

# Knowledge, Attitudes and Practices Toward Physical Literacy Among the College Students During COVID-19 School Closure

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**Purpose:** To investigate the knowledge, attitudes and practices (KAP) among college students toward physical literacy during COVID-19 school closure.

**Patients and Methods:** This web-based cross-sectional study was conducted between December 9th, 2022 and December 24th, 2022 among college students during COVID-19 school closure. A self-designed questionnaire was developed to collect demographic information of the college students, and assess their KAP toward physical literacy.

**Results:** A total of 969 students were recruited, with mean age of  $18.73 \pm 0.97$  years. The majority were male (54.70%), urban residents (78.02%), majoring in engineering (58.00%), and having exercise habits (61.09%). The mean KAP scores were  $6.57 \pm 0.95$ ,  $32.63 \pm 4.07$ , and  $27.06 \pm 7.23$ , respectively. Positive associations were identified between knowledge and attitude (OR = 2.01, 95% CI: 1.52–2.66,  $P < 0.001$ ), and between attitude and practice (OR = 1.17, 95% CI: 1.12–1.22,  $P < 0.001$ ). A bachelor's degree and being in the sophomore year were positively associated with knowledge (OR = 1.51–4.05, all  $P < 0.05$ ). Urban residence and being in the sophomore year were negatively associated with attitude (OR = 0.43–0.59, all  $P < 0.05$ ), while having daily exercise habits showed the opposite trend (OR = 1.85, 95% CI: 1.33–2.57,  $P < 0.001$ ). Father's education level of high school and technical secondary school (OR = 0.58, 95% CI: 0.37–0.93,  $P = 0.023$ ) and having daily exercise habits (OR = 3.88, 95% CI: 2.72–5.55,  $P < 0.001$ ) were associated with practice.

**Conclusion:** College students had sufficient knowledge, moderate attitudes and negative practices towards physical literacy during COVID-19 school closure. The findings hold significant potential for developing educational programs, fostering healthier lifestyles and promoting mental well-being among college students during public health outbreaks.

**Keywords:** knowledge, attitude, practice, cross-sectional study, physical literacy

## Introduction

Physical literacy encompasses intrinsic motivation, self-confidence, proficiency in physical skills, as well as knowledge and understanding of the benefits of physical activity.<sup>1,2</sup> It empowers individuals to appreciate the importance of physical activity and to actively participate in it, while also taking responsibility for their own lifelong engagement in physical activity. The global school closures imposed during the COVID-19 pandemic have profoundly disrupted educational systems worldwide, including higher education institutions.<sup>3,4</sup> College students have encountered notable challenges such as limited access to campus facilities, reduced opportunities for physical activities, and an increase in sedentary behaviors.<sup>5,6</sup> These circumstances have raised concerns about the detrimental effects of closures on the physical and mental health of students, underscoring the necessity for research to investigate their involvement in physical literacy during this period.<sup>3,7</sup>

Despite the increasing influence of school closures on the physical and mental well-being of college students, there is a paucity of studies specifically addressing physical literacy. Acquiring a comprehensive understanding of college

students' knowledge, attitudes, and behaviors concerning physical literacy can offer valuable insights into their overall participation in physical activities and the advancement of a healthy lifestyle.<sup>8,9</sup> Through an examination of the factors influencing physical literacy among college students, it becomes possible to develop targeted interventions and educational programs aimed at augmenting their levels of physical literacy.<sup>4,10</sup>

The Knowledge, Attitudes, and Practices (KAP) framework is a commonly utilized research methodology in health-related studies. It offers a structured survey approach that utilizes questionnaires to evaluate participants' present knowledge, attitudes, and practices concerning a particular subject matter.<sup>9</sup> This framework serves as a fundamental basis for enhancing health education and disease management strategies. To date, no KAP study was available to provide insights into the physical literacy among college students.

To address these research gaps, this study aims to utilize the KAP framework to investigate the knowledge, attitudes, and practices toward physical literacy among college students during the COVID-19 school closure. The findings hold significant potential for developing educational programs, fostering healthier lifestyles and promoting mental well-being and resilience during public health outbreaks.

