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Emotional intelligence and motor competence in children, adolescents, and young adults

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ABSTRACT

This study's purpose was to explore the relationship between emotional intelligence (EI) and motor competence (MC) in 540 children, adolescents, and young adults. Using the Schutte Self-Report Emotional Intelligence Scale (SSEIT), participants were divided in three groups of high, average, and low EI. The short form of Bruininks–Oseretsky Test for Motor Proficiency – 2 (BOTMP-2SF) evaluated MC. Within each age and sex group, associations between MC and a) EI as a global construct and b) the four subdomains of EI were overall significant (with $p < .01$ for 85 out of 90 correlations) and very strong (with 66 correlations $> .60$). A 3 (EI groups) x 3 (age groups) x 2 (sex) ANOVA on standardized overall MC scores revealed that in all age groups, participants with higher EI outperformed their peers with average and low EI with respect to MC ($p < .001$). Additionally, boys scored higher on MC tests compared to girls ($p < .001$). A third-order interaction effect ($p < .001$) revealed that boys' superiority in MC generally decreased from childhood to adulthood, especially in the low EI group. The outcomes of this study show a robust relationship between EI and MC from childhood through early adulthood, suggesting a novel MC correlate throughout the lifespan.

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KEYWORDS Motor proficiency; motor skill; age; development

Introduction

In the past decades, motor competence (MC), which can be defined as the degree of proficient behaviour in a variety of motor skills (Strauss et al., 2019), has received increased scientific attention. This

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increasing popularity is in part due to the emerging evidence for the role of MC in the holistic development of children and adolescents. The positive association of MC with engagement in physical activity (PA) has been extensively documented (Cattuzzo et al., 2016; Robinson et al., 2015): children with higher levels of MC are more likely to be and remain physically active throughout the lifespan. An active lifestyle is accompanied by health benefits, such as a healthy weight status and a decreased risk of cardio-vascular diseases (Poitras et al., 2016; Richards et al., 2016; Warburton & Bredin, 2017). Apart from physical health-related benefits, MC has also been found to directly relate to many other domains of human functioning. Positive associations with aspects of physical fitness like strength, speed, and cardiovascular endurance (Cattuzzo et al., 2016), academic performance (Jaakkola et al., 2015), and psychological well-being (Rose et al., 2015) have been documented.

With respect to the latter connection, the environmental stress hypothesis (Cairney et al., 2010) describes the pathway from MC to a broad area of psychological characteristics in children and adolescents. Although developed in the context of Developmental Coordination Disorder (DCD) research, this concept is also used as a framework to study associations between psycho-emotional development and (low) MC, the latter being the most prominent behavioural characteristic of individuals with DCD. In short, a lower level of coordination is assumed to act as a primary stressor that can lead to exposure to secondary stressors like frustration of not being able to successfully participate in physical activities, withdrawal from such activities that are necessary for a healthy development, and thus reduction of social interaction with peers (Cairney et al., 2010). Children with poor MC are by consequence at risk for not having opportunities to learn peer-related social skills, which puts them at risk for emotional problems such as depressions and anxiety (Missiuna & Campbell, 2014; Wilson et al., 2013). In turn, these emotional problems will hamper participation in these sports and physical activities and thus decrease their opportunities to stimulate and develop MC. As a result, it might be problematic to escape this vicious circle in which MC and emotional characteristics are key. The environmental stress hypothesis (Cairney et al., 2010) aligns well with the Piagetian

notions on the role of play and motor competence for other domains of human motor development. This has been extensively argued in the work of Pellegrini (2009) for example.

This study will focus on the specific area of Emotional Intelligence (EI). Within the domain of emotional development, EI has been defined as 'a type of social intelligence that involves the ability to monitor one's own and others' emotions, to discriminate among them and to use this information to guide one's own thinking and actions' (Olivier, 2017; Salovey & Mayer, 1990). Although several conceptual models of EI have been proposed in literature (Laborde et al., 2016; Nelis et al., 2009; Salovey & Mayer, 1990; Stough et al., 2009), there is a general consensus that emotionally intelligent individuals 'know' themselves well, are able to sense the emotions of others, and are characterized by being affable, resilient, and optimistic. The global concept of EI can be subdivided into four domains (Petrides & Furnham, 2000; Saklofske et al., 2003): optimism and mood regulation, appraisal of emotions, social skills, and utilization of emotions (see Methods for a more detailed explanation).

