





## ORIGINAL ARTICLE

# Childhood fever and medical students: A multicentre, educational intervention

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## Abstract

**Aim:** Misconceptions and non-evidence-based practices toward childhood fever are reported worldwide. Medical students might be ideal candidates to introduce long-lasting changes in clinical practice. However, no study has gauged the effectiveness of an educational intervention to improve fever management in this population. We conducted an educational, interventional study on childhood fever among final-year medical students.

**Methods:** We conducted a prospective, multicentre interventional study employing a pre/post-test design. Participants from three Italian Universities filled in a questionnaire just before the intervention (T0), immediately after (T1) and 6 months later (T2) in 2022. The intervention was a two-hour lecture focused on the pathophysiology of fever, recommendations for its treatment and risks associated with improper management.

**Results:** 188 final-year medical students (median age of 26 years, 67% females) were enrolled. Relevant improvements in the criterion for treating fever and conceptions about the beneficial effects of fever were observed at T1 and T2. Similar data were found for the reduction of physical methods advice to decrease body temperature and concerns for brain damage from fever.

**Conclusion:** This study shows for the first time that an educational intervention is effective in changing students' conceptions and attitudes toward fever both in the short and medium term.

## KEYWORDS

fever, fever phobia, pharmacological treatments, physical methods, training

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## 1 | INTRODUCTION

Although management of childhood fever is an everyday task, misconceptions about this symptom and non-evidence-based practices toward its management are reported worldwide among healthcare providers.<sup>1,2</sup> Misconceptions include the assumptions that high body temperature might cause brain damage or seizures.<sup>3,4</sup> Non-evidence-based practices involve, among others, aggressive pharmacological treatment or parental advice to use physical methods to decrease body temperature.<sup>3-5</sup> A few educational interventions, such as lectures or tutorials, have been performed for healthcare providers in the last decades.<sup>6</sup> Although trials reported mainly positive results, they involved a small number of subjects, showed little clinical impact, or had short follow-ups.<sup>6-8</sup> As a matter of fact, available recommendations on childhood fever often fail to be integrated into day-to-day practice.<sup>9-12</sup>

Recently, we observed that undue concerns about childhood fever and potentially harmful attitudes are common also among final-year medical students.<sup>13</sup> These subjects might be ideal candidates to introduce a change in clinical practice. Still, to the best of our knowledge, studies have yet to gauge the effectiveness of interventions to improve fever conceptions and management among medical students. This study aimed at evaluating the effect of an educational intervention on childhood fever in final-year medical students.

## 2 | METHODS

We conducted a prospective, multicentre interventional study employing a pre/post-test design. Eligible for the study were final-year medical students attending the University of Florence, the University of Milan and the University of Pisa, Italy. In view of the results of our previously mentioned study among students,<sup>13</sup> we agreed with the board of the medical faculties of the three universities to perform an educational intervention on the topic of childhood fever and evaluate its effectiveness for final-year medical students. For this purpose, a two-hour lesson exclusively focused on the topic of childhood fever was offered within the regular medical course between January and February 2022. The lesson was prepared with the same content and format (PowerPoint, Microsoft Office 2019) by two of the authors (G.P.M. and A.C.). Three experts on childhood fever (P.M., E.C., and D.P.) reviewed the content of the lesson and gave it to the students at their respective universities. The lesson comprised three sections: the first section was dedicated to the pathophysiology of the fever and its role during infections (~20min). The second section focused on available international recommendations for managing fever in childhood (~30min). The third section (~55min) focused on the potentially harmful effects associated with improper management of fever (e.g., drug overdose and complications of using physical methods). The three sections were lectures. The remaining part of the lesson

### Key Notes

- This study gauged for the first time the effectiveness of an educational intervention on childhood fever among medical students.
- This multicentre study shows that the educational intervention improved conceptions and attitudes toward childhood fever after 6 months.
- Medical students might be ideal candidates to introduce long-lasting changes in day-to-day clinical practice on childhood fever.

(~15 min) was dedicated to any questions from the students and to foster discussion about the topic of the lesson.

