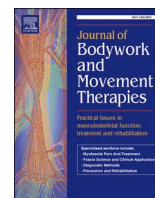


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Do young women have an accurate perception about their pelvic floor muscle contraction? An agreement study about self-perception and physical evaluation of the pelvic muscles contraction by the PERFECT scheme[☆]

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ABSTRACT

Background: Many women have difficulty in activating the pelvic floor muscles (PFM). This is a concerning factor for health professionals and public government institutions, as an unhealthy PFM could be associated with the presence of PFM dysfunctions. Therefore, the aim of the study was to analyze the agreement between the perception of young women about their PFM contraction and the results of a physical assessment, according to the strength, endurance, and contraction repetitions.

Method: Cross-sectional study with 43 university students between 18 and 35 years old. Examiner A filled out a semi-structured questionnaire to assess the self-perception about the ability to contract the PFM. The physical exam was performed by bidigital vaginal palpation, conducted by Examiner B, blinded to the answers of the previous stage, and according to the PERFECT scheme (P = power; E = endurance; R = repetitions of item "E;" F = fast contractions). Data was assessed by the Cohen's linear weighted kappa (K_w).

Results: The agreement between the self-perception and the physical evaluation of the PFM function presented a very poor agreement for all the items of the PERFECT scheme ($P_{(K_w)} = 0.12$; $E_{(K_w)} = 0.07$; $R_{(K_w)} = 0.09$; $F_{(K_w)} = 0.04$).

Conclusion: Young women do not have sufficient knowledge about PFM contraction and function. It should concern health government and institutions, as a poor PFM awareness might increase the difficulty to identify signs and symptoms related to PFM dysfunctions and reduces demand for and adherence to PFM treatment programs.

1. Introduction

A healthy pelvic floor muscles (PFM) is associated with the maintenance of many different functions (i.e., urine control, sexual function and support for abdominal and pelvic organs)(Bø and Sherburn, 2005), however, the percentage of women reporting a poor knowledge and ability to activate these muscles is high. Around 30% of women are unable to voluntarily contract their PFM(Bø and Stien, 1994; Fante et al., 2019; Talasz et al., 2007). This percentage increases to 70% in women with PFM dysfunction(Tibaek and Dehlendorff, 2014), especially urinary incontinence (UI), anal incontinence and pelvic organ prolapse (POP)(Chermansky and Moalli, 2016; Messelink et al., 2005; Oversand

et al., 2015). These dysfunctions directly affect the quality of life of women(Dedicção et al., 2009), and are also be associated with mortality(John et al., 2016).

One of the causes of these dysfunctions is the weakness of the PFM or the inability to correct contract them. As the PFM is not a visible group of muscles regarding their location (inside the pelvis), many women have difficulty in activating their muscles(Zubieta et al., 2016). Nonetheless, one of the main strategies to prevent and treat some PFM dysfunction is the PFM training (PFMT), an exercise that has as a pre-requisite the women's ability to perform a voluntary PFM contraction. The PFMT has the goal to increase the coordination of the PFM, especially regarding the activation of the muscles before and during an

[☆] This study was conducted at Federal University of São Carlos.

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increase in intra-abdominal pressure. Moreover, it is the first-line strategy to strengthen the PFM (Dumoulin et al., 2018), which directly improves the closure of sphincters and pelvic organ support, reducing the chance and the presence of PFM dysfunctions (Bø, 2004; Di Benedetto et al., 2008). A poor perception about the PFM activity could reduce demand for and adherence to PFM treatment programs (Zalm et al., 2008). Although it is already known that home-based exercises with no supervision are effective for treating stress UI and mixed UI symptoms in women (Cavkaytar et al., 2014), a poor perception of the PFM could impact the performance of patients that are encouraged to practice PFM exercises at home.