High EI is assumed to facilitate efficiency in many domains of human functioning and development (Fernández & Martín, 2015; Martins et al., 2010; Olivier, 2017). For example, Shah et al. (2014) reported a positive relationship between EI and academic achievement in medical undergraduates, and Naik and Kiran (2018) reported that EI increases student achievement motivation. Closer to the domain of motor development and PA, positive associations between EI and efficiency in learning writing skills (Ebrahimi et al., 2018), increased PA levels, and positive attitudes towards physical activity have been reported (Ebrahimi et al., 2018; Fernández & Martín, 2015). Such positive attitude is benefical to the development of an active lifestyle, including the development of a sufficient level of MC alluded to in the environemental stress hypothesis (Cairney et al., 2010).

However, despite the a) the environmental stress hypothesis providing a theoretical framework for the reciprocal EI-MC relationship, and b) the evidence that EI and MC are positively associated with a wide variety of health-related outcomes, there is a considerable and surprising shortcoming in knowledge about the potential direct relationship between both constructs. With respect to the direct relationship between EI and MC, our current knowledge is limited to a) cross-sectional data (preventing the establishment of causality), and b) studies being limited to specific populations or limited age ranges.

In athletic populations, a higher EI has systematically been associated with success in competition sports and aspects of movement quality. For instance, it has already been shown that high-level sports performance is positively affected by EI (Kopp & Jekauc, 2018). Also, a comparison between volleyball players at both the national and state levels in India revealed that there is a significant difference between state and national level volleyball players' EI (Mohammad et al., 2015). In a more clinical context Schoemaker et al. (1994), documented that clumsy 6-7-year-old children might suffer more from social and affective problems compared to their typically developing peers. Although the authors focused on introversion/extroversion, social behaviour, and self-perception rather than EI, this study supports the potential link between affective characteristics and MC. Further support for the association between MC and emotional disorders, however again in clinical populations, was given in the review of Emck et al. (2009).

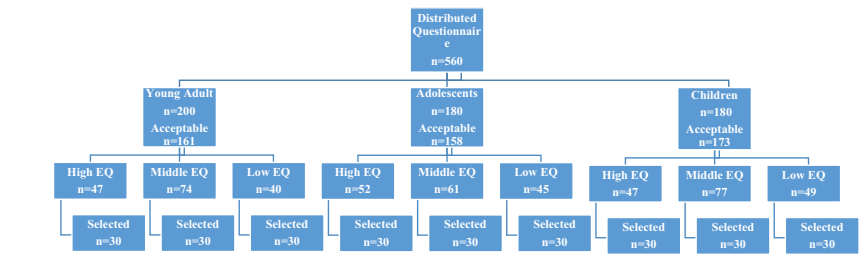
In conclusion, our current understanding of the relationship between EI and MC is very fragmented and built upon studies performed in a narrow age range and often in special groups or clinical populations not representative for typically developing children, adolescents, and young adults. In the current study, participants are Iranian children, adolescents and young adults living in a society where sports and PA are not promoted at the same level as many Western countries from which the studies above stem (Meier et al., 2021). The cultural, demographic as well as the economical context is different from other societies where most of the research on the current topic has been done. For example, the Gross Domestic Product (GDP) per capita is 4 times lower in Iran compared to Belgium according to the World Bank data of 2020 (World Bank, 2020). As such, this study allows to test the assumed generalizability of the EI-MC relationship. Therefore, the main aim of this cross-sectional study was to provide preliminary evidence for a direct association between EI and MC in different age groups ranging from childhood to young adolescents. Based upon assumptions made in the environmental stress hypothesis (Cairney et al., 2010), and the limited evidence in the literature on this topic, the central hypothesis of this study is that in general, individuals with a higher EI will also demonstrate higher levels of MC. As secondary aims in this study, we will exploratively investigate to what extent the MC is affected by age and sex. Given the particular position of sport participation and physical activity for adolescents and young adults in Iran, it is expected that MC levels will tend to drop in the older age groups in this study. Similarly, since females are still catching up with males when it

comes to sport participation and, more broadly speaking, attention for motor development in Iran (Meier et al., 2021), they are expected to score lower on MC compared to their male counterparts.