The utilisation of a questionnaire, based on Schmidt's seminal survey on childhood fever,<sup>14</sup> was employed to gauge the effectiveness of the intervention. The adaptation of this questionnaire for medical students and its reliability within this population have been detailed elsewhere.<sup>13</sup>

Briefly, the questionnaire included three main parts to collect the following students' information: (a) demographic data by close-ended questions; (b) conceptions and approach toward management of fever by close-ended questions; and (c) history of relevant experience (both personal and second-hand) with fever by close-ended (yes vs. no) and open-ended questions (description of the experience). Data on the validity of the questionnaire were previously reported.<sup>13</sup> Unlike the previous study, we did not collect information about previous training received on the topic of childhood fever during the medical course. The full questionnaire used for this study is reported in the online supplementary material.

Students who attended the lesson in person received a link to the questionnaire (on Google Form) by email and were asked to fill in it just before the intervention (T0), immediately after (T1), and 6 months later (T2). In these three universities, attending at least 75% of lessons in person is compulsory and students were not aware about the content of the lesson before it. Information on demographics and relevant experience with fever was collected only through the questionnaire administered before the lesson. To keep the questionnaires anonymous, each student self-generated a code (using the most important date of their life followed by the first two letters of their favourite colour, e.g., 11032010GR) that had to be included at the beginning of all three questionnaires. After 6 months from the intervention, students received three reminders to fill in the third questionnaire.

The whole study was explained to students just before the onset of the lesson. It was clarified that completing the questionnaire was not compulsory, and no fee or incentive was planned for participants. The Ethical Committee of the University of Milan approved the study ("Parere CE 28.10.21") and students gave their written informed consent to participate.

## 2.1 | Statistical analysis

All answers were collected into an online database, preliminary synthesised through frequencies and percentage or median and interquartile range (IQR), and graphically explored for descriptive statistics. For inferential statistics, responses regarding beliefs and attitudes toward fever were converted into dichotomous variables due to the low frequency of some answers.

We first analysed all available data. The answers at the three-time points were compared by Pearson's Chi-square or Fisher's exact test, as appropriate. In case of significant differences, responses between pairs of time points (T0 vs. T1, T1 vs. T2, T0 vs. T2) were further analysed by the same tests. Finally, differences by gender, regional area of students' university and personal or second-hand experience with childhood fever were also assessed. The characteristics of students who completed the study and drop-outs were also compared by Chi-square or Fisher's exact test, as appropriate.

To consider the longitudinal nature of the data, the analyses were then restricted to subjects answering all three-time points questionnaires. For this purpose, Cochran's Q (or nonparametric Friedman) test for three binary-matched pairs was performed. In case of significant differences, answers between pairs of time points were further explored by McNemar's test.

A  $p$ -value  $<0.05$  was considered as significant. The R software was used for all analyses.<sup>15</sup> The analyses of open-ended questions were conducted as previously described.<sup>13</sup>

## 3 | RESULTS

A total of 190 students attended the lesson and two declined to fill in the questionnaires. Therefore, 188 final-year medical students completed the questionnaire at T0. Participants were predominantly

female ( $N=125$ , 67%) with a median age of 26 (IQR 25–26) years. Most respondents ( $N=78$ , 42%) attended the University of Pisa. A similar number of students attended the University of Milan ( $N=57$ , 30%) and Florence ( $N=54$ , 28%). Thirty-six students (19%) declared to have experienced a personally relevant episode of childhood fever and 39 (21%) had a relevant second-hand experience.

The questionnaire was filled in by 148 students (79%) at T1, whereas 80 students (43%) at T2. No significant difference in the answers at T0 (Table S1) was found between students who completed the study and drop-outs. Moreover, also the characteristics of the samples at each time point did not significantly vary over time (Table 1).

The approach to fever reported by students at different time points is depicted in Figure 1, whereas beliefs and misconceptions are shown in Figure 2.

Differences in the criterion for treating fever, advice of physical methods, concerns for brain damage and the assumption that fever has mainly beneficial effects were observed among the three-time points (Table 2). Such differences were primarily observed between T0 and T1 and between T0 and T2. At T0, discomfort rather than body temperature was considered a criterion for treating fever only by 4% of participants. This figure increased up to 69% at T1 and slightly, but not significantly, decreased at T2 (49%). 65% of the students reported the advice for physical methods at T0 versus 5% and 6% at T1 and T2, respectively. Beliefs that fever might cause brain damage decreased over time from 23% at T0 to 4% and 2% at T1 and T2, respectively. Finally, the assumption that fever has mainly beneficial effects, was reported by 64% at T0, 95% at T1 and 87% at T2.