The inability to contract the PFM might also be related to the difficult to identify signs and symptoms related to PFM dysfunctions (such as UI, anal incontinence and POP) (Bø, 2004; Moen et al., 2009). Therefore, an incorrect activation of the PFM could contribute to a worsening of the women's perception about the PFM functions. This factor should concern health professionals, especially because some lifestyles habits (i.e., high-impact physical activity) performed by the young population may be associated with the presence of PFM dysfunctions in young women (Carvalho et al., 2019; Pisani et al., 2021). Thus, there is a need in identifying early predictive factors that could be modify in order to avoid PFM dysfunctions later in life. Moreover, actions taken during early adulthood can contribute to the development of strategies to prevent PFM dysfunction during aging (Talasaz et al., 2007). In addition, health professionals should be aware about the understanding of young and nulliparous women about the PFM, since one barrier to perform PFM exercises during the first pregnancy is the lack of knowledge and understanding about this group of muscles and exercises (Cooper and Carus, 2015).

There are many studies in the literature that investigated the women's capacity to voluntarily contract their PFM after receiving different interventions (i.e., verbal instruction, visual feedback, and others) (Díaz-Álvarez et al., 2022; Mateus-Vasconcelos et al., 2018; Silva et al., 2021; Vasconcelos et al., 2018), however, few studies aimed to analyze the agreement between self-perception and PFM contraction assessed by a trained examiner. A previous study (Uechi et al., 2019) reported a low correlation between the assessment performed by a trained assessor using vaginal palpation and the women's self-perception about their PFM strength. However, authors did not report the agreement between variables other than the maximal voluntary contraction of the PFM (i.e., endurance, coordination and speed of the contraction). Moreover, the external validity of their study applies to a specific population of women with a mean age of 46.83 and similar characteristics.

Thus, no previous study aimed to investigate the relationship between perception and PFM function (including the strength, endurance, and ability to repeat the PFM contraction) of young women (under 30 years old). Considering that a poor perception of the PFM could be related with the lack of activation of this group of muscles and knowing that there is a risk that young women develop PFM dysfunctions in the youthhood or later in life, findings of this study could elucidate for health professionals and public government institutions the need of creating different strategies to increase awareness about PFM, to treat and/or prevent PFM dysfunctions in the young population.

Therefore, the aim of the present study was to analyze the agreement between the perception of women about their PFM contraction (assessed by a semi-structured questionnaire) and the results of a physical assessment of the PFM function (performed by vaginal palpation), according to the strength, endurance, and repetitions of the PFM contraction (PERFECT scheme).

2. Methods

2.1. Study design

This is a cross-sectional study that was conducted between

November 2019 to March 2020, at the Women's Health Research Laboratory from the Federal University of São Carlos (UFSCar), and reported according to the STROBE guidelines. This study was approved by the Ethics Research Committee of the UFSCar (CAAE: 14043019.9.0000.5504).

2.2. Participants

Young university students were invited to participate by social media sites, brochures and websites. Those who agreed in participating signed a consent form before starting the data collection. We included nulliparous women between 18 and 35 years old that were not pregnant. Participants were excluded if they had vaginal and/or urinary infection, presence of neurologic disease or cognitive impairment, virginity, history of a surgical procedure in the pelvic or abdominal region in the 6 months before the day of the evaluation, pelvic organ prolapse beyond the vaginal opening, intolerance of vaginal palpation, inability to understand the proposed test and women undergoing physiotherapy treatment related to the pelvic floor.

2.3. Examiners

Two examiners (Examiner A and B) were responsible for data collection. Both had <1 year of experience evaluating PFM function. However, before starting the data collection, a 24-h training session was conducted by a senior physiotherapist with 15 years of experience and a specialist in Women's Health by the Brazilian Federal Council of Physiotherapy. In addition, a pilot study was carried out with three participants excluded from the final statistical analysis. Nonetheless, the intrarater reliability of the bidigital vaginal palpation conducted by Examiner B was reported previously and it was considered substantial ($\kappa = 0.62$) (Silva et al., 2021).

2.4. Procedures

2.4.1. Self-perception about the PFM muscles

Initially, Examiner A interviewed the participants to fill out a semi-structured questionnaire with questions related to their socio-demographic and gynecological characteristics. Moreover, participants were instructed to answer questions related to their previous knowledge about the PFM function (Have you ever received information related to the functions of the pelvic floor musculature?) and dysfunctions (Have you ever received information related to the dysfunctions of the pelvic floor musculature?). It was also asked if the participants had already been instructed on how to perform a PFM contraction and how they had access to this information. Sequentially, symptoms of urinary incontinence (UI) were screened using two questions from the Brazilian Portuguese version of the King's Health Questionnaire (KHQ) (Brusaca et al., 2022): 1) "Do you lose urine with physical activities such as: coughing, sneezing, running?" and 2) "Do you lose urine when you feel a strong desire to urinate?". Women were considered incontinent if they answered positively one or both questions.

