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Technical and tactical evaluation of ball possession in international youth water polo matches using the Team Sport Assessment Procedure (TSAP) instrument

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Abstract

In water polo, the playing style of a team is characterized by players' tactical behaviour. The purpose of this study was to provide an analysis of offensive actions, by means of the Team Sport Assessment Procedure (TSAP) of the first four youth national teams during the 20th FINA Junior Water Polo World Championships. Twenty-nine elite youth (U20) water polo matches, involving the national teams of Greece (n=7), Serbia (n=7), Italy (n=7) and Croatia (n=8) were selected for the analysis. The TSAP included: i) two indicators of gaining possession of the ball; ii) four indicators of disposing the ball. Using these indicators, the following indices of technical performance were computed: Volume of Play (VP), Efficiency Index (EI) and Performance Score (PS). The field was divided in twelve zones. The one-way ANOVA showed no significant differences between teams for all parameters ($p>0.05$), except that for Offensive Balls (OB) and Successful Shots (SS) occurred in specific zones of the field: for OB significant differences were found in zone 1 ($p=.019$), in zone 2 ($p=.014$) and in zone 5 ($p=.007$); for SS significant differences were found in zone 1 ($p=.026$) and in zone 2 ($p=.008$). The main reason of between-teams differences could be explained by the presence of a left-hand player in the game, and by the tactical behaviour of coaches and players. The TSAP instrument could offer productive feedback to coaches to perceive the different requirements of playing and to evaluate how players understand the game.

Keywords: *match analysis, offensive phase, performance index*

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Introduction

Water polo, which originated in the late 1800s, is one of the oldest team sports of the modern Olympic Games, being part of the Summer Olympics program since the second games, in 1900. Since 1973 the Federation Internationale De Natation (FINA) also organize the Men's World Championship, with the last edition (the 19th) held in Hungary (Budapest). This competition has been also extended to the youth categories, with the Men Water Polo World Junior Championships (currently named U20) played since 1981. The tournament consists of a preliminary group stage phase, with teams divided into two groups and playing once with each other, followed by a knockout phase (eight-, quarter-, semi-final, and finals). Despite the situational nature of water polo, like other team sports, makes difficult the game analyses in terms of replication (Lupo et al., 2010), in literature are present different types of investigation, including physiological characteristics (Botonis et al., 2019a; Smith, 1998), monitoring of training (Lupo et al., 2014a; Botonis et al., 2019b), as well as swimming capabilities (Dimitrić et al., 2022; Perazzetti et al., 2022). Regarding the technical and tactical aspects, specific studies have been provided involving men and women collegiate teams (Lupo et al., 2011), playing role efficacy (Botonis et al., 2018), game rules evolution (Borges-Hernández et al., 2022), different competitive levels (Lupo et al., 2012a), and influence of match outcome (Ruano et al., 2016). However, from our point of view, in water polo, the absence of a valid and reliable instrument to objectively assess the players' level of tactical awareness and game knowledge, to use on both match and training contexts, is responsible for the paucity of studies on these topics.

The Team Sport Assessment Procedure (TSAP) instrument has been used in both sport and physical education by students, teachers, coaches, and researchers (Grehaigne et al., 1997) to assess performance in games as the integration of tactical understanding, decision-making and skill performance. Its primary objective is to provide coaches with objective data on players' offensive performance in different invasion and net games, while avoiding standardized tests which do not provide tactical behaviours of players (Richard et al., 2002). Indeed, the basic idea of this procedure is to consider the players' and teams' specific behaviours during the game and to summarize the data collected either under the form of total occurrences or under the form of some performance index. For that reason, the TSAP method is focused on the offensive ball aspects of the game, assessing how a player or team gains the ball possessions, and how a player or team disposes the ball (Grehaigne et al., 1997). In current literature, studies regarding the use of TSAP instrument have been published in soccer (Blomqvist et al., 2005), basketball (Catarino et al., 2017), ice-hockey (Nadeau et al., 2008) and volleyball (Richard et al., 2002). However, in water polo, to the best of our knowledge, only one study was conducted using this instrument, showing how the TSAP could be a valid procedure to evaluate the performance of international youth teams during international water polo competitions (Perazzetti & Tessitore, 2021). Therefore, the present study aimed at providing the TSAP analysis of the last Men's Water Polo World Junior Championships organized by FINA and played in Kuwait at the end of the 2019, before the spread of coronavirus pandemic.