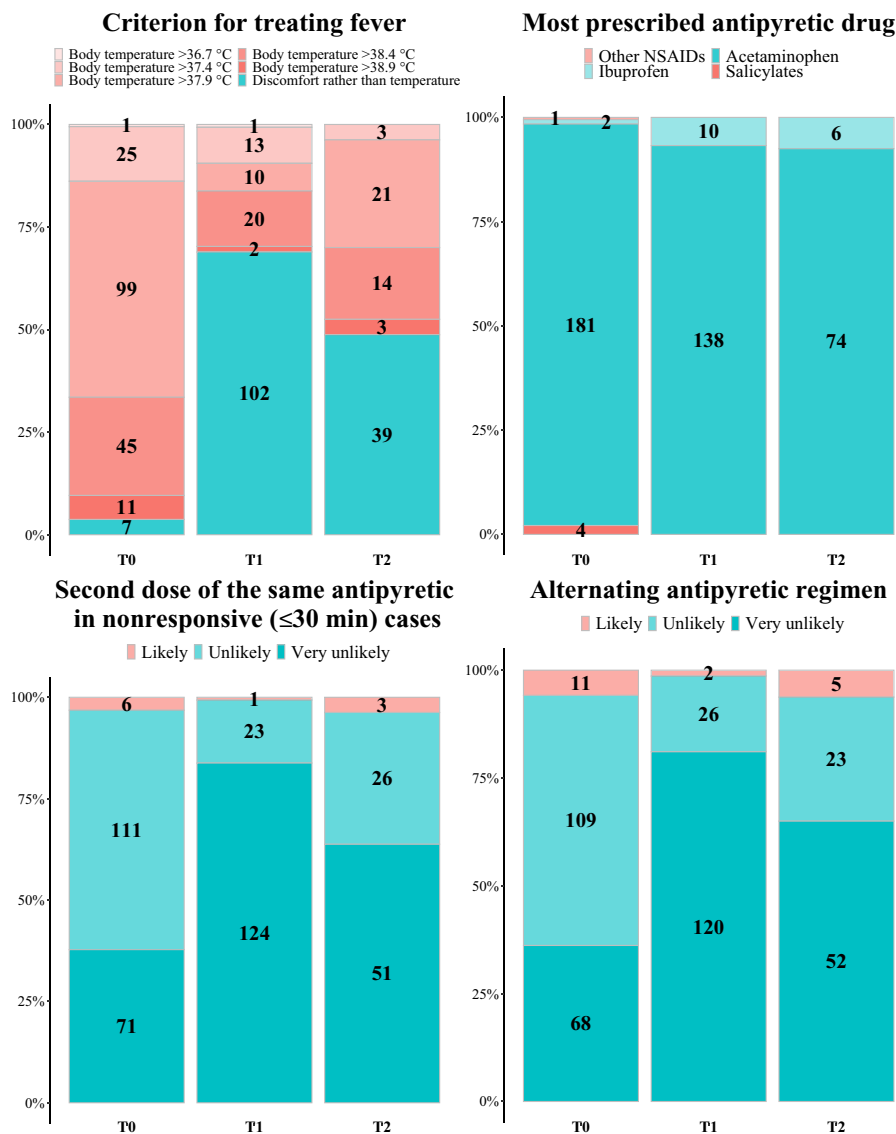
Personal experience of fever in childhood was associated with the belief that fever can cause brain damage at T0 ( $p=0.03$ ), but not at T1 and T2. Similar changes were observed considering the beneficial effects of fever across the three universities. Answers about the most prescribed antipyretic drug, second antipyretic dose and

TABLE 1 Characteristics of study participants at each time point: absolute frequencies and percentages

	N (%)		
	Time 0N = 188	Time 1N = 148	Time 2N = 80
Sex			
Male	63 (33)	47 (32)	22 (28)
Female	125 (67)	101 (68)	58 (72)
	$p=0.62$		
University			
Milan	57 (30)	47 (32)	18 (22)
Florence	53 (28)	51 (34)	31 (39)
Pisa	78 (42)	50 (34)	31 (39)
	$p=0.27$		
Personal relevant experience of childhood fever	36 (19)	32 (22)	20 (25)
	$p=0.55$		
Referred relevant experience of childhood fever	39 (21)	37 (25)	18 (23)
	$p=0.65$		

Note: P-values are referred to chi-square test.