Secondly, participants answered a second semi-structured questionnaire created by the researchers to assess the self-perception of the ability to contract the PFM, according to the PERFECT scheme (please check Appendix 1 to have full access to the questionnaire). Questions for this instrument were based on the PERFECT scheme domains. Therefore, participants were encouraged to answer one specific questions for each one the PERFECT domains. The participants' self-perception was assessed in sequence, as the following: first, they were requested to answer a question related to their perception about a maximal voluntary contraction, followed by the perception about sustained contractions, and repetitions of sustained and fast contractions of the PFM. Each one of the PERFECT domains was assessed by a different question.

This evaluation was performed before the physical exam. Before filling out the questions, Examiner A explained to the participants how a

correct contraction of the PFM should be performed (a contraction towards the cranial and ventral directions, with circular closure of the vaginal introitus (Bø and Sherburn, 2005)) and which scale and scheme Examiner B would use during the physical exam (Modified Oxford Scale and PERFECT scheme, respectively) (Laycock and Jerwood, 2001). After that, participants answered six questions.

Firstly, women were asked about their perception of the strength of a maximal voluntary contraction (MVC) of the PFM. They should signalize which degree of contraction (between 0 and 5, according to MOS) they guess they would achieve during a voluntary PFM contraction. Secondly, women were asked about their perception of the endurance of one PFM contraction by signaling 1) if they would not be able to sustain a MVC, or 2) if they could sustain it between 1 and 3 s, 3) 4–6 s or 4) 7–10 s. Two similar questions with the same answers' options were asked to the participants to identify their perception of the ability to perform repetitions of a sustained and fast contraction (item "R" and "F" of the PERFECT scheme, respectively). The fifth question was related to the difficulty level to perform the contraction. The following question was asked: "How difficult do you consider performing a pelvic floor muscle contraction?". Six answer options varied from "very easy" to "very hard" and "I don't know".

2.4.2. Physical assessment

The physical exam was conducted in one private room, and women were instructed to lie down in dorsal decubitus, with knees and hips flexed at 45°. Disposable gloves and lubricating gel were used during the assessment. The physical exam of the PFM function was performed by bidigital vaginal palpation and conducted by Examiner B, who was blinded to the answers of the previous stage and from the participants' self-perception responses. During the assessment, participants were instructed (I) to contract the PFM as if they were holding urine and performing a movement with the muscles up- and inward, (II) to inhale with relaxed PFM and exhale with contraction of the PFM, and (III) to avoid contraction of the muscles of the abdomen, gluteus or leg during contraction of the PFM (Silva et al., 2021). The assessment of the PFM function was performed using the PERFECT scheme (version 2001), according to the definitions proposed by Laycock and Jerwood: P = power; E = endurance; R = repetitions of item "E;" F = fast contractions; ECT = every contraction timed (Laycock and Jerwood, 2001).

To assess **Power**, participants were instructed to perform a MVC that was graded according to one of the following six degrees of MOS: 0 = absence; 1 = flicker; 2 = weak; 3 = moderate; 4 = good; 5 = strong (Laycock and Jerwood, 2001). During the **Endurance** assessment, participants were instructed to perform a sustained voluntary contraction with the same degree of strength as assessed by MOS, with a maximum time of 10 s. The **Repetitions** evaluated how many times the participant repeated the contraction performed in Endurance, with a 4-s rest between each repetition, with a maximum of ten repetitions. **Fast** contractions assessed how many contractions the participant was able to perform vigorously and quickly with the same initial Power strength, with a maximum of ten contractions being considered. One minute rest was adapted between the evaluations of each item. "ECT" is a standardized reminder from the scheme destined to the examiners in order to time all items previously assessed. Therefore, this item did not require scoring.

