



The Open Sports Sciences Journal

Content list available at: <https://opensportssciencesjournal.com>



RESEARCH ARTICLE

Research on Physical Fitness Development for U10 five-a-side Football Teams

Vinh Huy Chau^{1,*}

¹Department of Administration, Ho Chi Minh City University of Physical Education and Sport, Ho Chi Minh City, Vietnam

Abstract:

Background:

Football is a team sport; players often have fierce ball disputes to limit the opponent's ability, resulting in a lot of physical consumption.

Objective:

To evaluate the professional development of physical fitness for U10 five-a-side football teams, this study introduces several exercises to test and improve their physical strength.

Methods:

We introduce 5 tests, including long jump on the spot, 15-meter sprint, 5x30m sprints, 5-minute running, and 1-minute rope skipping. 6 months of training was divided into 3 phases with four 90-minute training sessions/week. Phase 1 was aimed for the players to adapt to normal training, phase 2 was to develop the maximum focus speed, and phase 3 was to develop professional physical strength.

Results:

The results show that after 6 months of training, the participants' physical achievements in all tests have witnessed growth. The growth was statistically significant because $t_{\text{calculated}} > t_{\text{standard}}$ at the possibility $P < 0.05$, especially in the test of rope skipping in one minute with the highest growth rate $W = 9.47\%$.

Conclusion:

The results of this research can be used as a reference and scientific basis of general physical fitness development in football for kids to build training programs and improve their effectiveness.

Keywords: Physical fitness, Football, Development, Sprint, Skipping, Training programs.

Article History

Received: February 19, 2021

Revised: August 5, 2021

Accepted: August 27, 2021

1. INTRODUCTION

Football is a team sport where players move the ball beyond the goal line into the opposing goal. Therefore, they often compete fiercely for the ball to prevent the opposing players from scoring, especially in the area in front of the goal. In a professional match, collisions and fouls are committed so many times, sometimes more than one hundred times from both teams, which shows how fierce, competitive and physical-strength-consuming a football match can be. A match of male five-a-side football lasts 40 minutes, and sometimes it extends to the penalty shootout to determine the winner [1 - 3]. In such matches, every player has to move around a lot while perform-

ing many techniques with and without the ball, which consumes a great deal of energy. Therefore, a fierce match consumes a lot of players' energy [4, 5]. Consequently, it is vital to study methods to develop professional physical fitness for footballers, especially from their tweens.

Helgerud *et al.* [6] studied how to improve the strength and endurance of players in leading football teams in the pre-season period by implementing a highly intense training program to maximize the endurance. 21 players were selected to participate in the study in 8 weeks. The results showed that combining strength and endurance training with professional training regularly would remarkably improve players' physical capacity. Bujnovsky *et al.* [7] identified if players' speed, agility and aerobic ability depend on their positions. Through the research on 123 footballers, including goalkeepers,

* Address correspondence to this author at the Department of Administration, Ho Chi Minh City University of Physical Education and Sport, Ho Chi Minh City, Vietnam; E-mail: huyvcc@upes.edu.vn

left/right defenders, central defenders, left/right midfielders, center midfielders, and attacking midfielders. The results demonstrated the notable impact of positions on linear sprint performance, strategically useful for coaches and doctors to make specific adjustments to each position. Karthick *et al.* [8] studied the impact of SAQ training on the physical parameters and capacity of middle school footballers. 30 players were selected for this study and its results showed that thanks to SAQ training, such physical parameters as their speed, agility and capacity had improved dramatically. Chen [9] analyzed advanced footballers' physical characteristics. Through relevant data gathering, it was concluded that the level of physical fitness training is closely related to the players' morphological and functional characteristics. Atakan *et al.* [10] investigated the link between anthropometric measurements and the performance of young football players. A total of 17 young male footballers volunteered to participate in the study. The measurements of weights, mineral content, fat mass, *etc.*, before and after the training were carried out to find the correlations among these indicators. Finally, the authors concluded that to football players, changes in body composition play an important role in sports activities, especially sprint and agility. Asian *et al.* [11] examined motion characteristics over time of football teams in La Liga. And the outcomes demonstrated the difference in physical performance between various competitive levels. Both successful and unsuccessful teams imposed the same running requirements at higher speeds. These findings provide valuable information about physical requirements, which depend on the teams' standing at the league table. Published studies show us the importance of professional physical fitness development for footballers as one of the decisive factors to a match's result [12 - 17].