**FIGURE 1** Students' approach to fever: answers at each time point (N=188 at T0, N=148 at T1, N=80 at T2).



alternating antipyretic regimen showed no significant changes over time.

Similar results were found when considering only questionnaires available for all the three time points (Table S2). The open-ended questions' results are given in the supplementary online material (Tables S3 and S4).

#### 4 | DISCUSSION

This is the first study investigating the effectiveness of an educational intervention on childhood fever among medical students. This multicenter study shows that a two-hour intervention effectively improved students' conceptions about and attitudes toward fever in the short and medium term. Furthermore, it shows that an educational intervention might modify culturally and individually learned traits about fever.

Self-limiting viral illnesses cause most episodes of paediatric fevers, but caregivers often perceive them as harmful and potentially

associated with life-threatening effects.<sup>16</sup> Although many data point out that fever is positively involved in the inflammatory process to fight infections, it is known that many healthcare providers sometimes reinforce negative assumptions about fever among caregivers and tend to treat this symptom aggressively.<sup>17-19</sup> A recent study in New Zealand showed that only 10% of physicians and nurses in emergency departments adhere to guidelines on childhood fever management.<sup>18</sup> Moreover, a recent qualitative study concurrently involving caregivers and primary care paediatricians, showed that the relationship between healthcare providers and parents plays a crucial role in the so-called "fever phobia".<sup>2</sup> The mentioned data suggest that a change in the behaviours toward fever among healthcare providers is likely the first step to improving the approach of caregivers to feverish children. However, modifying the attitudes of experienced physicians might be challenging and with only short-term effects.<sup>20</sup> A study including 31 Australian nurses found that a 30-min tutorial on childhood fever pathophysiology and management was associated with an improved knowledge after 2 months.<sup>7</sup> However, a high variability in knowledge acquisition was observed