2.4.3. Sample size calculation

The sample size calculation was performed using an online platform (<https://wnarifn.github.io/ssc/sskappa.html>) created based on scientific papers from the literature (Donner and Eliasziw, 1992; Shoukri et al., 2004). Considering the level of significance at 5%, 80% statistical power in the calculated estimate, a minimum sample of 40 participants was estimated to yield data for the main research question, for a minimum kappa value $K_w = 0.81$.

2.5. Statistical analysis

The software SPSS (Statistical Package for the Social Sciences), version 21.0 (IBM Corporation, Armonk, NY) was used to analyze data. Continuous variables were analyzed by mean and standardized deviation. The agreement between self-reported results and the physical exam assessment was assessed by the Cohen's linear weighted kappa (K_w). K_w indices and interpreted according to Cohen's standardized values: 0.00–0.20 = none to slight; 0.21–0.40 = fair; 0.41–0.60 = moderate; 0.61–0.80 = substantial; and 0.81–1.00 = almost perfect (Cantor, 1996).

3. Results

A total of 43 healthy young women were included. The participants' mean age was 24.16 (3.84 SD) (range from 19 to 34). Most of the participants were single university students (93%), classified as eutrophic (69.8%), followed by overweight (14%), obese (9.3%) and low weight (7%). Urgency UI was prevalent among the participants (n = 32.6%), followed by stress UI (30.2%). Results are presented in Table 1.

Thirty participants reported previous knowledge regarding the PFM function, while 29 women had previous knowledge about the PFM dysfunctions. Twenty-four participants received previous instructions about how to contract their PFM and the source of these instructions were related to personal research (n = 13; 30.2%), school/university (n = 7; 16.3%), health professionals (n = 6; 14%) and chatting with friends (n = 3; 7%). Fig. 1 is a graph with the difficulty perception of the participants about performing a PFM contraction. Twenty-three women reported that they thought the PFM was "not easy and not hard" to perform.

Table 2 shows the agreement between the self-reported perception of the participants about their PFM contraction and the results from the physical exam conducted by bidigital vaginal palpation. All the assessments present a none to slight agreement, representing a very poor agreement between the young women and results from physical assessment of the PFM contraction according to the PERFECT scheme. Most participants presented a PFM >3 during the physical assessment (67.5%), which is classified as a strong contraction (Laycock, 1994), as the assessor can measure the cranial and ventral displacement associated with the closing of the vaginal introitus (Bø and Sherburn, 2005). Moreover, there was a high prevalence of women who suggested that they would be able to sustain a MVC for more than 7 s (58.1%), and the physical evaluation found only 18% of the participants that were able to hold this contraction for longer.

Although equal percentages around the repetitions of the sustained contractions were found between the self-perception and physical assessment for one to three repetitions (34.9%), the distribution around the other categories of the item was inconsistent. Only one participant

Table 1
Sample characteristics from participants included in the study.

Variables	n (%)
Age (mean and SD)	24.16 (3.84)
Body mass index classification (kg/m²)	
Low weight	3 (7)
Eutrophic	30 (69.8)
Overweight	6 (14)
Obese	4 (9.3)
Education level	
Bachelor student	28 (65.1)
Graduation student	15 (34.9)
Marital status	
Single	40 (93)
Married	3 (7)
Urinary dysfunctions	
Urgency urinary incontinence	14 (32.6)
Stress urinary incontinence	13 (30.2)

SD: standard deviation.

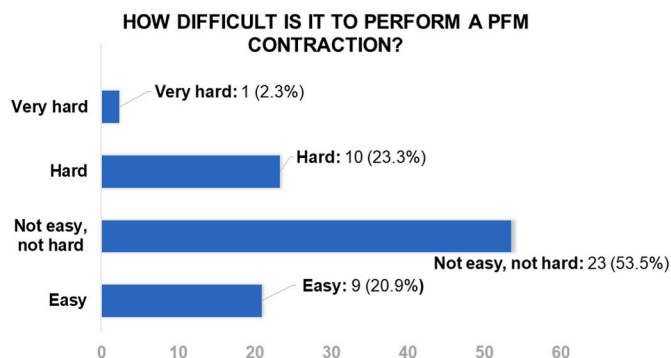


Fig. 1. Participants' perception about the PFM contraction. Legends: PFM: pelvic floor muscles.

Table 2 Agreement between self-reported perception of PFM contraction and results from the physical exam.

