



ASSOCIATION OF PHYSICAL ACTIVITY AND SPORTS PARTICIPATION WITH ANXIETY, DEPRESSION AND MENTAL WELL-BEING AMONG ADOLESCENTS (13-18 Years)

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ABSTRACT:-

Introduction: Physical activity (PA) practices and especially inactivity, track significantly from adolescence to young adulthood. PA is speculated to heighten psychosocial outcomes, such as self-esteem and cognitive functioning. However, PA levels have decreased with age across adolescence, with more female preponderance. This study aimed to explore the associations between physical activity and adolescent's mental health.

Methodology: A cross-sectional study design was opted to evaluate associations between frequency of physical activity and sports participation with mental well-being, and symptoms of depression and anxiety in adolescents (13-17 years). Validated instruments were used to assess frequency of physical activity, participation in sports, mental wellbeing (WEMWBS), depressive and anxiety symptoms (RCADS). Results: A total of 796 adolescents were enrolled. A minority of the sample (8.0% of boys and 4.2% of girls) were found to meet WHO's PA guidelines. Frequency of activity was noted to lessen with age and was positively associated with mental well-being, and negatively associated with symptoms of anxiety and depression. Boys had higher levels of well-being and lower levels of anxiety and depressive symptoms across all age-groups. Conclusion: Adolescents involved in sports were found to have higher levels of well-being and lower symptoms of anxiety and depression with team sport deliberating an added advantage. Prospect physical activity advocacy for adolescents should encompass psychophysical benefits.

Keywords: Adolescent, Exercise, Mental well-being, Physical activity, Team sport

INTRODUCTION:-

According to the World Health Organization^[1] (WHO), mental health is “a state of well-being in which the individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to

his or her community". A steep increase in the worldwide-pooled prevalence for ICD-10 psychiatric disorders in the population of 7–16-year-olds has been documented from 13.4% to 16.5% over a period of 3 years (2015-2018)^[2,3].

Puberty is a notable biological transition when an accelerated gain in height, weight and a momentous alteration in body composition occurs that will construe how the human-being transforms physically and physiologically into adulthood^[4]. Mental health problems during infancy, childhood, or adolescence affect the processes of adaptation and functionality in adulthood. Mental health problems pose an emotional, social and academic burden on the children and their parents and family members. Studies have shown that 1 in 3 children and/or adolescents may have one or more psychiatric disorders by the age of 16 years^[5,6]. Adolescent girls are more than twice as likely to experience depression than boys, 15.9% vs 7.7%^[7]. Similarly anxiety and panic disorders change from equal female–male prevalence to a 2:1 female–male prevalence after puberty, because of their tough control strategies and metacognitive beliefs, which lead them to emotional and neurotic problems^[8]. Research evidence indicates that adolescent depression can lead to self-harm, suicidality, substance/drug misuse, poor academic achievements, and impaired social functioning^[9].

Physical activity and sport's participation is imperative to enhance the prediction of healthy living. The consequential health-favour and vigilant effect of routinely engaging in physical activity (PA) is well-reported, containing improved physical fitness^[10], heightened self-concept^[11], refined cognitive functioning^[12], healthy dietary habits^[13], and well-being^[14,15].

Physical activity provides an opportunity for social interaction (relatedness), mastery in the physical domain^[16] (self-efficacy and perceived competence), improvements in self-perception of appearance^[17] and independence (autonomy)^[18]. Also, physical activity has been identified to be beneficial for brain structures that support executive functioning and cognitive control, including neural networks supportive of executive functioning, which can reduce the risk of depressive symptoms^[19,20].

This study was conducted to delve into the associations between physical activity, sports participation and adolescent's mental health, in particular, depression and anxiety.

METHODOLOGY:-

A cross-sectional study design was accomplished in the outpatient setting of Saveetha Medical College and Hospital, Chennai. Ethical clearance was obtained from the Institutional Ethical Committee.