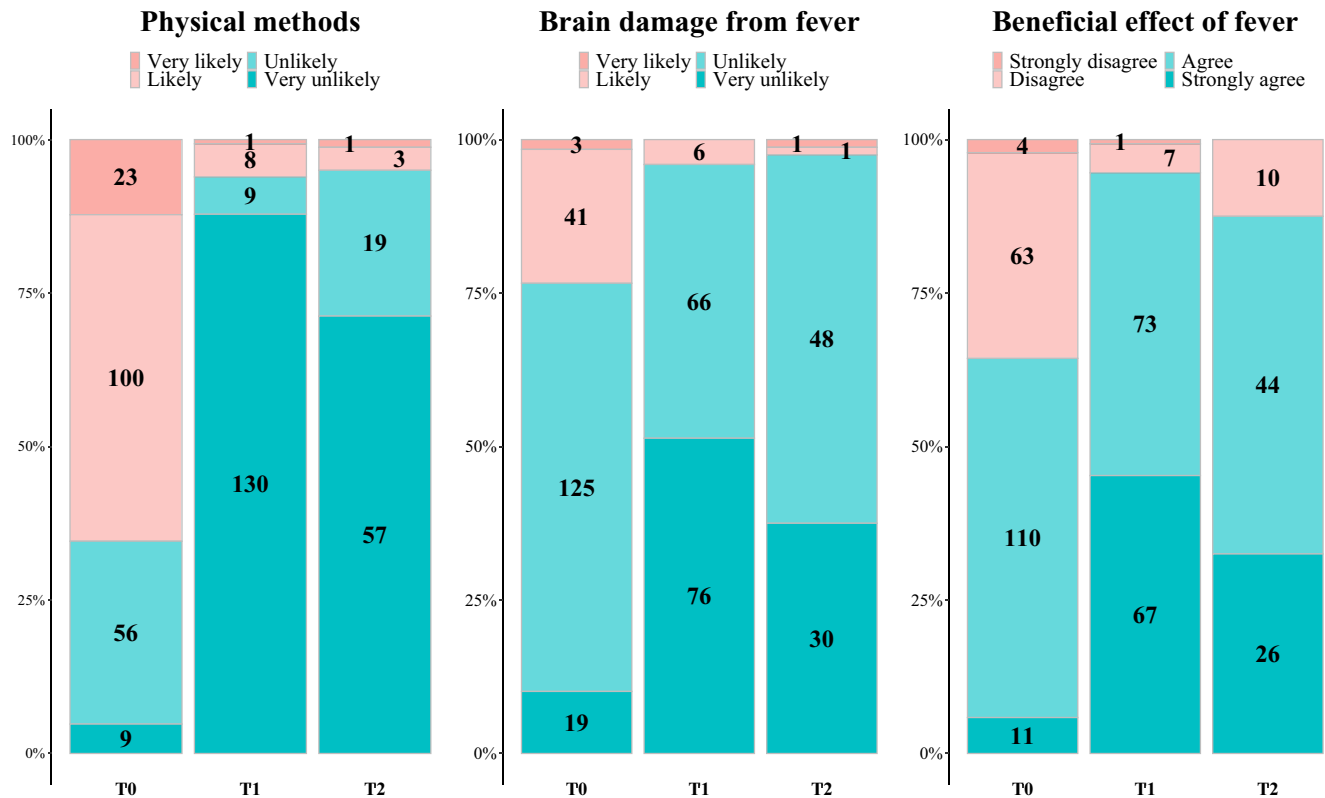


FIGURE 2 Students' beliefs and misconceptions about fever: answers at each time point (N=188 at T0, N=148 at T1, N=80 at T2).

among participants. A further study investigated the effect of an educational intervention to improve parental advice regarding fever management. The study observed an increase in providing specific written instructions to caregivers at discharge on antipyretic medications (from 23 to 78%) after 2 months from the intervention. Yet, no longer follow-up was available.<sup>21</sup> In this study, most final-year medical students considered body temperature as the criterion to treat fever and would have advised parents to use physical methods to decrease it before the educational intervention. Immediately after the intervention and 6 months later, most respondents considered discomfort rather than body temperature as the main indication for a symptomatic treatment of febrile children and would not advise physical methods anymore. Despite less marked, a significant improvement was also observed in the percentage of students who were concerned about cerebral damage associated with fever and who assumed that fever has mainly beneficial effects on children. These data point out that final-year medical students might be an ideal target for a potentially long-lasting change in the conceptions and the approach to fever in children.

Previous investigations suggested that “fever phobia” is a culturally learned trait. A Swiss study including German, French and Italian-speaking paediatricians found significant differences in these three groups on the criteria to symptomatically treat fever, the use of alternating drug regimens, and the concerns about the consequences of fever.<sup>22</sup> A systematic review conducted by some of the authors identified a relationship between parental ethnicity and fever phobia.<sup>10</sup> Pursell and Collins found that fever phobia did not

wane over time and speculated that the extensive cultural transmission of this phenomenon makes educational interventions unlikely to be effective.<sup>11</sup> In the present study, we could not explore in detail the role of cultural aspects related to the effectiveness of the educational intervention. On the other hand, this study included universities from different geographical areas: the University of Milan in Northern Italy, and the University of Florence and Pisa in Central Italy. Although differences in the answers related to the assumption that fever has mainly beneficial effects, were observed before the educational intervention among the three universities, these differences disappeared after the educational intervention. The results of our study also suggest that the relevant personal experience of fever in childhood might be associated with undue concerns about the consequences of fever. However, this association disappeared after the educational intervention. Altogether, these findings suggest that an educational intervention among final-year medical students might effectively overcome culturally and personally learned concerns and modify the approach toward fever.

The study of specific diseases is currently the cornerstone of most medical curricula. Accordingly, fever is mainly taught as a symptom or sign pointing to the possible existence of inflammatory or infectious diseases and, correctly, focus is mainly pointed at learning the pertaining differential diagnosis. Upon definition of diagnostic procedures and the exclusion or management of potentially life-threatening conditions, academic curricula should incorporate training on the symptomatic management of fever. Undue concerns about fever are associated with an over-use of antipyretic