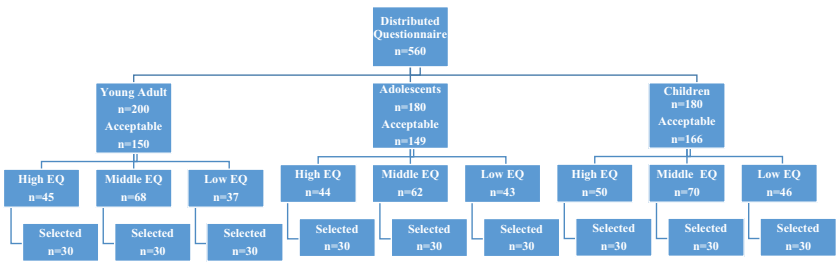
Materials and methods

Participants

In the current study, data of 540 participants (50% males), divided into three different age categories, was collected through multi-stage clustering (see, Figures 1(a,b) and Table 1). First, a total of 1120 children (N = 360), adolescents (N = 360), and young adults (N = 400) from, respectively, four primary schools, four high schools, and a public university (faculties of chemistry, law, and literature) in Tehran were asked to complete the Schutte Self-Report Emotional Intelligence Scale (SSEIT; Schutte et al., 1998; see methods for details). All participants were in good physical and mental health based upon school/university health records. During this phase, which took place in the school/university environment, two test leaders were present to explain the purpose of the test and to provide additional information if necessary. Questionnaires were considered as acceptable only if all questions were



a Sampling Design in Female



b Sampling Design in Male

Figure 1. (a) Sampling design in female (b) Sampling design in male.

Table 1. Descriptive information on the participants.

		n	Age (yr)	Height (cm)	Weight (kg)
				M (SD)	
Children	Female	90	8.42 (.84)	121.93 (3.27)	27.03 (1.66)
	Male	90	8.44 (.87)	119.38 (3.16)	22.35 (3.62)
Adolescents	Female	90	13.67 (.92)	153.44 (4.69)	47.16 (2.95)
	Male	90	13.26 (.94)	155.36 (11.39)	55.02 (12.89)
Young Adults	Female	90	19.52 (.82)	159.81 (2.97)	54.38 (3.49)
	Male	90	19.42 (.94)	182.57 (6.83)	81.75 (9.66)
	Female	270	13.87 (4.62)	145.06 (17.00)	42.81 (12.00)
	Male	270	14.13 (8.28)	152.44 (27.09)	53.04 (26.12)
Total		540	14.00 (6.70)	148.75 (22.89)	47.93 (20.94)

Table 2. Means ± SD of emotional intelligence in each of the EI, age, and sex groups.

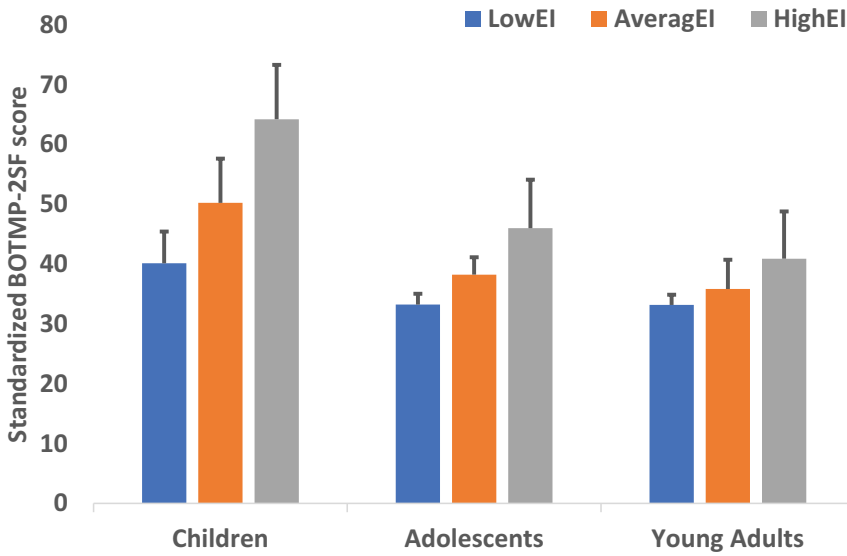
	Children M (SD)		Adolescents M (SD)		Young Adults M (SD)	
	Male	Female	Male	Female	Male	Female
Low EI	N = 30 57.90 (11.94)	N = 30 53.60 (12.29)	N = 30 48.07 (12.67)	N = 30 54.60 (12.68)	N = 30 51.20 (13.57)	N = 30 53.00 (11.92)
Middle EI	N = 30 92.87 (11.24)	N = 30 97.67 (10.76)	N = 30 95.67 (12.13)	N = 30 98.13 (9.30)	N = 30 91.07 (14.90)	N = 30 94.80 (10.06)
High EI	N = 30 148.20 (12.16)	N = 30 147.73 (9.19)	N = 30 146.23 (9.80)	N = 30 142.90 (11.17)	N = 30 141.47 (9.91)	N = 30 139.23 (10.98)