Methods

Twenty-nine matches of the 2019 FINA World Men's Junior Water Polo Championships (Kuwait City, Kuwait), involving the national teams of Greece (n=7), Serbia (n=7), Italy (n=7) and Croatia (n=8) were selected for the analysis. The TSAP instrument (Grehaigne et al., 1997) was used to assess Received Balls (RB) and Conquered Balls (CB) as variables for gaining possession of the ball; and Offensive Balls (OB); Successful Shots (SS), Neutral Balls (NB) and Lost Balls (LB), as variables for disposing of the ball. Then, the Volume of Play [VP: RB+CB], Efficiency Index [EI:(OB+SS)/(10+LB)] and Performance Score [PS:(VP/2)+(EI*10)] were calculated as performance indicators (Table1). The EI used in this study is the adapted version of Richard et al. (2000), which differs from the original version of Grehaigne et al. (1997; EI:(VP)/(10+LB)) and poses an emphasis on the ball possession management (i.e. pass or shoot on goal) (Light et al., 2008).

Table 1. TSAP Components in Water Polo*

GAINING POSSESSION OF THE BALL	
Receiving the ball (RB)	The player receives the ball from a partner and does not immediately lose control of it.
Conquering the ball (CB)	A player is considered having conquered the ball if he or she intercepted it, stole it from an opponent, or recaptured it after an unsuccessful shot on goal or after a near-loss to the other team.
DISPOSING OF THE BALL	
Playing a neutral ball (NB)	A routine pass to a partner or any pass which does not truly put the other team in jeopardy is considered a neutral ball.
Losing the ball (LB)	A player is considered having lost the ball when he or she loses it to the other team without having scored a goal (Shot, Passages, Lost Ball, Contrafoul).
Playing an offensive ball (OB)	An offensive ball is a pass to a partner which puts pressure on the other team and, most often, leads to a shot on goal (Assist, Offensive passages, Center Ball) or a gained exclusion with the ball in the hand
Executing a successful shot (SS)	A shot is considered successful when it scores or possession of the ball is retained by one's team (Goal and Shots)
PERFORMANCE INDICATORS	
Volume of Play (VP)	VP: RB+CB
Efficiency Index (EI)	EI: (OB+SS)/(10+LB)
Performance Score (PS)	PS: (VP/2)+(EI*10)

*Adapted from Grehaigne et al. (1997). Journal of teaching in Physical Education, 16(4), 500-516

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Through the LongoMatch Pro software (LongoMatch By Fluendo, Windows version 1.7) we customized a specific water polo dashboard to collect TSAP parameters during all ball possessions for each observed team. For the CB, LB, OB and SS parameters has also been provided an analysis of their frequency of occurrence in relation to the zone in which they took place. The field was divided in twelve zones according to the ususal classification used by water polo coaches and adopted in a previous study by Perazzetti and Tessitore (2021). In particular, the field was divided in a "defensive half" (DH) (left zones: -1 and -2; right zones: -4 and -5; and central zones: -3 and -6) and an "offensive half" (OH) (right zones: 1 and 2; left zones: 4 and 5; and central zones: 3 and 6) (Figure 1).