PERFECT scheme	Self-reported perception n (%)	Physical exam n (%)	Agreement (K_w)
P (ower) (Modified Oxford Scale)			
0	0 (0)	3 (7)	0.12
1	1 (2.3)	3 (7)	(none to slight)
2	10 (23.3)	8 (18.6)	
3	19 (44.2)	13 (30.2)	
4	13 (30.2)	14 (32.6)	
5	0 (0)	2 (4.7)	
E (ndurance) (seconds)			
I don't know	2 (4.7)	–	0.07
Absence	0 (0)	7 (16.3)	(none to slight)
1–3 s	15 (34.9)	15 (34.9)	
4–6 s	19 (44.2)	13 (30.2)	
7–10 s	25 (58.1)	8 (18.6)	
R (epetitions)			
I don't know	4 (9.3)	–	0.09
Absence	1 (2.3)	9 (20.9)	(none to slight)
1–3	19 (44.2)	18 (41.9)	
4–6	17 (39.5)	9 (20.9)	
7–10	2 (4.7)	7 (16.3)	
F (ast contractions)			
I don't know	4 (9.3)	–	0.04
Absence	0 (0)	5 (11.6)	(none to slight)
1–3 s	9 (20.9)	4 (9.3)	
4–6 s	21 (48.8)	0	
7–10 s	9 (20.9)	34 (79.1)	

(2.3%) suggested she would be able to perform one repetition of the “E”, but nine participants were unable to perform this task (20.9%). Similarly, more than 39.5% of the participants suggested they would be able to repeat the sustained contraction four times or more, however, only 9 (20.9%) participants were able to perform this task during the physical assessment.

Although during the assessment of the fast contractions most of the participants suggested they would not be able to perform more than 6 repetitions of the contraction, 34 (79.1%) participants concluded this task.

4. Discussion

The main findings of the present study show that the perceptions of young women about their PFM contraction do not agree with the results of a physical assessment of the PFM function performed by a trained assessor. Moreover, the results highlighted that there is an over-estimation of the self-perception related to the strength and endurance of the PFM contraction, and the number of repetitions of a sustained voluntary contraction. However, it seems that women have underestimated their capacity to perform fast contractions, as the physical

assessment results were superior to the self-perception assessed by a questionnaire. These results highlight that young women have a poor awareness of their PFM contraction.

Our results are similar to reports of a previous study conducted with Brazilian women around 40 years old, with history of previous delivery and without urinary complaints (Uechi et al., 2019). Authors concluded that there was no agreement between the physical assessment and self-perceived PFM contraction, considering the PFM strength assessed by vaginal palpation and classified by the MOS categories. Authors associated this inconsistency with the low body awareness of the pelvic floor area, which could also explain the results of the present study.

Moreover, the awareness of PFM may have influenced the results of another study that included 46 women between 36 and 40 years old, who used to practice Pilates and were constantly asked to contract their PFM during the exercise (Dar and Saban, 2022). Authors concluded that an agreement of 80% was found between the perception of the PFM contraction and the objective examination performed by ultrasound. Although the study has not reported how participants were taught about how to perform the PFM contraction during classes, the study included women that were attending Pilates classes at least once a week and were weekly receiving verbal instructions for the PFM contraction. It is already known that verbal instruction can improve the perception of the PFM, besides an improvement in the contraction performance (Mateus-Vasconcelos et al., 2018; Silva et al., 2021).

However, in disagreement with previous studies that analyzed women's knowledge about PFM function (Neels et al., 2016a, b; O'Neill et al., 2017), the majority of participants included in the present study reported previous knowledge related to the PFM functions and dysfunctions, and were instructed in how to perform the PFM contraction before the data collection. Nonetheless, they were not contracting their PFM as they thought they would. Moreover, most of participants in the present study reported that they found information about PFM contraction by their personal research. Previous literature already concluded that even adult women who reported having some knowledge about PFM may be unable to perform the PFM contraction correctly (de Freitas et al., 2018; Henderson et al., 2013; Kandadai et al., 2015). These results might be a highlight for health professionals, who have an important role in instructing women on performing the PFM contraction correctly.