answered and if there were no obvious indications of repetition of the same answer in all questions (variability of answers). The vast majority (N = 957 or 85.4%) returned acceptable forms according to these criteria. In each age and sex group, participants were categorized as having low, average, or high EI by using tertile scores. From each of these groups, 30 participants were randomly selected to participate in the next stage (see, Figures 1(a,b)). Subsequently, MC of 180 children between 7 and 10 years of age (mean 7.76 ± .79 years), 180 adolescents between 12 and 15 years (mean 12.97 ± .76), and 180 young adults (mean 19.47 ± .97 years) between 18 and 21 years of age was evaluated. All participants above the age of 18 provided written informed consent, while parents or legal guardians delivered this consent for participants younger than 18 years prior to participation in the study. The study was organized in accordance with the guideline of the Declaration of Helsinki (World Medical Association, 2013).

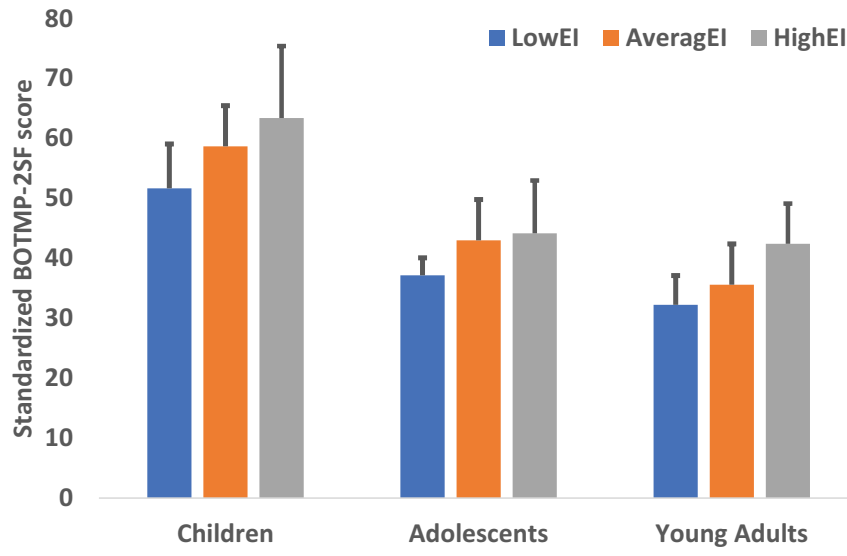
Measures

The Schutte Self-Report Emotional Intelligence Scale (SSEIT; Schutte et al., 1998) was used to assess EI. The SSEIT is a valid (Kinman & Grant, 2010; Schutte et al., 1998) and reliable (internal consistency: Cronbach's alpha = .87; and test–retest reliability: r = .78; (O'Connor et al., 2019; Schutte et al., 1998) self-report scale to assess EI in adults (e.g.Eranıl & Özcan, 2019), adolescents (e.g., Zeidner et al., 2005), and children (e.g., Ghorbanzadeh et al., 2020). The SSEIT measures four sub-regulations of EI (see, Petrides & Furnham, 2000; Saklofske et al., 2003): (1) optimism and mood regulation (11 items; α = .95 in the current sample; e.g., 'I motivate myself by imagining a good outcome to tasks I take on'), (2) appraisal of emotions (6 items; α = .92; e.g., 'By looking at their facial expressions, I recognize the emotions people are experiencing'), (3) utilization of emotions (4 items; α = .89; e.g., 'When my mood changes, I see new possibilities'), and (4) social skills (5 items; α = .90; e.g'I help other people feel better when they are down'). Participants rated the extent to which they agreed with statements by using a 5-point Likert-scale ranging from 'strongly disagree' (1) to 'strongly agree' (5). This procedure resulted in total scores ranging from 33 to 165, with higher scores indicating higher EI.