## Methods and Materials

### Study Design and Participants

This web-based cross-sectional study was conducted between December 9th, 2022 and December 24th, 2022 at University of Shanghai for Science and Technology among college students. Inclusion criteria included: 1) between 18 and 25 years of age; 2) without difficulties in communication and understanding. Exclusion criteria included: 1) with pre-existing cardiovascular or related diseases that could affect limb movement function, 2) having physical impairments that hindered participation in physical activity within the past six months, and 3) with professional sports experience, such as college athletes.

This study was ethically approved by the Committee on Ethics of Medicine, Shanghai Gongli Hospital and written informed consent was obtained from the participants. Our study complies with the Declaration of Helsinki.

### Sample Size Calculation

The calculation of sample size was as follows:<sup>11</sup>

$$n = \left( \frac{Z_{1-\frac{\alpha}{2}}}{\delta} \right)^2 \times p \times (1 - p)$$

where  $n$  denoted the sample size, and  $p$  was assumed to be 0.5 to ensure the maximum sample size.  $\alpha$ , also known as the type I error, was set to 0.05. In this case,  $Z_{1-\frac{\alpha}{2}} = 1.96$ . Assuming an effective questionnaire recovery rate of 80%, the final target is to collect at least 480 completed questionnaires.

### Questionnaire introduction and Collection

The questionnaire was developed with guidance from the Guiding Opinions of the Ministry of Education on Deepening the Teaching Reform of Undergraduate Education and Comprehensively Improving the Quality of Talents Cultivation (Higher Education [2019] No. 6) and relevant literature.<sup>12-14</sup> The questionnaire underwent further refinement incorporating feedback from five senior experts, each holding the professional title of associate professor in the field of physical education and possessing a minimum of thirty years of professional experience and then pilot tested on a small scale ( $n=46$ ), resulting in a Cronbach's  $\alpha$  of 0.76, indicating acceptable internal consistency.

The final questionnaire was in Chinese and consisted of four dimensions: demographic information, knowledge, attitudes and practices. The demographic information was consisted of 12 items, while the knowledge, attitude, and practice dimensions comprised 9, 9, and 10 items, respectively. As for education level in the demographic information, junior college typically refers to a two-year post-secondary education program that offers vocational training and academic courses. On the other hand, obtaining a bachelor's degree involves completing a four-year undergraduate program at a university or college. Besides, freshmen in the item of academic grade refers to students in their first year of

university. Sophomores and juniors are students in their second and third year of university, respectively. Seniors are students in their fourth and final year of university. Moreover, those above senior includes graduate students pursuing master's or doctoral degrees, as well as students in specialized programs beyond the undergraduate level.

The knowledge items were scored 1 point for a correct answer and 0 points for incorrect answers. Two logically contradictory trap questions, namely "Physical literacy significantly influences the physical and mental well-being of college students, particularly during the COVID-19 pandemic". (K3) and "Physical literacy has a negligible impact on the physical and mental health of college students". (K4), were excluded from statistical analysis, resulting in a potential score range of 0 to 7. The attitude items scored on a five-point Likert scale ranging from very positive (5 points) to very negative (1 point), with a possible score range of 9 to 45. The practice items also scored on a five-point Likert scale, ranging from always (5 points) to never (1 point), with a possible score range of 10 to 50. The data were collected using an online questionnaire hosted on Sojump (<http://www.sojump.com>). The online questionnaire was distributed through various social media platforms, including WeChat, and web links. A group of specialized medical professionals and healthcare personnel offered support to participants throughout the completion process, specifically addressing inquiries related to the questionnaire. Subsequent to data collection, the research team rigorously scrutinized the quality of the collected data, identifying and excluding responses with evident logical inconsistencies or repetitive patterns.

## Statistical Analysis

STATA 17.0 (Stata Corporation, College Station, TX, USA) was used for statistical analysis. The continuous variables were expressed as Mean  $\pm$  SD, and the categorical variables were represented as n (%). The normal distribution of continuous data was checked using the Kolmogorov–Smirnov test. The continuous variables conforming to the normal distribution were analyzed using Student's *t*-test (two groups) or ANOVA (more than two groups). Those with a skewed distribution were analyzed using the Mann–Whitney *U*-test (two groups) or the Kruskal–Wallis analysis of variance (more than two groups). Those scored in the top 70% were considered to have sufficient knowledge, positive attitudes and proactive practices. Univariate and multivariate logistic regression analysis was conducted to explore the relationships between demographic data and KAP scores. Variables with  $P < 0.05$  in univariate logistic regression analysis were further incorporated in multivariate logistic regression analysis. Two-sided  $P < 0.05$  were considered statistically significant.