The Shapiro–Wilk test was applied to ascertain the normal

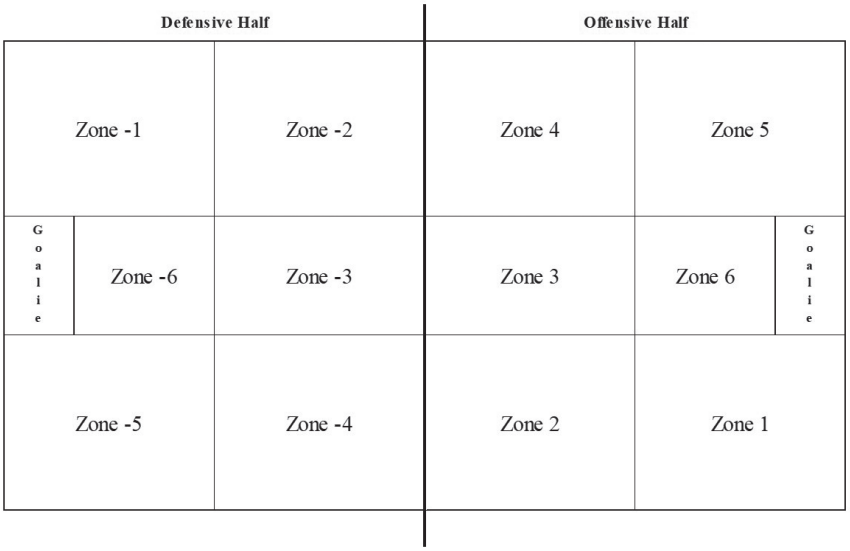

Figure 1. The division of the water polo field in twelve zones

distribution of data. Descriptive statistics of all TSAP parameters, including means and standard deviations, for Greek, Serbian, Italian and Croatian teams and pooled data were calculated. The one-way ANOVA was used to analyse differences between teams for all parameters and according to the zones of the field, while the independent t-Test with pooled data was used to analyse differences, for the same parameters, between tournament phases (preliminary round vs final round) (García-Marín et al., 2017) and match status in relation to the difference of number of goals scored by the two opponent teams [balanced (≤3 goals) vs unbalanced (>3 goals)] (Lupo et al., 2012b). A Pearson correlation was used to characterize the association between TSAP's parameters and total amount of gained exclusions, gained penalties, goals conceded, and goals scored. The correlation coefficients were defined as follows: small 0.1–0.3; moderate 0.3–0.5; strong 0.5–0.7; very strong 0.7–1.0 (Schober et al., 2018).

The statistical analyses were conducted using the statistical package SPSS (version 20.00; Institute, Inc., Cary, NC), and the criterion for significance was set at a 0.05 alpha level.

Results

Table 2 shows the total amount of TSAP parameters of the 29 matches analysed, indicating minimum, maximum, mean and SDs.

Table 2. Total amount of TSAP parameters (29 matches) with pooled sample (Greece, Serbia, Italy and Croatia national teams)

	DESCRIPTIVE STATISTICS				
	Mean	SD	CV (%)	Min	Max
RB	197.7	34.6	17.5	126	257
CB	9.3	3.6	39.1	3	16
VP	207	33.4	16.1	142	269
NB	135.1	34.3	25.4	70	203
LB	22.7	5.9	26.1	9	33
OB	31.7	7.8	24.5	18	46
SS	17.5	6.2	35.6	7	32
EI	1.6	0.7	43.8	.7	3.5
PS	119.6	17	14.2	84	157.4
Goals Scored	13.1	6	45.3	4	27
Goals Conceded	7.2	3	41.9	2	15
Gained Exclusions	11	4.5	49.2	3	23

Note. RB= received balls; CB= conquered balls; VP= volume of play; NB= neutral balls; LB= lost balls; OB= offensive balls; SS= successful shots; EI= efficiency index; PS= performance score