To evaluate MC, the short form of the Bruininks–Oseretsky Test of Motor Proficiency (BOTMP-2SF; Bruininks, 2005), developed for 4 to 21 year old participants, was used. The BOTMP-2 is a standardized and individually administered test battery to measure MC, consisting of 53 items in the full version or 14 items in the short form. Items are organized into four motor area composites: (a) fine manual control (fine motor precision and fine motor integration e.g., drawing lines through paths), (b) manual coordination (manual dexterity and upper-limb coordination, e.g., dribbling a ball), (c) body coordination (bilateral coordination and balance, e.g., standing heel-toe on a beam), and (d) strength and agility (running speed, agility, and strength, e.g., hopping on one leg). Its maximum Total Point Score (or raw score) is 88, and its range of standard score is 20–80. The participants were evaluated strictly according to the guidelines of the BOTMP-2SF manual (Bruininks, 2005). The point scores of the four motor-area composite scores were combined in a total motor composite score and converted into an age and sex standardized MC score (see, Figures 2(a,b)). These standardized overall score was submitted to the statistical analyses described below.



a (Female participants)



b (Male participants)

Figure 2. (a) Female participants (b) Male participants.

The test was completed in indoor facilities within the school or university context for children and adolescents, and young adult participants, respectively. Before the actual test, and after length and weight had been measured, hand and foot preference was determined by means of a ball throwing and kicking task according to the BOTMP-2SF manual. After describing the purpose of each test, supplemented by additional verbal information or a demonstration if necessary, each participant was allowed one test trial for each test item. In addition, each test was video recorded from the anterior-posterior and media-lateral planes. After the test, a total score for each participant was obtained and reported. Two researchers independently scored each participant in real life, and from the two data series, interrater reliability was calculated and found very high (89.1% agreement). However, if there was a difference in the scores of the first and second researcher, the score of the first researcher was used for further analysis due to the higher experience and expertise of the first researcher. A third researcher calculated the point scores from the raw scores for each items, as well as the overall point score (range: 0–88 pionts). The first author converted the total point scores into standardized scores (range 20–80) according to the manual guidelines.

Analyses

All data were analysed using Statistical Package for the Social Sciences version 25 software. First, the data were assessed for normality using the Kolmogorov–Smirnov test. Subsequently, we calculated the descriptive for all the variables and examined the correlations 1) between total MC and EI, and 2) between total MC and each of the four EI sub-regulations, in each of the EI (i.e., low, middle and high), age (i.e., children, adolescents and young adults) and sex (i.e., male and female) categories. As to address the aims of the study, a 3 (EI) x 3 (age) x 2 (sex) ANOVA on the standardized MC scores was performed. Post hoc tests were conducted in accordance with the Bonferroni procedure. In case of significant interactions, the 'split file' function in SPSS was used to disentangle these effects with separate ANOVAs. The significance level was set at $p < .05$ for all analyses. Effect size were reported as partial eta squared (0.2 or less: small effect; 05: moderate effect; 0.8: large effect; Cohen, 1988).

Table 3. Motor competence scores (mean ± SD) based on emotional intelligence, age and sex categories.

	Children M (SD)		Adolescents M (SD)		Adults M (SD)	
	Male	Female	Male	Female	Male	Female
Low EI	n = 30	n = 30	n = 30	n = 30	n = 30	n = 30
	51.87 (7.4)	40.13 (5.3)	37.17 (2.9)	33.23 (1.8)	32.23 (4.9)	33.17 (1.7)
Middle EI	n = 30	n = 30	n = 30	n = 30	n = 30	n = 30
	58.67 (12.7)	50.23 (7.4)	43.00 (7.9)	38.23 (2.9)	35.60 (3.8)	35.83 (4.9)
High EI	n = 30	n = 30	n = 30	n = 30	n = 30	n = 30
	63.40 (12)	64.20 (9.1)	44.17 (8.8)	46.00 (8.1)	42.43 (6.7)	40.90 (7.9)

Results

Tables 2 and 3 show means and standard deviations of the participants' EI and MC for each EI, age and sex group separately. An overview of the correlation coefficients between total MC and total EI, and between total MC and each of the four EI sub-regulations, for each EI, age and sex group is provided in Table 4.