Participants:

All children aged between 13 years and 17 years attending the outpatient department of paediatrics at Saveetha Medical College and Hospital were recruited into the study after getting the informed ascent. All children were questioned on the

demographic details and were made to fill the structured questionnaire on particulars of their physical activity with emphasis on their mental health.

Physical activity (PA):

PA was assessed via a modified version of the Take PART questionnaire^[21] by measuring the number of days during the past 2 weeks that participants had accumulated 60 minutes of physical activity. Responses range from 0-14 days.

Sports participation:

Participants were asked about regular (at least one time per week) engagement in one or more sports during the past 6 months, with possible responses being “Yes” or “No”^[22]. Participants were enquired about their individual sports activity. Listed sports were later coded by the investigator as either no sport, individual activity or team sport. The working definition of team sport^[23] was “those that typically involved three or more players on each side who compete concurrently”.

Mental health:

Well-being: Well-being was assessed via the Warwick Edinburgh Mental Wellbeing Scale^[24] (WEMWBS), which is a measure of mental well-being focusing entirely on positive aspects of mental health through a 14 item self-report questionnaire. Each question is scored from 1 to 5 with total possible scores ranging from 14 to 70. Higher scores represent the highest possible levels of well-being.

Anxiety and Depression: These symptoms were weighted using Revised Child Anxiety and Depression Scale^[25] (RCADS), an 47-item likert scale, youth self-report questionnaire which measures symptoms of depression and anxiety in children and adolescents aged 8 – 18 with six subscales including: separation anxiety disorder (SAD) - (items 5, 9, 17, 18, 33, 45, 46), social phobia (SP) - (items 4, 7, 8, 12, 20, 30, 32, 38, 43), generalized anxiety disorder (GAD) - (items 1, 13, 22, 27, 35, 37), panic disorder (PD) - (items 3, 14, 24, 26, 28, 34, 36, 39, 41), obsessive compulsive disorder (OCD) - (items 10,16, 23, 31, 42, 44), and major depressive disorder (MDD) - (items 2, 6, 11, 15, 19, 21, 25, 29, 40, 47). It also yields a Total Anxiety Scale (sum of the 5 anxiety subscales) and a Total Internalizing Scale (sum of all 6 subscales). Each item is rated on a 4-point Likert-scale from 0 (“never”) to 3 (“always”).

Statistical Analysis

The complete dataset was entered into MS Excel. Based on their reported frequency of physical activity, participants were categorized as Least Active (60 minutes or more of activity on 0–4 days in the past 2 weeks), Somewhat Active (60 minutes or more of activity on 5–8 days in the past 2 weeks), or Most Active (60 minutes or more of activity

on 9–14 days in the past 2 weeks). T-tests were used to compare mean frequency of physical activity between girls and boys.

Mean scores on the psychological variables (RCADS and WEMWBS) between the three physical activity sub-groups; and amongst girls and boys were compared using two-way ANOVA. Independent samples t-tests were performed on RCADS total scores and on all the subscales to measure gender differences.

To examine associations between frequency of physical activity and mental health measures (RCADS and WEMWBS); multilevel mixed effects linear regression was carried out. The coefficients from this model were used to estimate curves illustrating associations between frequency of activity and each of the mental health measures.

Analyses were carried out using SPSS version 20 and Stata version 13.

RESULTS:-

Participant characteristics:-

In total, 796 adolescents [boys 463 (58.2%), girls 333 (41.8%)] participated in our study. Most participants belonged to the age of 13 years (n = 183, 23%) followed by 14 years (n = 178, 22.4%), 15 years (n = 158, 19.8%), 16 years (n = 143, 18%), and the least participants from 17 years (n = 134, 16.8%). Ages ranged from 13 to 17 years. The mean (SD) age of the sample was 15 (1.6) [Table 1].