The playing field of a five-a-side football is rectangular, with a maximum length of 42m and a minimum of 25m; a maximum width of 25m and a minimum of 15m. The penalty area is marked from the horizontal line of each part of the field, taking the posts of the two goalposts as the center and draw a quarter of a circle with a radius of 6m. The connecting of the endpoints of the two arcs is a 3.16m long straight line which parallels the goal line (goal line) 6m. The area within the bounds by those lines is the penalty area. In the middle of each goal line, there is a goal frame consisting of two vertical columns perpendicular to the ground and 3 meters apart (from the inside edge). They are connected by a parallel crossbar and 2 meters from the floor (from the bottom edge). The width and thickness of the vertical posts and crossbars must be 8cm in size.

According to the actual situation of Vietnamese football, this paper introduces several professional physical training exercises for U10 five-a-side football teams in Vietnam. The aim is to evaluate the players' professional physical fitness development before and after 6 months of training, which serves as a reference and scientific basis of general physical fitness development in football for kids. Additionally, it contributes to building up training programs and improving the effectiveness of youth football training in Vietnam.

2. MATERIALS AND METHODS

Pre-teens start to witness drastic growth and change in terms of both mentality and physicality. Therefore, at this age, the typical changes are a significant increase in height, fast growth in spine and limb bones, and slow growth in ribs, which results in a narrow chest compared to the height [18,19]. During this period, muscular strength increases yet is not accompanied by endurance development. This is the reason for excessive muscle tension, where pre-teens start to perform activities stretching their muscles much more intensely and longer than their capacities, resulting in bone structure disorders or scoliosis. To avoid that, it is essential to pay special attention in sports activities and physical training. Players should do physical exercises suitable for their age. With the above characteristics, pre-teens should not work on exercises requiring excessive strength, sudden movements, compression and high-speed running exercises. Exercises with moderate muscle intensity and endurance are much more appropriate [20, 21].

Based on the mental and physical characteristics of preadolescence, as well as suggestions of experts, coaches and teachers, we introduce 5 tests, including long jump on the spot, 15-meter sprint, 5x30m sprints, 5-minute running and 1-minute rope skipping.

2.1. Long Jump on Spot

Purpose: to evaluate players' strengths.

Times of performance: twice (count the time with better performance).

Results: in centimeter (cm)

Tools: chalk, tape measure, paper and pen.

How to perform: The participant stands behind the line, crouches deep and low on the spot, and then stomps on the ground with the whole body's strength, particularly legs', while swinging hands from above to back then to the front in order to take the body off into the air. The participant lands with knees down, using impulsive force to counter impact force and swinging hands from above to back then to front to keep balance. The result is measured from the starting line to the nearest landing point of the body.

2.2. 15-meter Sprint

Purpose: to evaluate players' ability to move at the highest speed.

Times of performance: twice (count the time with better performance).

Results: in seconds (s).

Tools: tape measure, cones, stopwatch, flag, paper and pen, pitch.

How to perform: The participant is in a high-hipped starting position at the start line. Upon getting the starting signal, the participant quickly leaves the start line and runs fast to cross the finish line. The examiner standing at the finish line starts the stopwatch with the starting signal and stops it when the runner touches the plane perpendicular to the finish line.

2.3. 5x30m Sprints

Purpose: to evaluate players’ ability to endure speed.

Times of performance: twice (count the time with better performance).

Results: in seconds (s).

Tools: tape measure, stopwatch, pitch.

How to perform: Divide participants into 7 groups of 2. In each run, the stopwatch starts with the participants leaving the start line and stops when they cross the finish line. The participants run 5 times, with a break of 20 seconds between runs. The result is the total time of 5 runs (breaks are not included).

2.4. 5-minute Running

Purpose: to evaluate players’ general endurance (aerobic endurance)

Times of performance: twice (count the time with better performance).

Results: in meter (m).

Tools: tape measure, cones, stopwatch, paper and pen, pitch (36-meter long x 18-meter wide). Put cones at the distances of 2 meter along the touchlines and goal lines to record results more easily.