The correlation analyses between MC and total EI score revealed strong to very strong associations between both constructs (all coefficients between .70 and .94, all p-values < .001). MC correlated significantly with the EI sub-regulations in 66 of the 72 analyses in all age and sex groups., For the sub-regulation of Optimism and Mood Regulation, Appraisal of Emotions, Utilization of Emotions, and Social Skills based on EI, these ratios of significant correlations were 18/18, 17/18, 15/18, and 16/18, respectively (Table 4).

A three-way ANOVA revealed significant main effects of EI ($F = 121.532$, $p < .001$, $\eta^2_p = .318$), sex ($F = 20.725$, $p < .001$, $\eta^2_p = .038$), and age ($F = 293.017$, $p < .001$, $\eta^2_p = .529$) on MC. Post hoc analyses indicated that all EI groups were significantly different from each other with respect to MC with the higher EI group showing the highest MC (all comparisons $p < .001$). Males systematically outperformed females. MC scores decreased with increasing age, all age groups being significantly different from each other (all p-values < .001). We also identified interaction effects for 1) EI group x sex ($F = 6.57$, $p < .01$, $\eta^2_p = .025$) with males outperforming females in the low ($F = 14.426$, $p < .001$, $\eta^2_p = .075$) and the average ($F = 7.010$, $p < .01$, $\eta^2_p = .038$) EI group but not in the high EI group ($F = .033$, $p = .857$, $\eta^2_p = .000$), 2) EI group x age ($F = 6.93$, $p < .001$, $\eta^2_p = .050$) with children displaying higher MC scores than adolescents

Table 4. Correlations between total BOTMP-2SF and total emotional intelligence, optimism/mood regulation, appraisal of emotions, utilization of emotions & social skills based on emotional intelligence, age and sex categories.

	Children										Adolescents									
	Male					Female					Male					Female				
	EI	O/MR	AE	UE	SS	EI	O/MR	AE	UE	SS	EI	O/MR	AE	UE	SS	EI	O/MR	AE	UE	SS
Low EI	.85***	.75***	.80***	.65***	.71***	.70***	.74***	.59**	.48*	.58**	.87***	.78***	0.80***	.60***	.76***	.89***	.76***	.80***	.65***	.79***
MiddleEI	.84***	.67***	.67***	.21	.60**	.73***	.56**	.33	.29	.48**	.91***	.72***	.71***	.44*	.49*	.80***	.59**	.52**	.85***	.41*
HighEI	.82***	.77***	.69***	.40*	.70***	.88***	.78***	.49**	.52**	.46*	.87***	.77***	.75***	.72***	.74***	.90***	.84***	.71***	.69***	.73***

Young Adults										
	Male					Female				
	EI	O/MR	AE	UE	SS	EI	O/MR	AE	UE	SS
	.82***	.83***	.67***	.71***	.55**	.94***	.86***	.82***	.73***	.83***
	.72***	.69***	.59**	.40*	.26	.77***	.76***	.40*	.42*	.05
	.77***	.53**	.61***	.46*	.54**	.83***	.71***	.60***	.36	.67***

*p < .05; **p < .01; ***p < .001.
EI = Emotional Intelligence.
O/MR = Optimism/Mood Regulation.
AE = Appraisal of Emotions.
UE = Utilization of Emotions.
SS = Social Skills.