Table 1 - Participants by Year and Gender

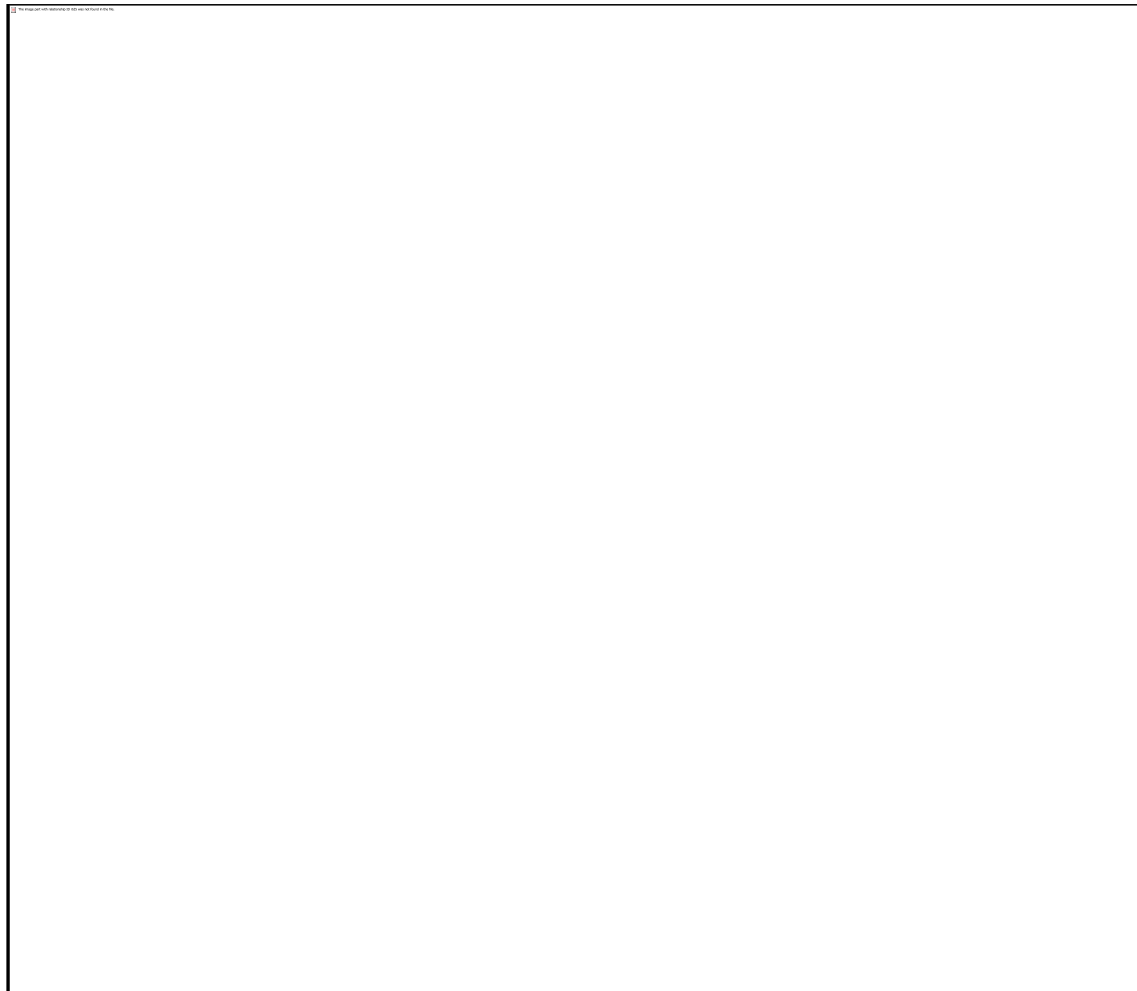
Years	Boys n (%)	Girls n (%)	Total n (%)
13	105 (22.7)	78 (23.4)	183 (23.0)
14	101 (21.8)	77 (23.1)	178 (22.4)
15	95 (20.5)	63 (18.9)	158 (19.8)
16	83 (17.9)	60 (18.1)	143 (18.0)
17	79 (17.1)	55 (16.5)	134 (16.8)
Total	463 (58.2)	333 (41.8)	796 (100)