Recently, social media has an exponential increased about the Women's Health content and, it is known that this type of content usually is not validated before being published, which is unfortunate, especially when the subject of the material is health-related (Ranade et al., 2020). Therefore, many women might have received inaccurate information about the role of PFM contraction and other functions and/or dysfunctions of this group of muscles. Specialized professionals should create and coordinate strategies to increase the dialogues and awareness about the perineal region and PFM function.

It is known that increasing knowledge and awareness of PFM is important for the contraction to occur properly even in women who are able to perform the contraction (Devreese et al., 2004). In addition, actions taken during early adulthood may benefits the development of strategies to prevent PFM dysfunction during aging (Talaszi et al., 2007), fact that should be highlighted by the results of the present study, as only nulliparous and young women (under 30 years old) were included. Nonetheless, the prevalence of incontinent women was high in our study. Our findings should concern health government and institutions, as it is already known that women with poor awareness of their PFM might have difficulty to identify signs and symptoms related to PFM dysfunctions and reduces demand for and adherence to PFM treatment programs (Zalm et al., 2008).

According to the authors knowledge, this is the first study that analyzed the agreement between self-perceptions of young women (18–30 years old) and results from a physical evaluation of the PFM, according to the complete PERFECT scheme. Moreover, the perception of different muscle proprieties was analyzed in the present study (e.g.,

strength, endurance, ability to repeat sustained and fast contractions), which is a novelty in the literature. These results could contribute to the development of health strategies in order to increase the perception of women about PFM functionality, as it is already known that the strength, endurance and reaction time might be important characteristics to be analyzed to prevent and treat PFM dysfunctions, as UI (Vieira et al., 2019).

This study has some limitations. The data collection about the PFM perception was collected by a semi-structured questionnaire created by the authors, as no previous validated instrument with this purpose has been published. However, we also believe it could be a strength of the study, by highlighting the need to create a specific tool for this type of assessment. Although the inclusion of women with or without incontinence generated a mixed sample, the population included in our study theoretically presented more predisposed to have worse PFM function, which narrows the external validity of our data to a population with similar characteristics. A final limitation could be that the self-perception and physical assessment were performed on the same day. However, different from a previous study that first performed the physical evaluation followed by the self-perception of the contraction, we decided to assess the self-perception before performing the vaginal palpation, which could have decreased the bias related to the increase of the awareness of the perineal area. Future studies should investigate the agreement between women's perception about their PFM contraction with a different population (e.g., pregnant women).

5. Conclusion

The perception of young women about their PFM function showed a very low agreement with the results of a physical assessment performed by a trained assessor according to the PERFECT scheme. These findings might indicate that young women do not have sufficient knowledge about PFM contraction and function, which could impact their health and lead to PFM dysfunctions (i.e., UI, fecal incontinence, sexual dysfunctions and others) in the future.

6. Clinical relevance

- Regardless age, the perception of young women about their pelvic floor muscles contraction is not in accordance with physical examination.
- A low perception of the pelvic floor muscles might be related with the presence of dysfunctions, as urinary and fecal incontinence, sexual dysfunctions and pelvic organ prolapse.
- Therefore, our findings should highlight for health and government agencies the urgent need to create new strategies to increase the awareness of pelvic floor muscles in young women, as actions in the early adulthood might prevent the presence of dysfunctions.

Data availability statement

Authors do not intend to make the data available.

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Conflict of interest disclosures

The authors completed the ICJME Form for Disclosure of Potential Conflicts of Interest and reported no conflicts of interest.

Ethics approval

This study was approved by Ethics and Research Committee of

Federal University of São Carlos (CAAE: 14043019.9.0000.5504).

Clinical trial registration

This study does not have a clinical registration, as it is characterized by a cross-sectional study.

CRediT authorship contribution statement

Jordana Barbosa-Silva: Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Formal analysis, Conceptualization. **Sara Campana Zanello:** Writing – review & editing, Visualization, Investigation, Data curation. **Cristine Homsy Jorge:** Writing – review & editing, Visualization. **Patricia Driusso:** Writing – review & editing, Visualization, Supervision, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Jordana Barbosa-Silva reports financial support was provided by Coordination of Higher Education Personnel Improvement. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Not applicable.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jbmt.2024.04.054>.

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