and young adults in all three EI groups (all *p*-values < .001), and adolescents outperforming young adults in the average EI group ($p < .05$), but not in the low ($p = .131$) or high ($p = .111$) EI group, and 3) sex x age ($F = 8.075$, $p < .001$, $\eta^2_p = .030$), with males outperforming females in children ($F = 11.664$, $p = .001$, $\eta^2_p = .062$) but not in adolescents ($F = 3.817$, $p = .052$, $\eta^2_p = .021$ – although borderline significance was attained) or young adults ($F = .017$, $p = .896$, $\eta^2_p = .000$). Furthermore, a third-order interaction effect of EI group, sex and age ($F = 4.121$, $p < .05$, $\eta^2_p = .031$) emerged. Breakdown of this interaction effect revealed that the EI x sex interaction was significant in children ($F = 6.298$, $p < .05$, $\eta^2_p = .068$) and adolescents ($F = 4.283$, $p = .015$, $\eta^2_p = .047$) but not in young adults ($F = .942$, $p = .392$, $\eta^2_p = .011$). In all three ages' groups, the high EI group displayed significantly higher MC scores than the average EI group, who, in turn, also displayed higher MC scores than the low EI group (all *p*-values ≤ .001). In children and adolescents, males also outperformed females ($p < .05$) while this was not the case in young adults ($p = .872$).

Discussion

The main purpose of this study was to investigate the association between 1) MC and EI as an overall construct, and 2) MC and each of the four domains of EI in children, adolescents, and young adults. Related to this, we expected to find better MC scores in individuals with higher EI in a comparative analysis, irrespective of age or sex. In line with the expectations, moderate to strong positive correlations between MC and EI domain scores were found in each age and sex category, which resulted in strong to very strong MC-EI total score associations in each category. Similarly, participants with higher EI scores outperformed their peers with lower EI scores in the domain of MC. The main secondary outcomes of this study were that male participants outperformed their female counterparts on MC, and that standardized MC levels decreased from children over adolescents to young adults. These findings are further discussed below, with an emphasis on the statistical results accompanied by the most meaningful effect sizes.

The relationship between EI and MC

Whilst there is minimal research that allows for direct comparisons of results, the way previous studies have linked EI and individuals with specific levels of MC may provide some context to our findings. For

example, Mohammad et al. (2015) observed that elite volleyball players, who are known to possess excellent levels of MC (Pion et al., 2015), playing at the national-level displayed higher levels of EI than those competing at the state-level. Similar positive, although variable in strength, associations between EI and athletic competitive performance emerged in a recent meta-analysis including data of 3431 individual and team sports athletes (Kopp & Jekauc, 2018). According to these authors, plausible explanations of this relationship are mainly related to the emotional and psychological characteristics that are known to positively affect athletic performance, such as planning, motivation, and coping with emotions that go along with winning and losing (Kopp & Jekauc, 2018). The potential direct relationship between EI and the developmental aspects of MC is not mentioned here, in spite of the compelling evidence that a basic level of MC is crucial or the development of elite athletes (Vandorpe et al., 2012). In clinical populations, indications of a positive association between MC and aspects of socio-emotional development have been reported (Emck et al., 2009; Schoemaker et al., 1994). Furthermore, children with deficits in emotional development often exhibit difficulties in the domain of gross MC and vice versa (Emck et al., 2009). The current study, however, is one of the first to extensively document the positive association between EI and MC in typically developing children, adolescents, and young adults outside the competitive or clinical context, and as such supporting at least in part the environmental stress hypothesis. According to this hypothesis, a lack of EI – that might in itself be one of the consequences of a low MC level from the early years on – might keep an individual from participating in play and sport, and thus limiting the opportunities for MC development in a child, adolescent, or young adult. Our results strongly underline the potential direct relationship between EI and MC, although the experimental design did not allow conclusions with respect to the causality of the association.

Referring back to the review by Emck et al. (2009), it was striking that in the few studies in young patients, socio-emotional problems not only associated with lower levels of MC, but also with a disturbed perception of one's MC. This observation aligns well with the hypothesis put forward based upon the model of MC development of Stodden et al. (2008). In this model, perceived MC, a construct positively associated with actual MC, might be affected by the capacities of the individual to cope with emotions that stem from peer comparisons, and coping with failure to achieve specific aims that have been proposed (Emck et al.,

2009). As a result, EI might be a factor that could affect the well-established actual and perceived MC relationship (De Meester et al., 2020). According to Olivier (2017) EI ensures individuals success in life through self-awareness, self-regulation, motivation, social awareness and social skills for learning, and social communication. These statements are not only supported by the strong MC-EI correlations in this study, but also by similar correlations between MC and the four sub-regulations of EI: optimism and mood regulation, appraisal of emotions, social skills, and utilization of emotions. Individuals with high EI are motivated to participate in sports, and are, due to their better social skills, more likely to be successfully active in sports and group activities. This in turn is beneficial to their everyday success and motivation. People with high EI have a better understanding of their strengths and weaknesses, so they are more likely to overcome their weaknesses, depending on the environment they are in, and to emphasize and further develop their strengths, which can also be true for MC (Olivier, 2017).