Frequency of physical activity and sports participation:-

In our sample, 37 (8%) boys and 14 (4.2%) girls reported engaging in at least 60 min of physical activity every day. The percentage of adolescents meeting PA guidelines

declined through advancing age from 13 years (10.9%) through 14 (9.6%), 15 (5.1%), 16 (2.8%) and 17 years (1.5%) [Figure 1].

Figure 1 - Percentage of students meeting PA guidelines by year and gender



Out of the study subjects, 240 adolescents (30.2%) reported participation in team sport, with large sex differences (46.7% of boys, 7.3% of girls; $p < 0.0005$). Just under one-third of the sample (32.8%) reported no participation in sport, while 37% reported participation in an individual sport.

There were significant sex differences in the proportion of youngsters in each of the activity subgroups; with more boys than girls in the least active (27.6% of boys, 18.8% of girls; $p < 0.0005$) and most active groups (39.1% of boys, 30.4% of girls; $p < 0.0005$), and more girls than boys in the somewhat active group (40.8% of girls, 33.3% of boys; $p < 0.0005$) [Table 2].

Table 2 - Gender differences on frequency of physical activity and sports participation

Variable	Total sample n (%)	Boys n (%)	Girls n (%)
Frequency of activity			
Least active (0-4 days)	194 (24.4)	128 (27.6)	66 (19.8)
Somewhat active (5-8 days)	313 (39.3)	154 (33.3)	159 (47.8)
Most active (9-14 days)	289 (36.3)	181 (39.1)	108 (32.4)
Sport Participation			
No sport	261 (32.8)	107 (23.1)	154 (46.2)
Individual Sport	295 (37)	140 (30.2)	155 (46.5)
Team Sport	240 (30.2)	216 (46.7)	24 (7.3)

The most frequently reported number of days where PA guidelines were met was 5 (n = 65, 14%) and 5 (n = 56, 16.8%) followed by 9 (n = 50, 10.8%) and 6 (n = 37, 11.1%) in boys and girls respectively [Figure 2].

Figure 2 - Days of physical activity 60+ min during past 2 weeks



Mental health measures:-

There were significant differences between physical activity sub-groups in terms of scores on all of the mental health measures examined ($p < 0.05$ for both sexes on RCADS, WEMWBS) [Table 3]. Higher frequency of activity was associated with lower levels of depression and anxiety and greater well-being.

Participation in sport (team or individual/fitness) was associated with significantly lower levels of anxiety and depressive symptoms and higher levels of well-being ($p < 0.05$ for both girls and boys on RCADS, WEMWBS) [Table 3]. Comparisons between boys in terms of sport participation sub-groups showed significant differences on the mental health measures, with team sport being associated with higher well-being score and lower anxiety and depressive symptoms.

Table 3 - Associations between frequency of physical activity, sport participation and well-being, anxiety and Internalizing scale

	Well-being score Mean (SD)		Total Anxiety Scale Mean (SD)		Total Internalizing Scale Mean (SD)	
	Boys	Girls	Boys	Girls	Boys	Girls
Frequency of activity						
Least active (0-4 days)	18.1 (1.6)	20.0 (7.8)*	63.3 (7.2)	102.7 (3.7)**	82.3 (9.3)	130.5 (4.4)**
Somewhat active (5-8 days)	35.1 (3.7)	33.7 (8.0)*	44.3 (4.9)	79.5 (7.3)**	60.2 (6.0)	102.0 (8.3)**
Most active (9-14 days)	50.3 (6.8)	45.9 (9.5)**	16.8 (11.3)	48.5 (12.3)**	23.6 (16.2)	62.5 (16.9)**
Sport Participation						
No sport	17.7 (1.4)	24.0 (7.7)**	65.2 (6.2)	95.1 (9.4)**	84.7 (7.7)	120.9 (12.0)**
Individual Sport	32.3 (6.4)	40.1 (6.3)**	47.3 (4.0)	62.1 (12.6)**	63.6 (4.7)	80.6 (16.3)**
Team Sport	48.2 (8.0)	56.8 (5.6)**	20.2 (13.1)	31.3 (0.9)**	28.2 (18.3)	38.7 (1.3)*