## Results

Initially, 1117 questionnaires were collected. Subsequently, 148 responses were excluded due to incorrect answers to trap questions, leaving 969 valid questionnaires. This resulted in an effective response rate of 86.75%. Among the college students, 530 (54.70%) of them were male, 756 (78.02%) of them live in the urban area, 562 (58.00%) of their major are engineering, 592 (61.09%) of them have exercise habits in daily life and 566 (58.41%) of them fell within the BMI of 18.5–23.9 kg/m<sup>2</sup>. The mean knowledge, attitudes, and practices scores of them were 6.57 $\pm$ 0.95 (possible range: 0–7), 32.63 $\pm$ 4.07 (possible range: 9–45), and 27.06 $\pm$ 7.23 (possible range: 10–50), respectively. The knowledge varied among participants of different education level ( $P = 0.001$ ) and academic grade ( $P = 0.020$ ). The attitudes scores varied among participants of different education level ( $P = 0.001$ ), academic grade ( $P < 0.001$ ) and exercise habit ( $P < 0.001$ ). The practices varied among participants of different gender ( $P < 0.001$ ), academic grade ( $P < 0.001$ ), major ( $P = 0.026$ ), and exercise habit ( $P < 0.001$ ) (Table 1).

Almost all the knowledge items exhibit a high level of accuracy with correctness rate ranging from 82.15% to 99.79%. The knowledge item with the highest correctness rate were Physical literacy significantly influences the physical and mental well-being of college students, particularly during the COVID-19 pandemic". (K3). The knowledge item with the lowest correctness rate were "Competitive team sports (eg, football, basketball) do not contribute to the development of competitive synergy and social interaction within the Physical literacy of college students". (K9) (Table 2).

In terms of attitudes, approximately 96.49% of them strongly agree or agree that physical literacy is especially important for maintaining the physical and mental health of the college students in the time of COVID-19 (A1). Moreover, about 86.58% of them confirmed that in the special time of COVID-19 school closure, the college students should make self-management bring into play in actively assessing their own conditions and summing up their