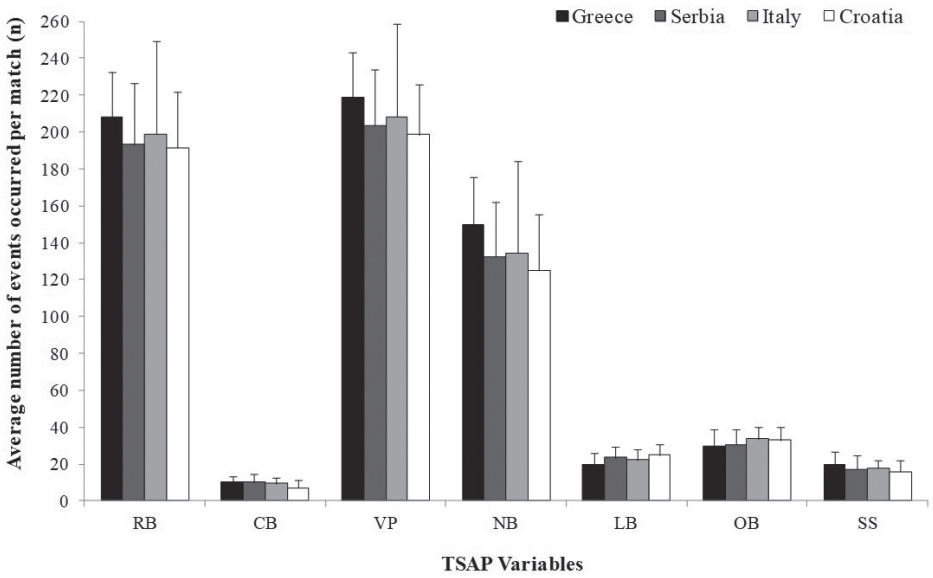

Figure 2. Comparison of the TSAP variables' mean values per match between national teams (Greece, Serbia, Italy and Croatia) (p>0.05); Note. RB= received balls; CB= conquered balls; VP= volume of play; NB= neutral balls; LB= lost balls; OB= offensive balls; SS= successful shots

Regardless the tournament phase, the one-way ANOVA showed no significant differences between national teams (Greek, Serbian, Italian and Croatian) for any of the TSAP parameters (Figure 2).

Through the analysis of the field zones, the pooled data showed that CB occurred more in the defensive half (n=270) of the field than in the offensive one (n=2). Contrariwise, the LB, OB and SS parameters have mainly occurred in the offensive half of the field (LB, n=647; OB, n=894; SS, n=495) compared to the defensive one (LB, n=11; OB, n=26; SS, n=13). Regarding the distribution of the zones of the field, for the defensive half zone -6 showed the highest number of CB occurred per match (n= 5±2), while for the offensive half zone 6 for LB (n=6±3), zone 2 for OB (n=7±3), and zone 6 for SS (n=6±4) showed the highest values. Instead, the one-way ANOVA showed significant differences (p<0.05) between the four teams for OB played in zone 1 (p=.019), in zone 2 (p=.014) and in zone 5 (p=.007) and for SS performed in zone 1 (p=.026) and in zone 2 (p=.008) (Table 3).

Table 3. Distribution of the frequency of occurance per match for the CB, LB, OB and SS parameters according to the zones of the field.

		DEFENSIVE HALF					
Parameters	Teams	Zone -1	Zone -2	Zone -3	Zone -4	Zone -5	Zone -6
CB	Greece	1.3±1.1	1.3±1.1	1.6±0.8	0.3±0.5	0.1±0.4	6.0±2.0
	Serbia	1.1±1.1	0.3±0.5	1.6±1.8	0.6±0.8	0.9±0.9	5.7±2.6
	Italy	0.8±0.7	1.0±1.0	1.9±1.7	0.4±0.8	0.1±0.4	5.3±2.3
	Croatia	0.7±1.0	0.9±0.8	0.7±1.0	0.1±0.4	0.7±0.9	4.0±2.6
		OFFENSIVE HALF					
Parameters	Teams	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
LB	Greece	2.3±2.0	2.9±1.9	5.7±2.8	3.0±1.6	2.6±1.4	3.4±2.4
	Serbia	2.4±1.6	5.3±2.4	5.1±2.6	3.9±2.4	1.6±1.7	4.7±1.9
	Italy	1.7±1.5	3.9±1.0	5.1±3.4	2.4±1.6	0.7±0.5	7.6±3.2
	Croatia	2.9±2.8	5.0±2.9	5.1±3.0	2.1±2.0	2.4±2.0	7.1±4.1
OB	Greece	4.7±1.7	4.9±2.4	7.3±1.9	3.6±2.8	3.6±2.4	5.3±4.1
	Serbia	3.9±2.4	8.7±2.9	6.4±3.3	3.3±3.2	1.9±1.7	4.0±1.5
	Italy	4.7±1.1	6.0±2.3	8.4±4.1	4.1±2.3	4.4±2.2	5.6±3.1
	Croatia	7.0±2.0	8.7±2.5	5.1±3.4	3.9±1.9	1.0±1.0	6.7±1.7
SS	Greece	1.1±1.0	1.7±1.6	5.0±2.8	2.6±1.1	2.1±1.7	6.9±3.0
	Serbia	1.4±0.9	3.3±1.5	4.4±2.4	1.1±0.7	2.4±1.7	4.1±3.2
	Italy	2.1±1.3	1.0±0.8	3.1±1.4	0.9±0.9	3.0±4.0	6.9±3.6
	Croatia	0.4±0.7	1.1±0.9	3.5±2.2	1.4±2.3	2.0±1.2	6.9±5.3

Note. CB= conquered balls; LB= lost balls; OB= offensive balls; SS= successful shots

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The analyses with pooled data (29 matches) by means of the independent t-Test showed significant differences between preliminary round (17 matches) and final round (12 matches) for CB (p=.038), LB (p=.048), OB (p=.013), SS (p=.000), EI (p=.002).