How to perform: Divide participants into 4 groups, 2 groups of 4 and 2 groups of 3. Upon the starting signal, participants take the cones at the starting line and run around the pitch (the participants can run, jog or walk). They stop upon the timeout signal and place the cones at the stop point to record results. The time counts from the starting signal until the duration of 5 minutes is over.

2.5. 1-minute Rope Skipping

Purpose: to evaluate players’ endurance and strength of lower limbs’ muscle groups

Times of performance: twice (count the time with better performance).

Results: the times of skipping over the rope.

Tools: stopwatch, jumping rope, paper and pen.

How to perform: The participants stand ready with hands holding the rope. Upon the starting signal, they twirl the rope from side to side and jump. The stopwatch starts with the participants’ first jump and stops when 1 minute is over. The result is the time of skipping over the rope in 1 minute (If the participants trip over the rope, they twirl the rope and jump again).

2.6. Statistical Analysis Method

We used the average value, standard deviation, coefficient of variation, relative error of mean value, and correlation coefficient indices to evaluate the effectiveness of the proposed method [22].

3. RESULTS

To carry out the experiment, we selected 14 players from U10 five-a-side male football team of Binh Tan District Children Center, Ho Chi Minh City, Vietnam. 6 months of training was divided into 3 phases with four 90-minute training sessions/week. Phase 1 was aimed for the players to adapt to normal training, phase 2 was to develop the maximum focus speed, and phase 3 was to develop professional physical strength. Through training, we observed a growth in their general physical strength. The final results were outstanding and statistically significant with $t_{calculated} > t_{standard} = 2.145$ at $P < 0.05$. The results are presented in Table 1 and Fig. (1).

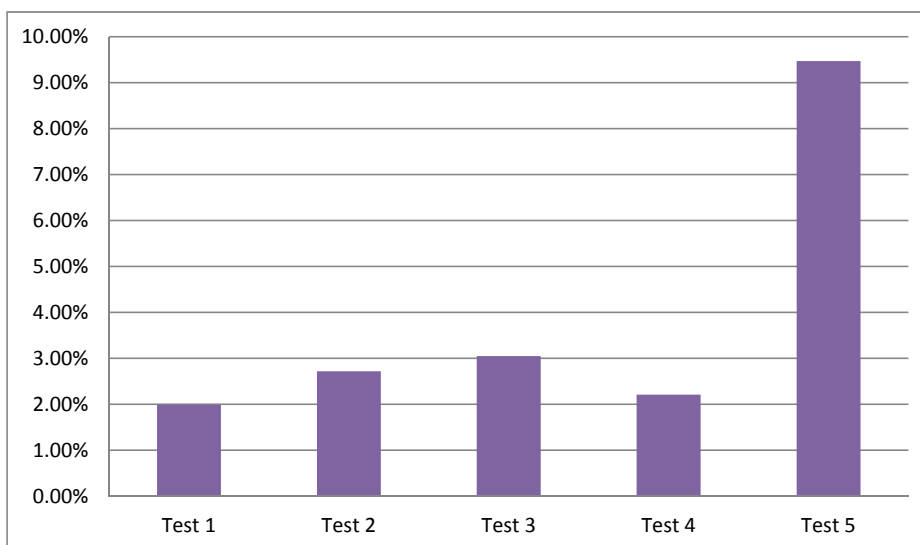


Fig. (1). The growth rate of professional physical fitness development of the U10 five-a-side male football team after 6-month training.
 Note: Test 1 is a long jump on the spot, Test 2 is a 15-meter sprint, Test 3 is 5x30m sprints, Test 4 is a 5-minute running, and Test 5 is a 1-minute rope skipping.

Table 1. The test results of U10 five-a-side male football team before and after 6-month training (n1=n2=14).

Test	Testing Time	\bar{X}	S	C_v (%)	ϵ	W (%)	t	P
Long jump on spot (cm)	Before training	170.02	7.52	4.42	0.025	1.99	13.44	<0.05
	After training	173.44	6.93	4.00	0.023			
15-meter sprint (s)	Before training	2.72	0.12	4.41	0.025	2.72	6.83	<0.05
	After training	2.65	0.09	3.33	0.019			
5x30m sprints (s)	Before training	31.72	1.79	5.66	0.032	3.05	6.82	<0.05
	After training	30.77	1.57	5.09	0.029			
5-minute running (m)	Before training	920.84	68.10	7.40	0.042	2.21	10.63	<0.05
	After training	941.21	67.24	7.14	0.041			
1-minute rope skipping (time)	Before training	65.36	5.49	8.39	0.048	9.47	12.22	<0.05
	After training	71.86	6.19	8.61	0.049			

Note: \bar{X} is the average value, S is the standard deviation, C_v is coefficient of variation, ϵ is relative error of mean value W is the growth rate, t is the test value of 2 related samples, P is the correlation coefficient.