Note: ** $p < 0.001$; * $p < 0.05$

There was a significant difference in the total anxiety scores for girls [75.1 (22.7)] and boys [38.8 (21.0)]; total internalizing scores for girls [96.2 (28.7)] and boys [52.0 (27.0)]. Girls exhibited higher levels of anxiety and depression than boys on all subscales [Table 4].

Table 4 - Gender differences on RCADS total scores and subscale scores

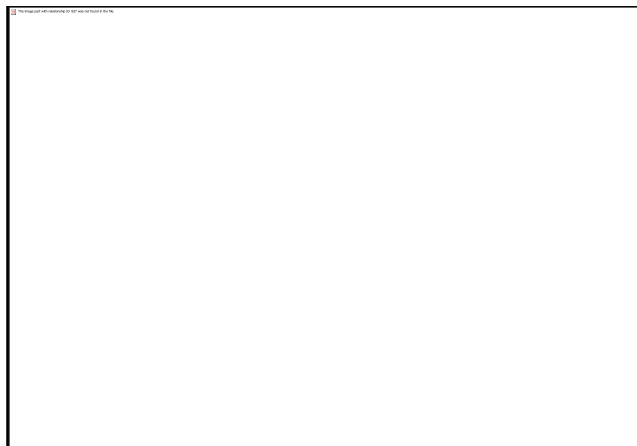
RCADS	Total Sample (n = 796)	Boys (n = 463)	Girls (n = 333)
Separation Anxiety	9.9 (5.7)	6.5 (3.9)	14.5 (4.5)*
Generalized Anxiety	9.0 (5.0)	6.3 (3.8)	12.9 (3.7)*
Panic Disorder	13.7 (6.7)	10.8 (5.5)	17.6 (6.2)*
Social Phobia	12.5 (6.6)	9.1 (5.0)	17.1 (5.7)*
Obsessive-Compulsive	9.0 (4.8)	6.0 (3.1)	13.1 (3.4)*
Major Depression	16.5 (7.3)	13.2 (6.2)	21.1 (6.2)*
Total Anxiety Scale	54.0 (28.2)	38.8 (21.0)	75.1 (22.7)*
Total Internalizing Scale	70.5 (35.3)	52.0 (27.0)	96.2 (28.7)*

Note: *p < 0.0001; Mean (SD)

To further examine associations between frequency of activity and mental health measures, multi-level mixed effects linear regression was carried out. The coefficients from this model were used to estimate the curves represented in Figure 3, 4 and 5.

There was a positive correlation between frequency of PA and well-being for both boys and girls [Figure 3].

Figure 3 - Associations between frequency of physical activity and Well-being score



A negative correlation was found between frequency of PA and anxiety, depressive symptoms for both sexes [Figure 4, 5].