Age and sex effects on MC

According to the model of motor development (Gallahue et al., 2006), adolescents and young adults are expected to have better MC than children. When scores of a test battery are standardized to age, the expectation is that no age-related differences will emerge. However, our results do not align with this assumption, as do several other studies (Díaz et al., 2015; Mohammadi Orangi et al., 2017, 2018). In children, the average standard score (54.70) corresponds to percentile 66, implying that their MC status can be considered as normal for their age. In adolescents, the average percentile score was 16 (standard score of 40.29), and in young adults it dropped to percentile 10 (standard score of 36.69), clearly showing that their MC is far below the expectation given the age of the participants. While this result is not completely new (see, Díaz et al., 2015), but the unexpectedly low MC levels in adolescents and young adults is this sample warrant further investigation. According to Díaz et al. (2015), a possible explanation for this phenomenon is that children and adolescents in our study have more opportunities for motor skill development than the young adults had when they were children or adolescents. Another potential explanation is that after adolescence, young-adults cease, or reduce, their structured and unstructured physical

activities and thus the possibilities to maintain their motor skill level. More specifically, while additional information on the societal context of the participants in this study was not collected, it seems plausible that cultural and economic characteristics of the Iranian society might render the stimulation of sport participation for all and development of MC not the top priority (see, Meier et al., 2021).

The overall observation that female participants perform lower than their male counterparts, even when standardized scores are used, might also relate to the cultural traditions in the sample studies here, and more particularly the position of the women in the Iranian society. Meier et al. (2021) recently described the position of women in sports, and the recent evolution therein, thereby illustrating that women in Iran are still catching up with men when it comes to participation in recreational and competitive sport (Meier et al., 2021). The interesting observation that MC in female participants seems to converge to the level of their male counterparts from childhood to adulthood might also be related to cultural traditions in the sample studied here.

Strengths, limitations, and recommendations for future research

This study is, as far as the authors are aware, the first to examine and document the strong and positive association between EI and MC in a large sample of males and females of various age groups, representing several stages across the lifespan. However, given the cross-sectional nature of the data, we were unable to determine any potential causality between EI and MC. Longitudinal (cohort) or experimental studies could provide more insight into the directionality of the relationship between EI and MC. In these future studies, the potential moderating role of PMC should also be explored to substantiate the theoretical rationale developed in this study. Another limitation is the specific participant recruitment strategy that was applied, resulting in specific subsamples with discrete ranges of EI (i.e., one-third of the sample low EI, one-third average, and one-third high). Even though the selected subsamples are representative of the general population, it might have been better to select participants from the entire continuum (i.e., having more participants with average EI and slightly less low or high EI). Finally, we did not investigate the impact of known correlates of the two examined

constructs. It is recommended that future, by preference longitudinal, studies take these potential moderators (e.g., PMC, personality type) into account when examining the relationship between MC and EI. For example, in the recent meta-analysis of Kotsou et al. (2019) it has been shown that EI is not a static construct but can be positively affected by adequate interventions including positive retention effects at follow-up. Whether and to what extent such intervention efforts might also affect MC is still to be investigated.

Conclusion and perspectives

The results of this research highlight that participants with high EI, irrespective of age, have higher MC. The strength of the associations between EI and MC warrants further research on the topic in order to unravel the direction of the association. Whether EI influences MC development or vice versa cannot be determined from this first large-scale correlational analysis. Both pathways seem to be supported by theoretical models and assumptions, and longitudinal studies or intervention studies focusing on development of EI or MC might unravel this relationship further. Such information could reveal important causal connections between MC and EI that could change our current view on how to stimulate these aspects of human development.

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Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to restrictions their containing information that could compromise the privacy of research participants.

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