The test of long jump on spot: The average result before training was $\bar{X}_1 = 170.02\text{cm}$, with $S_1 = 7.52\text{cm}$ and the average result after training was $\bar{X}_2 = 173.44\text{cm}$, with $S_2 = 6.93\text{cm}$. After 6-month training, the players' results of long jump on spot were 3.42 cm longer, with the growth rate $W = 1.99\%$. The growth was statistically significant because $t_{\text{calculated}} = 13.44 > t_{\text{standard}} = 2.145$, at the possibility $P < 0.05$.

The test of 15-meter sprint: The average result before training was $\bar{X}_1 = 2.72\text{s}$, with $S_1 = 0.12\text{s}$, and the average result after training was $\bar{X}_2 = 2.65\text{s}$, with $S_2 = 0.09\text{s}$. After 6-month training, the players' results of 15-meter sprint were 0.07s faster, with the growth rate $W = 2.72\%$. The growth was statistically significant because $t_{\text{calculated}} = 6.83 > t_{\text{standard}} = 2.145$, at the possibility $P < 0.05$.

The test of 5x30m sprints: The average result before training was $\bar{X}_1 = 31.72\text{s}$, with $S_1 = 1.79\text{s}$ and the average result after training was $\bar{X}_2 = 30.77\text{s}$, with $S_2 = 1.57\text{s}$. After 6-month training, the players' results of 5x30m sprints were 0.95s faster, with the growth rate $W = 3.05\%$. The growth was statistically significant because $t_{\text{calculated}} = 6.82 > t_{\text{standard}} = 2.145$, at the possibility $P < 0.05$.

The test of 5-minute running: The average result before training was $\bar{X}_1 = 920.64\text{m}$, with $S_1 = 68.1\text{m}$ and the average result after training was $\bar{X}_2 = 941.21\text{m}$, with $S_2 = 67.24\text{m}$. After 6-month training, the players' results of 5-minute running were 20.57m longer, with the growth rate $W = 2.21\%$. The

growth was statistically significant because $t_{\text{calculated}} = 10.63 > t_{\text{standard}} = 2.145$, at the possibility $P < 0.05$.

The test of 1-minute rope skipping: The average result before training was $\bar{X}_1 = 65.36$ times, with $S_1 = 5.49$ times and the average result after training was $\bar{X}_2 = 71.86$ times, with $S_2 = 6.19$ times. After 6-month training, the players' results of 1-minute rope skipping were 6,5 times more, with the growth rate $W = 9.47\%$. The growth was statistically significant because $t_{\text{calculated}} = 12.22 > t_{\text{standard}} = 2.145$, at the possibility $P < 0.05$.

The above analysis shows that after 6 months of training, the participants' results in all tests have witnessed growth. The growth was statistically significant because $t_{\text{calculated}} > t_{\text{standard}}$ at the possibility $P < 0.05$.

4. DISCUSSION

The results show that the physical fitness of the male athletes in all the tests has increased after 6 months of training; the growth was statistically significant because the $t_{\text{calculated}} > t_{\text{standard}}$ and the possibility $P < 0.05$.

In a football match which has five players in each team, the number of participants is large. The coordination between attack and defense is relatively difficult and much more complicated than in other sports such as volleyball, table tennis, badminton. Soccer players must use the least flexible parts of the body - the legs to dominate and control the ball to make it move all the time. Therefore, it is quite difficult to practice and master football techniques.

An official match lasts 40 minutes; sometimes, the two teams have to take a penalty shootout to determine the winner. In a fierce match, each player has to move a lot. In addition, there are many technical moves with and without the ball. The body's energy expenditure is huge.