Figure 4 - Associations between frequency of physical activity and Total Anxiety score

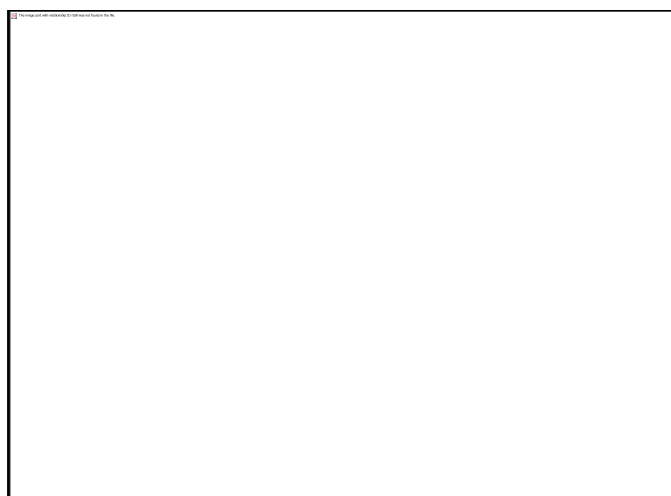


Figure 5 - Associations between frequency of physical activity and Total Internalizing score



DISCUSSION:-

A small minority (6.4%) of the sample reported meeting the level of physical activity recommended for good physical health, which is similar to the results by Gregory et al^[26]. Boys (8%) were more than twice as likely to meet PA guidelines in comparison with girls (4.2%), indicating boys and girls within our sample differ markedly with respect to daily participation in moderate physical activity. Our results are in accordance with previous studies^[27,28].

Our study reveals participation in sport (team or individual) confers an additional mental health benefit independent of frequency of activity, comparable with a study by Eime et al^[29] and Rodríguez-Bravo et al^[30]. Team sports are said to bolster the five C's: Commitment, Communication, Concentration, Control, and Confidence^[31]. The benefits of team sport participation is how to deal with other people, about learning how to be a leader and to be a part of something greater than yourself. But conversely, Hoffmann et al^[32] have concluded that participation in individual sport compared to non-sport participation was associated with 16% higher anxious/depressed scores.

Our findings of significant associations between physical activity and mental health are consistent with previous findings^[22,33,34]. In terms of well-being, we can suggest based on our findings that moderately increasing activity in inactive adolescents could result in a meaningful improvement in well-being.

LIMITATIONS:-

The limitations of this study include the use of a self-report instrument measuring physical activity, which may be prone to recall bias. Yet another limitation was cross-sectional study design wherein detecting causal or temporal relationships between physical activity and mental health was futile. Further research could include in-depth cross-cultural comparisons and longitudinal approaches.

CONCLUSION:-

We conclude that there is a definite association between physical activity and mental health in adolescents, with positive correlation displayed between physical activity and well-being and with negative correlation between physical activity and anxiety, depressive symptoms. Our findings emphasize the importance of imparting education on increasing physical activity levels among adolescents.

Engagement in sports activities, particularly team sport, confers additional benefits than that provided by activity alone. School and community organizations should be a medium for providing varied physical activities that would help in the optimal development of physical and mental health among adolescents.

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CONFLICT OF INTEREST:-The authors have no conflict of interest and nothing to declare.

AUTHOR CONTRIBUTIONS:-

Melpakkam Venkatesan Srinath and *A.S.Vaanmathi* indemnified to the visualization, conceptualization, and project administration of the study. *Melpakkam Venkatesan Srinath* aided in writing original draft preparation and data curation. *A.S.Vaanmathi* advocated validation and formal analysis. All authors endorsed manuscript revision and have certified the submitted manuscript.

REFERENCES:-

1. World Health Organization. Promoting mental health: concepts, emerging evidence, practice (Summary Report) Geneva: World Health Organization; 2004.
2. Polanczyk GV, Salum GA, Sugaya LS, Caye A, Rohde LA. Annual research review: a meta-analysis of the worldwide prevalence of mental disorders in children and adolescents. *J Child Psychol Psychiatry*. 2015;56(3):345–65.
3. Philipp J, Zeiler M, Waldherr K, Truttmann S, Dür W, Karwautz AFK, Wagner G. Prevalence of emotional and behavioral problems and subthreshold psychiatric disorders in Austrian adolescents and the need for prevention. *Soc Psychiatry Psychiatr Epidemiol*. 2018 Dec;53(12):1325-1337.
4. Richter, L.M. (2006). Studying adolescence. *Science*, 312(5782), 1902-1905.