TABLE 2 Differences in students' answers over the three-time points

	N (%)		
	T0N=188	T1N=148	T2N=80
<b>Criterion for treating fever</b>			
Body temperature	181 (96)	46 (31)	31 (51)
Discomfort rather than the temperature	7 (4)	102 (69)	39 (49)
Overall test	$p < 0.001$		
Paired tests	T0-T1: $p < 0.001$	T1-T2: $p = 0.08$	T0-T2: $p < 0.001$
<b>Most prescribed antipyretic drug</b>			
Acetaminophen or Ibuprofen	183 (96)	138 (93)	80 (100)
Salicylates or Other NSAIDs	5 (4)	10 (7)	-
Overall test	$p = 0.10$		
<b>Second dose of the same antipyretic in nonresponsive (<math>\leq 30</math>min) cases</b>			
Yes (Very likely/Likely)	6 (3)	1 (1)	3 (4)
No (Unlikely/Very unlikely)	182 (97)	147 (99)	77 (96)
Overall test	$p = 0.17$		
<b>Alternating antipyretic regimen</b>			
Yes (Very likely/Likely)	11 (6)	2 (1)	5 (6)
No (Unlikely/Very unlikely)	177 (94)	146 (99)	75 (94)
Overall tests	$p = 0.06$		
<b>Physical methods</b>			
Yes (Very likely/Likely)	123 (65)	9 (6)	4 (5)
No (Unlikely/Very unlikely)	65 (35)	139 (94)	76 (95)
Overall test	$p < 0.001$		
Paired tests	T0-T1: $p < 0.001$	T1-T2: $p = 1$	T0-T2: $p < 0.001$
<b>Brain damage from fever</b>			
Yes (Very likely/Likely)	44 (23)	6 (4)	2 (2)
No (Unlikely/Very unlikely)	144 (77)	142 (96)	78 (98)
Overall test	$p < 0.001$		
Paired tests	T0-T1: $p < 0.001$	T1-T2: $p = 1$	T0-T1: $p < 0.001$
<b>Beneficial effect of fever</b>			
Yes (Strongly agree/Agree)	121 (64)	140 (95)	70 (87)
No (Disagree/Strongly disagree)	67 (36)	8 (5)	10 (13)
Overall test	$p < 0.001$		
Paired tests	T0-T1: $p < 0.001$	T1-T2: $p = 0.10$	T0-T2: $p < 0.001$

Note: Data are given as frequencies (percentages) of the dichotomized responses. The corresponding independence test was performed.

Abbreviation: NSAIDs, Non-steroidal anti-inflammatory drugs.

drugs, unjustified prescription of antibiotics, and over-use of health services. Reducing these phenomena might prevent risks to the health of patients and decrease avoidable costs for the healthcare systems.<sup>23-25</sup>

This study has limitations. First, there was no control group. The possibility of having a group of students who could attend the lesson and one that could not, was evaluated by us and by the board of the universities as unpractical and potentially unethical. However, the data obtained in our previous study conducted just before the graduation among final-year medical students are comparable with the results obtained at T0 in this study.<sup>13</sup> Second, a not negligible

drop-out occurred over time. Although several reminders were sent to reduce the drop-out, this trend was expected considering available data on online longitudinal surveys among students.<sup>26,27</sup> Importantly, no significant difference was observed between students who completed the study and drop-outs, thus reducing the risk of a selection bias. Third, the study was limited to three Italian universities. Fourth, since a standardised educational platform for childhood fever does not exist,<sup>6</sup> the intervention was developed ad hoc for this study. Its reproducibility in other contexts should be explored in future studies. Fifth, some observations showed that the relational component between healthcare providers and parents

plays an important role in fever management,<sup>2</sup> but this was not addressed in the intervention. Finally, we did not examine whether the changes in the answers will translate into an actual improvement in the future clinical practice. However, we speculate that the present results might be relevant for future practice also considering previous observations showing that students' knowledge and attitudes often do not change after graduation.<sup>28</sup>

## 5 | CONCLUSION

This study shows for the first time that an educational intervention among final-year medical students is effective in changing both conceptions and attitudes toward childhood fever. Future studies should evaluate such intervention also in other countries and consider the implementation of specific training dedicated to childhood fever in the medical curricula.

### AUTHOR CONTRIBUTIONS

Drs. Milani, Chiappini, Marchisio and Peroni conceptualised and designed the study. Drs. Corsello acquired the data and performed the analysis. Dr. Comotti performed the statistical analysis. Schulz, Fadda, Gianni and Alberti gave a significant contribution in data interpretation. Drs. Milani and Comotti drafted the initial manuscript. All authors reviewed and revised the manuscript and approved the final manuscript as submitted.

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### CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to disclose.

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## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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