Laws and principles in football are relatively simple; so are the field and training equipment. In general, training is rarely restricted by time, number of players, stadiums, etc. Only in official competition applies strict rules are set, for example, goalkeeper's holding time, time to make a corner kick, direct free kicks, indirect free kicks, second penalty. All must take no more than 4 seconds.

Nguyen [23] studied the physical fitness development of the U10 futsal team at primary school. Hoang [24] assessed the basic technical and physical fitness for U12 male football athletes after one year of training. These studies are based on some standards to evaluate the ability of athletes after a period of training. Although specific scores have been given to athletes, they have not shown the reliability of the tests. Our research has shown exercises to improve athletes' fitness, and also given the accuracy and reliability of the tests. The research results are the basis for coaches to offer appropriate exercises for young Vietnamese athletes. However, in reality, it is necessary to expand research on the development of physical strength and psychology of athletes.

CONCLUSION

From the research results, we have selected a mix of appropriate tests to evaluate the professional physical fitness development of U10 five-a-side male football teams. This study has built up the grading scale and criteria of classification to examine the general physical strength of young male football players before and after 6-month training. In addition, it also helps to assess exercises' effectiveness in reality. Its results are the basis for coaches and PE teachers to refer and build training plans for U10 five-a-side male football teams.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Ministry of Education Fund Project of Vietnam (No. B-2021-STS-01).

HUMAN AND ANIMAL RIGHTS

No animals were used for this research. All human research procedures were followed in accordance to the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2013.

CONSENT FOR PUBLICATION

All participants signed informed consent prior to participating in the research.

AVAILABILITY OF DATA AND MATERIALS

The data sets used during the current research can be provided from the corresponding author [V.H.C.], upon reasonable request.

FUNDING

None.

CONFLICT OF INTEREST

The author declares no conflict of interest, financial or otherwise.

ACKNOWLEDGEMENTS

Declared none.