5. Costello EJ, Mustillo S, Erkanli A, Keeler G, Angold A. Prevalence and development of psychiatric disorders in childhood and adolescence. *Arch Gen Psychiatry*. 2003 Aug;60(8):837-44.
6. Caqueo-Urizar A, Flores J, Escobar C, Urzúa A, Irrázaval M. Psychiatric disorders in children and adolescents in a middle-income Latin American country. *BMC Psychiatry*. 2020 Mar 5;20(1):104.
7. Merikangas KR, He JP, Burstein M, Swanson SA, Avenevoli S, Cui L, Benjet C, Georgiades K, Swendsen J. Lifetime prevalence of mental disorders in U.S. adolescents: results from the National Comorbidity Survey Replication--Adolescent Supplement (NCS-A). *J Am Acad Child Adolesc Psychiatry*. 2010 Oct;49(10):980-9.
8. Bahrami F, Yousefi N. Females are more anxious than males: a metacognitive perspective. *Iran J Psychiatry Behav Sci*. 2011 Fall;5(2):83-90.
9. Krause, K.R.; Bear, H.A.; Edbrooke-Childs, J.; Wolpert, M. Review: What Outcomes Count? A Review of Outcomes Measured for Adolescent Depression between 2007 and 2017. *J. Am. Acad. Child. Adolesc. Psychiatry* 2019, 58, 61–71.
10. Francisco José Borrego Balsalobrea, Guillermo Felipe LópezSánchez, Arturo DíazSuárez. (2014) Relationships between physical fitness and physical self-concept in Spanish adolescents. *Procedia - Social and Behavioral Sciences*, 132: 343 – 350.
11. Fernández-Bustos JG, Infantes-Paniagua Á, Cuevas R and Contreras OR (2019) Effect of Physical Activity on Self-Concept: Theoretical Model on the Mediation of Body Image and Physical Self-Concept in Adolescents. *Front. Psychol*. 10:1537.
12. MM, Chu X. Exercise, cognition, and the adolescent brain. *Birth Defects Res*. 2017 Dec 1;109(20):1672-1679.
13. Wadolowska, L., Kowalkowska, J., Lonnie, M. et al. Associations between physical activity patterns and dietary patterns in a representative sample of Polish girls aged 13-21 years: a cross-sectional study (GEBaHealth Project). *BMC Public Health* 2016 16, 698.
14. Penedo FJ, Dahn JR. Exercise and well-being: a review of mental and physical health benefits associated with physical activity. *Curr Opin Psychiatry*. 2005 Mar;18(2):189-93.
15. Biddle SJ, Ciaccioni S, Thomas G, Vergeer I. Physical activity and mental health in children and adolescents: an updated review of reviews and an analysis of causality. *Psychol Sport Exerc*. 2019 May 1;42:146–55.
16. Reigal, R., Videra, A., and Gil, J. (2014). Prácticafísica, autoeficacia general y satisfacción vital en la adolescencia. [Physical exercise, general self-efficacy and life satisfaction in adolescence]. *Rev. Int. Med. Ciencias Act. FísicaDeporte* 14, 561–576.

