explore how the integration of Centering in physical education can represent a proactive approach to promote not only physical performance improvement but also overall well-being among adolescents, offering a transversal model, which, if found appropriate, could be applicable in various educational contexts.

2. Materials and Methods

Participants:

191 female participants aged between 15 and 17 years (average age 16 years) were recruited, all students with a healthy lifestyle and the same amount of physical education hours per week. The decision to focus exclusively on adolescent females is based on the identification of adolescence as a critical period for the development of functional and sensitive capacities, especially in girls (Malina, 2004).

The participants were selected based on their regular participation in specific sports-physical activities, which consisted of 2-3 weekly sessions, highlighting the importance of regular training to maintain and improve health in adolescents (Smith, 2003). Moreover, measurements were taken during the follicular phase of the participants' menstrual cycle, a time chosen based on literature indicating less variability in physical and mood performance and ensuring greater consistency in the data collected during this phase (Johnson & Davies, 2007).

One month before the start of the study, all participants took part in a familiarization session with the chosen tests, to ensure the accuracy and reliability of the measurements (Brown & White, 2005). The tests consisted of an indirect assessment of intra-abdominal pressure, which was used to assess the actual capacity, after the experimental training, to Center (thus to consciously increase pressure on the experimenter's request). The Cooper Test was also administered to check that any changes were not linked to a general cardio-respiratory improvement given by the training.

Furthermore, the number of respiratory acts per minute at rest was evaluated, and the stress level was assessed using the validated PSS-10 test.

Centering, only in the initial and final evaluation phase, was measured with a Manual muscle tester dynamometer, specifically the pressure dynamometer model

from Lafayetteinstrument, a widely used and validated tool in the literature (Turner & Blackwell, 2009).

The Cooper Test, validated and widely used in physical education, is based on 12 minutes of constant speed running. It was used to measure aerobic capacity, and is recognized for its validity and reliability in monitoring physical performance (Cooper, 1968) and was performed on a 400m track at the same times of the day with the same material to reduce the possible contribution of external variables. In the hypothesis of future studies in diversified educational contexts, the adapted Cooper test could be used.

The number of Respiratory Acts was measured both through the subject's listening to the movements of the thoracic cage and to increase the reliability of the data with a solution of Masimo SET®, a system known for its precision in non-invasive detection of respiratory rate (Green et al., 2012) in the form of a digital finger oximeter.

The PSS-10 Test, standardized and validated in many scientific works, was used to assess the perceived stress level, in the form of ten questions, as it is free from and with a copyright and scientifically valid (Cohen & Williamson, 1988).

All participants were evaluated at two moments: T0 (before the start of the study) and T1 (after 12 weeks of intervention). During training, the key difference between the groups was Centering. The focus during the exercises was profoundly different for equal work: the experimental group focused on the regulation of IAP, i.e., on "Centering," while the control group focused on the peripheral musculature, specifically foot positioning.

The assignment to the groups was random, thus ensuring the objectivity of the results. Moreover, the examiners were unaware of the training protocol followed by each participant, to further reduce the risk of bias (Jones et al., 2015).

Table 1. Simple work protocol suitable for any warm-up.

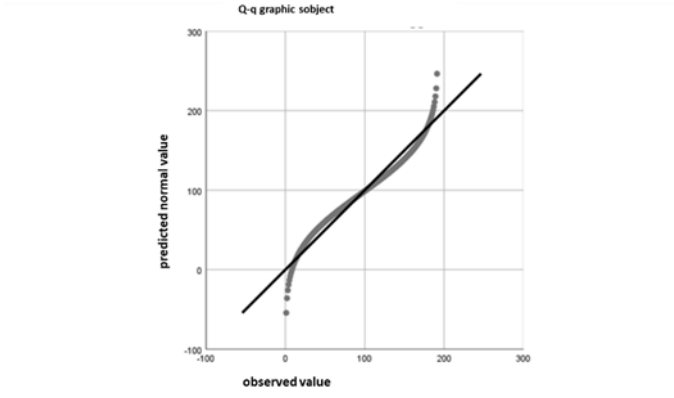
EXERCISE	SET x REPS	EXPERIMENTAL GROUP (Centering)	CONTROL GROUP (Foot Positioning)
Gaits (skip and rotation kick)	10 min (progression)	Focus on intra-abdominal pressure and Centering	Focus on correct foot positioning
Mobility: upper limb rotation	3x10	Focus on intra-abdominal pressure and Centering	Focus on correct foot positioning
Supermen	3x10	Focus on intra-abdominal pressure and Centering	Focus on correct foot positioning
Bridge	3x10	Focus on intra-abdominal pressure and Centering	Focus on correct foot positioning

3. Data Analysis

The data underwent a preliminary analysis with SPSS software to verify the normality of the distribution. The Blom fractional rank estimation method was

adopted to assign an average rank to correlated values. The analysis confirmed the assumption of normal distribution, as evidenced by the Q-Q chart.