REFERENCES

- [1] Dvorak J, Junge A. Football injuries and physical symptoms. A review of the literature. *Am J Sports Med* 2000; 28(5)(Suppl.): S3-9. [http://dx.doi.org/10.1177/28.suppl_5_s-3] [PMID: 11032101]
- [2] Helsen W, Bultynck JB. Physical and perceptual-cognitive demands of top-class refereeing in association football. *J Sports Sci* 2004; 22(2): 179-89. [<http://dx.doi.org/10.1080/02640410310001641502>] [PMID: 14998096]
- [3] Gebert A, Gerber M, Pühse U, Gassmann P, Stamm H, Lamprecht M. A comparison of injuries in different non-professional soccer settings: Incidence rates, causes and characteristics. *Open Sports Sci J* 2019; 12(1) [<http://dx.doi.org/10.2174/1875399X01912010028>]
- [4] Woods CT, Cripps A, Hopper L, Joyce C. A comparison of the physical and anthropometric qualities explanatory of talent in the elite junior Australian football development pathway. *J Sci Med Sport* 2017; 20(7): 684-8. [<http://dx.doi.org/10.1016/j.jsams.2016.11.002>] [PMID: 27899276]
- [5] Fitzhugh EC, Hardin R, Boyer W, Post E, Behnke Z. Health-enhancing physical activity during practice among student football managers at a Division I university. *J Am Coll Health* 2019; 67(7): 647-53. [<http://dx.doi.org/10.1080/07448481.2018.1499656>] [PMID: 30285555]
- [6] Helgerud J, Rodas G, Kemi OJ, Hoff J. Strength and endurance in elite football players. *Int J Sports Med* 2011; 32(9): 677-82. [<http://dx.doi.org/10.1055/s-0031-1275742>] [PMID: 21563031]
- [7] Bujnovsky D, Maly T, Ford KR, *et al.* Erratum: Bujnovsky, D., *et al.* Physical fitness characteristics of high-level youth football players: Influence of playing position. *Sports* 2019, 7, 46. *Sports (Basel)* 2019; 7(12): 46. [<http://dx.doi.org/10.3390/sports7020046>] [PMID: 31835901]
- [8] Karthick M, Radhakrishnan MT, Kumar SK. Effects of saq training on selected physical fitness parameters and kicking ability of high school level football players. *Int J Appl Res* 2016; 2(7): 600-2.
- [9] Chen Y. Analysis on the physical characteristics of high-level football players. *Education Research Frontier* 2019; 9(4)
- [10] Atakan M M, Unver E, Demirci N. Effect of body composition on fitness performance in young male football players. *Turkish J Sport Exer* 2017; 19(1): 54-9.
- [11] Asian Clemente JA, Requena B, Jukic I, Nayler J, Hernández AS, Carling C. Is physical performance a differentiating element between more or less successful football teams? *Sports (Basel)* 2019; 7(10): 216. [<http://dx.doi.org/10.3390/sports7100216>] [PMID: 31575073]
- [12] Altavilla G, RIELA L, Di Tore AP, Raiola G. The physical effort required from professional football players in different playing positions. *J Phys Educ Sport* 2017; 17(3): 2007-12.
- [13] Coutinho D, Gonçalves B, Travassos B, Abade E, Wong DP, Sampaio J. Effects of pitch spatial references on players' positioning and physical performances during football small-sided games. *J Sports Sci* 2019; 37(7): 741-7. [<http://dx.doi.org/10.1080/02640414.2018.1523671>] [PMID: 30306840]
- [14] Svensson K, Alricsson M, Olausson M, Werner S. Physical performance tests - a relationship of risk factors for muscle injuries in elite level male football players. *J Exerc Rehabil* 2018; 14(2): 282-8. [<http://dx.doi.org/10.12965/jer.1836028.014>] [PMID: 29740564]
- [15] Vitale JA, Caumo A, Roveda E, *et al.* Physical attributes and NFL combine performance tests between Italian National League and American football players: a comparative study. *J Strength Cond Res* 2016; 30(10): 2802-8. [<http://dx.doi.org/10.1519/JSC.0000000000001377>] [PMID: 26890970]
- [16] Williams KT, Coopoo Y, Fortuin C, Green A. Anthropometric and physical performance attributes of first division female football players in Gauteng province, South Africa. *African J Phy Act Health Sci* 2019; 25(3): 433-43. [AJPHES].
- [17] Patel R, Nevill A, Cloak R, Smith T, Wyon M. Relative age, maturation, anthropometry and physical performance characteristics of players within an Elite Youth Football Academy. *Int J Sports Sci Coaching* 2019; 14(6): 714-25. [<http://dx.doi.org/10.1177/1747954119879348>]
- [18] Rössler R, Junge A, Bizzini M, *et al.* A multinational cluster randomised controlled trial to assess the efficacy of '11+ Kids': a warm-up programme to prevent injuries in children's football. *Sports Med* 2018; 48(6): 1493-504. [<http://dx.doi.org/10.1007/s40279-017-0834-8>] [PMID: 29273936]
- [19] Beaudouin F, Rössler R, Aus der Fünten K, *et al.* Effects of the '11+ Kids' injury prevention programme on severe injuries in children's football: a secondary analysis of data from a multicentre cluster-randomised controlled trial. *Br J Sports Med* 2019; 53(22): 1418-23. [<http://dx.doi.org/10.1136/bjsports-2018-099062>] [PMID: 30279219]
- [20] Rössler R, Verhagen E, Rommers N, *et al.* Comparison of the '11+ Kids' injury prevention programme and a regular warmup in children's football (soccer): a cost effectiveness analysis. *Br J Sports Med* 2019; 53(5): 309-14. [<http://dx.doi.org/10.1136/bjsports-2018-099395>] [PMID: 30131330]
- [21] Nielsen G, Bugge A, Andersen LB. The influence of club football on children's daily physical activity. *Soccer Soc* 2016; 17(2): 246-58. [<http://dx.doi.org/10.1080/14660970.2015.1082754>]
- [22] Chuan CL, Penyelidikan J. Sample size estimation using Krejcie and Morgan and Cohen statistical power analysis: A comparison. *Jurnal Penyelidikan IPBL* 2006; 7(1): 78-86.
- [23] Nguyen DC. Research on the development of physical strength and

basic technique of the U10 futsal team at primary school. Sports publishing 2015.

[24] Hoang VD. Study on assessment of physical fitness and basic technical for male U12 football athletes after one year of training. Vietnam: Physical Education and Sports University 2017.

© 2021 Vinh Huy Chau

This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 International Public License (CC-BY 4.0), a copy of which is available at: <https://creativecommons.org/licenses/by/4.0/legalcode>. This license permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.