17. Gualdi-Russo E, Rinaldo N, Zaccagni L. Physical Activity and Body Image Perception in Adolescents: A Systematic Review. *Int J Environ Res Public Health*. 2022 Oct 13;19(20):13190.
18. Lubans D, Richards J, Hillman C, Faulkner G, Beauchamp M, et al. (2016) Physical activity for cognitive and mental health in youth: A systematic review of mechanisms. *Pediatrics* 138.
19. Chaddock L, Pontifex MB, Hillman CH, Kramer AF (2011) A review of the relation of aerobic fitness and physical activity to brain structure and function in children. *J Int Neuropsychol Soc* 17: 975-985.
20. Reigal RE, Moral-Campillo L, Juárez-Ruiz de Mier R, Morillo-Baro JP, Morales-Sánchez V, Pastrana JL and Hernández-Mendo A (2020) Physical Fitness Level Is Related to Attention and Concentration in Adolescents. *Front. Psychol.* 11:110.
21. Woods, C. B., Nelson, N. M., O’Gorman, D. J., Foley, E., & Moyna, N. M. (2009). The Take PART study (physical activity research for teenagers): rationale and methods. *Journal of Physical Activity and Health*, 6(2), 170–177.
22. McMahon, E. M., Corcoran, P., O’Regan, G., Keeley, H., Cannon, M., Carli, V., Wasserman, C., Hadlaczky, G., Sarchiapone, M., Apter, A., & Balazs, J. (2017). Physical activity in European adolescents and associations with anxiety, depression and well-being. *European child & adolescent psychiatry*, 26(1), 111–122.
23. Zhou, J., Heim, D., & O’Brien, K. (2015). Alcohol consumption, athlete identity, and happiness among student sportspeople as a function of sport-type. *Alcohol and alcoholism*, 50(5), 617–623.
24. Stewart-Brown S, Platt S, Tennant A, et al The Warwick-Edinburgh Mental Well-being Scale (WEMWBS): a valid and reliable tool for measuring mental well-being in diverse populations and projects *J Epidemiol Community Health* 2011;65:A38-A39.
25. Chorpita, B. F., Yim, L., Moffitt, C., Umemoto, L. A., & Francis, S. E. (2000). Assessment of symptoms of DSM-IV anxiety and depression in children: A revised child anxiety and depression scale. *Behaviour research and therapy*, 38(8), 835-855.
26. Knell G, Durand CP, Kohl HW 3rd, Wu IHC, Pettee Gabriel K. Prevalence and Likelihood of Meeting Sleep, Physical Activity, and Screen-Time Guidelines Among US Youth. *JAMA Pediatr*. 2019 Apr 1;173(4):387-389.
27. vanSluijs EMF, Ekelund U, Crochemore-Silva I, Guthold R, Ha A, Lubans D, Oyeyemi AL, Ding D, Katzmarzyk PT. Physical activity behaviours in adolescence: current evidence and opportunities for intervention. *Lancet*. 2021 Jul 31;398(10298):429-442.
28. J Brazo-Sayavera, S Aubert, JD Barnes, SA González, MS Tremblay. Gender differences in physical activity and sedentary behavior: Results from over 200,000 Latin-American children and adolescents *PLoS One*, 16 (2021), Article e0255353.

29. Eime, R.M., Young, J.A., Harvey, J.T. et al. A systematic review of the psychological and social benefits of participation in sport for children and adolescents: informing development of a conceptual model of health through sport. *Int J Behav Nutr Phys Act* 10, 98 (2013).
30. Rodríguez-Bravo AE, De-Juanas Á and García-Castilla FJ (2020) Effect of Physical-Sports Leisure Activities on Young People's Psychological Wellbeing. *Front. Psychol.* 11:543951.
31. Chris Harwood, Richard Anderson. *Coaching Psychological Skills in Youth Football: Developing the 5Cs*, illustrated, Publisher Bennion Kearny, 2015.
32. Hoffmann MD, Barnes JD, Tremblay MS, Guerrero MD. Associations between organized sport participation and mental health difficulties: Data from over 11,000 US children and adolescents. *PLoS One.* 2022 Jun 1;17(6):e0268583.
33. Biddle SJ, Asare M (2011) Physical activity and mental health in children and adolescents: a review of reviews. *Br J Sports Med* 45(11):886–895.
34. Bell, S.L., Audrey, S., Gunnell, D. et al. The relationship between physical activity, mental wellbeing and symptoms of mental health disorder in adolescents: a cohort study. *Int J Behav Nutr Phys Act* 16, 138 (2019).