Figure 1. Normal distribution.



Descriptive statistics were then calculated for the "control" and "experimental" groups and for each variable considered:

Table 2. Descriptive Statistics

Variable	Group	Mean	Median	Standard deviation
Centering T0	0	2	2	0
Centering T0	1	2	2	1
Centering T1	0	3	3	0
Centering T1	1	8	8	2
Respiratory acts T0	0	21	21	2
Respiratory acts T0	1	21	21	3
Respiratory acts T1	0	21	21	2
Respiratory acts T1	1	20	20	2
Cooper T0	0	2037	2000	109
Cooper T0	1	2065	2050	120
Cooper T1	0	2047	2050	84
Cooper T1	1	2068	2050	115
PSS T0	0	27	27	4
PSS T0	1	27	27	4
PSS T1	0	26	26	4
PSS T1	1	25	25	3

An ANOVA-multivariate test was conducted comparing the control group to the experimental group for the different study variables. The results were as follows:

- Centering T0: The model is not significant ($p = 0.960$). Only the intercept was found to be significant.
- Centering T1: The model is significant ($p < 0.001$) with both the intercept and the group being significant.
- Respiratory acts T0: The model is not significant ($p = 0.376$) but the intercept is.
- Respiratory acts T1: Model is significant ($p < 0.001$) with both intercept and group being significant.
- Cooper T0: Not significant ($p = 0.131$).
- Cooper T1: Not significant ($p = 0.237$).
- PSS T0: Not significant ($p = 0.304$).
- PSS T1: Significant at 5% ($p = 0.037$).

In summary, "Centering T1" and "Respiratory acts T1" show significant differences between the groups. "PSS T1" is significant at the 5% level, while the other variables show no significant differences in the multivariate ANOVA analysis.

Lastly, T-tests for paired samples divided by groups were performed. For the experimental sample, the following significant differences were detected:

- Centering T0 compared to kg Centering T0: $t = -36.068$; $p < 0.001$.
- Respiratory acts T0 compared to respiratory acts T0: $t = 14.814$; $p < 0.001$.
- PSS T1 compared to PSS T0: $t = 14.493$; $p < 0.001$
- No significant differences emerged between "Cooper T0" and "Cooper T1". In the control sample, no significant differences were detected between the variables compared in T0 and T1.

4. Data Analysis

Our study aimed primarily to evaluate the effectiveness of "Centering" in physical education and its impact on adolescents. The data show a reduction in the number of Respiratory Acts in the experimental group after the intervention, suggesting that Centering promotes calmer and more controlled breathing, an aspect that aligns with the existing literature on the importance of respiratory mechanics (Green et al., 2021; Malwanage & Sterling, 2022). This result implies that Centering might be particularly useful in the educational context for promoting beneficial breathing practices, positively influencing the overall health of students.

The significant decrease in the level of perceived stress, as measured by the PSS-10, in the experimental group is, according to the authors, an important finding, considering the high prevalence of stress and anxiety during adolescence (Russell et al., 2013; Smith, 2017). This suggests that Centering could be an effective stress management tool, which can be integrated into physical education programs for a positive impact on student well-being.

It is important to note that the absence of changes in the Cooper test indicates that Centering does not have direct impacts on cardiovascular capabilities, allowing to isolate the specific effects of the same on respiratory mechanics and stress.

5. Conclusions

The results of this study highlight the value of integrating innovative techniques, even from diversified sectors, into physical education. The difference in results between the groups, based on the change of focus from the physical to the respiratory aspect, underlines the importance of well-defined and targeted teaching methods. This research opens up new possibilities for a more inclusive and cross-disciplinary approach in physical education, suggesting that techniques like Centering could be used to support students with different needs, including those who may benefit most from stress and breathing control.

Obviously, the authors hope to be able to expand this study to diversified samples, with an approach to mixed or male samples to explore the hoped-for applicability of Centering in a broader context.

Declaration of Conflicts of Interest

The authors declare that there are no conflicts of interest in relation to this study. No funding or support was received from organizations that could have benefited from the study or that could have influenced its outcome. The authors are independent and have no financial relationship with entities that might have interests in the field of study.

Moreover, this study was conducted in accordance with ethical standards, ensuring respect for the principles of equity, integrity, and respect for all participants involved.

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