The difference of the number of goals scored by the two opponent teams per match showed that a margin of ≤3 goals (balanced) occurred in 11 matches (38%) while a margin >3 goals (unbalanced) occurred in 18 matches (62%). Regarding the analysis of match status in relation to the tournament phases, data showed that of the 11 balanced matches 18.2 % (n=2) and 88.6% (n=9) were registered during the preliminary and final phases, respectively; while of the 18 unbalanced matches 83.3% (n=15) and 16.7% (n=3) were registered during the preliminary and final phases, respectively. Moreover, the independent t-Test, showed a significant difference (p<0.05) between matches with balanced and unbalanced scores for RB (213±24 vs 188±37), CB (7±3 vs 10±4), NB (153±29 vs 124±33), LB (26±4 vs 20±6), SS (13±4 vs 20±6) and EI (1±0.5 vs 2±1), respectively.

The Pearson correlation with pooled data showed a positive very strong correlation between VP and NB (r=.957, p=.000) and a negative very strong correlation between LB and Goals Scored (r=-0.903, p= .000) (Figure 3). Strong correlations were also showed between OB and SS (r=.605, p=.001), Total Gained Exclusions and RB (r= 0.597, p= .001), CB and Goals Scored (r= 0.506, p=.005). Moderate correlation was found between Goals Conceded and LB (r=.387, p=.038), while negative moderate correlation was showed between NB and Goals Scored (r=.-496, p=.006).

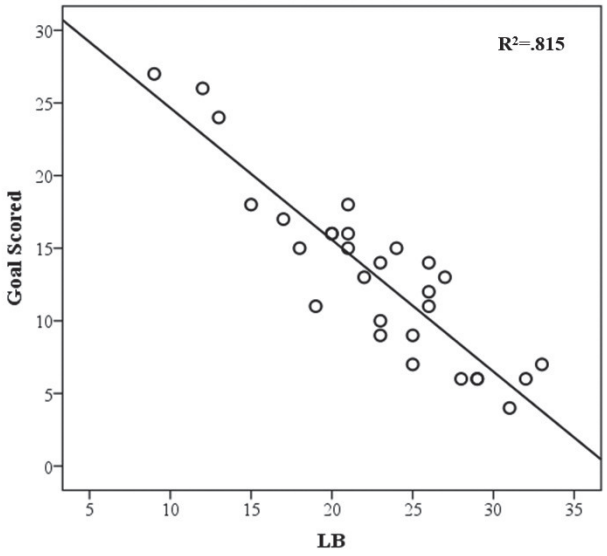

Figure 3. Pearson Correlation between LB and Goal scored (r=-.903); Note. LB= lost balls

Discussion

This study aimed to provide a technical and tactical analysis of offensive actions during international youth water polo competitions by means of the Team Sport Assessment Procedure instrument. The TSAP analysis has investigated the matches of the youth water polo national teams of Greece, Serbia, Italy and Croatia, which gained the first four placements at the 2019 FINA Men's Water Polo World Junior Championships (Kuwait City, Kuwait).

TSAP differences between teams and type of matches

The main findings showed that there were no significant differences between the four national teams for all TSAP parameters and indices. Nevertheless, the winner national team (Greece) showed higher mean scores per match for several parameters and indices (RB, n=208±24; CB, n=11±3; VP, n=219±24; SS, n=20±7; EI, n=2±1; PS, n=127±10) compared to the other three national teams. Furthermore, Greece showed the lowest score of LB per match (n=20±6), demonstrating a higher tactical awareness and ball possession ability compared to their opponents. The results of our winning team (Greek national team) confirm the findings of a previous study on elite and sub-elite men's water polo (Lupo et al., 2010), where the winning teams showed a higher duration of the even actions respect to the losing ones, speculating that winning teams were more able to maintain the ball possession and successively to defend their goal. When the analysis included the data distribution in relation to the different zones of the field, despite only OB and SS were significant, the four teams showed a different distribution of data. Such difference between the four national teams could be explained by the tactical behaviour of their coaches and the players' technical capabilities. In the World Junior Championships analysed in our study, the four national team coaches may have asked a different way to play NB and OB in relation to the gained position of their centre-forwards, and consequently according to the kind of defence adopted from each opponent teams. In fact, as suggested by Canossa et al. (2022), based on the new rules changes occurred at the international water polo level, a national team could adopt a more static or dynamic game that characterize its playing style. Therefore, these coaches' directions might have impacted on the distribution of the number of offensive passes in relation to the zone of the field influencing players' decision making and technical skills. In particular, the main reason of this difference between the four teams could be interpreted by the presence or not of a left-hand player in the game.

Anyway, considering the four national team pooled data, the zone -6 resulted to be the main position in which players conquered the possession of the ball (56% of the total

CB). Moreover, in zone 6, occurred the 26% of LB, as well as the 36% off SS, confirming this zone as the most dangerous position to score a goal in youth water polo matches, other than in senior elite level (Lupo et al., 2007). In addition, the 23% of OB took place in zone 2, demonstrating the relevance of this zone that is considered a 'play's construction' zone, where usually play 'perimetral' or 'wing' players. One of the main findings of this study, in line with previous ones (Lupo et al., 2012b), shows that the men's water polo matches of the World Junior Championships have mainly been characterized by the divergence between balanced (closed) and unbalanced games, as well as the comparison between preliminary and final rounds. Thus, it could be speculated that the game aspects of the youth elite men's water polo matches must be analyzed in relation to specific margins of results and the tournament phase (preliminary round or final round) and not only considering the winning or losing outcome.

TSAP parameters correlations

In terms of correlation, the results of this study suggest that for a team performing a higher value of VP doesn't mean to improve the possibility to score a goal compared to the opponent team. In fact, according to our results a higher value of VP improved only the number of NB, which were correlated with a decrease of the number of goals scored. Indeed, in youth water polo matches, the VP does not appear to be always a positive index, due to the strong correlation between RB and the total amount of gained exclusions occurring in a match. In fact, during a water polo match, it is widespread among coaches to ask their players not to rush to complete their attack and try to exchange the ball to find the best solution (Platanau & Varamenti, 2022). Furthermore, this aspect, could be explained by the fact that after an opponent exclusion (6 vs 5) players perform more passes, especially as NB, than during an even situation (6 vs 6). Our findings are in line with those of Platanau and Varamenti (2022), which demonstrated that the number of passes not always affect the scoring, especially in the power-play situations.

The results of our study, provide a useful indication for water polo coaches in terms of LB, showing how a higher number of LB decreases the number of goals scored and increases the number of goals conceded, confirming that the loss of ball possession might denote negative effects on the final outcome (Lupo et al., 2014b). Finally, our findings suggest that the number of CB and OB increase the number of goals scored, as in particular demonstrated by the Greece team (gold medal), which registered the highest values of TSAP parameters and indices between the four national teams.

Practical applications and future research perspectives

Based on our results, the use of TSAP instrument appears to produce an objective indication of teams' offensive performance in youth water polo matches. The findings from the analysis of the tournament could help to guide the training process along a championship or an entire season. In fact, this kind of monitorization could also offer productive feedback to coaches to perceive the different needs of playing, as well as to assess the way the players understand the game collectively or individually, for the purpose of adapt their planning and actions. Therefore, the coaching staff might use this information to establish common goals for trainings and matches of their teams. The coaches could have enough information to organize specific exercises, as small sided games, in their trainings to better reproduce the match situations (McCormick et al., 2012). Future directions of research could include individual scores and indexes of water polo players belonging the same team during a competitive season to see how all values changes according to the type of match and the period of the season.

Conflict of Interest

The authors have no conflicts of interest to declare. All co-authors have seen and agree with the contents of the manuscript and there is no financial interest to report.

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