**Table 1** Participants' Sociodemographic Information and KAP Scores

Variables	N (%)	Knowledge Score		Attitude Score		Practice Score	
		Mean $\pm$ SD	P	Mean $\pm$ SD	P	Mean $\pm$ SD	P
<b>Total</b>	969	6.57 $\pm$ 0.95		32.63 $\pm$ 4.07		27.06 $\pm$ 7.23	
<b>Gender</b>			0.744		0.087		<0.001
Male	530 (54.7)	6.56 $\pm$ 0.93		32.83 $\pm$ 4.24		28.26 $\pm$ 7.55	
Female	439 (45.3)	6.58 $\pm$ 0.99		32.38 $\pm$ 3.86		25.60 $\pm$ 6.54	
<b>Age</b>	18.73 $\pm$ 0.97						
<b>The only child</b>			0.411		0.486		0.484
Yes	530 (54.70)	6.59 $\pm$ 0.93		32.71 $\pm$ 4.12		27.21 $\pm$ 7.40	
No	439 (45.30)	6.54 $\pm$ 0.98		32.53 $\pm$ 4.02		26.88 $\pm$ 7.02	
<b>Residence</b>			0.739		0.241		0.395
Rural	213 (21.98)	6.59 $\pm$ 0.83		32.92 $\pm$ 3.95		26.69 $\pm$ 7.16	
Urban	756 (78.02)	6.56 $\pm$ 0.99		32.54 $\pm$ 4.11		27.16 $\pm$ 7.25	
<b>Monthly per capita income of Families (CNY)</b>			0.074		0.464		0.402
<2000	71 (7.33)	6.27 $\pm$ 1.33		32.24 $\pm$ 3.71		26.14 $\pm$ 8.02	
2000–5000	268 (27.66)	6.62 $\pm$ 0.91		32.36 $\pm$ 3.88		26.61 $\pm$ 7.14	
5000–10,000	322 (33.23)	6.59 $\pm$ 0.90		32.93 $\pm$ 4.05		27.27 $\pm$ 7.09	
10,000–20,000	214 (22.08)	6.54 $\pm$ 1.05		32.61 $\pm$ 4.17		27.21 $\pm$ 7.49	
>20,000	94 (9.70)	6.63 $\pm$ 0.57		32.68 $\pm$ 4.70		27.97 $\pm$ 6.69	
<b>Education level</b>			0.001		0.001		0.165
Junior College	10 (1.03)	5.60 $\pm$ 2.12		27.80 $\pm$ 5.29		23.90 $\pm$ 6.10	
Bachelor's degree in reading	959 (98.97)	6.58 $\pm$ 0.93		32.68 $\pm$ 4.03		27.09 $\pm$ 7.23	
<b>Father's education level</b>			0.895		0.731		0.792
Middle School and below	273 (28.17)	6.55 $\pm$ 0.98		32.59 $\pm$ 4.03		27.11 $\pm$ 7.62	
High school and Technical secondary school	287 (29.62)	6.60 $\pm$ 0.93		32.45 $\pm$ 3.95		26.76 $\pm$ 7.27	
Junior College and Bachelor's degree	374 (38.60)	6.57 $\pm$ 0.96		32.74 $\pm$ 4.09		27.29 $\pm$ 6.88	
Master's degree and above	35 (3.61)	6.49 $\pm$ 0.85		33.09 $\pm$ 5.21		26.60 $\pm$ 7.61	
<b>Mother's education level</b>			0.963		0.902		0.892
Middle School and below	324 (33.44)	6.58 $\pm$ 0.88		32.61 $\pm$ 4.08		26.82 $\pm$ 7.56	
High school and Technical secondary school	299 (30.86)	6.58 $\pm$ 0.93		32.51 $\pm$ 4.07		27.19 $\pm$ 7.11	
Junior College and Bachelor's degree	312 (32.20)	6.54 $\pm$ 1.06		32.73 $\pm$ 3.92		27.20 $\pm$ 6.80	
Master's degree and above	34 (3.61)	6.56 $\pm$ 0.82		32.85 $\pm$ 5.35		26.82 $\pm$ 8.91	
<b>Academic grade</b>			0.020		<0.001		0.004
Freshman	581 (59.96)	6.52 $\pm$ 1.00		33.29 $\pm$ 4.21		27.72 $\pm$ 7.47	
Sophomore	364 (37.56)	6.67 $\pm$ 0.83		31.57 $\pm$ 3.68		25.97 $\pm$ 6.64	
Junior	6 (0.62)	6.00 $\pm$ 0.89		31.83 $\pm$ 4.40		27.17 $\pm$ 3.49	
Senior and above	18 (1.86)	6.22 $\pm$ 1.52		32.89 $\pm$ 2.59		27.61 $\pm$ 9.20	
<b>Major</b>			0.991		0.082		0.026
Literature	109 (11.25)	6.56 $\pm$ 1.00		32.21 $\pm$ 3.82		26.09 $\pm$ 6.76	
Science	103 (10.63)	6.54 $\pm$ 0.99		32.96 $\pm$ 4.47		27.05 $\pm$ 7.49	
Engineering	562 (58.00)	6.57 $\pm$ 0.90		32.83 $\pm$ 4.15		27.61 $\pm$ 7.43	
Other	194 (20.12)	6.58 $\pm$ 1.06		32.09 $\pm$ 3.71		26.02 $\pm$ 6.60	
<b>Having exercise habits</b>			0.129		<0.001		<0.001
Yes	592 (61.09)	6.60 $\pm$ 0.86		33.35 $\pm$ 4.06		29.28 $\pm$ 6.99	
No	377 (38.91)	6.51 $\pm$ 1.09		31.48 $\pm$ 3.82		23.57 $\pm$ 6.14	
<b>BMI (kg/m<sup>2</sup>)</b>			0.907		0.017		0.091
<18.5	144 (14.86)	6.59 $\pm$ 0.87		32.68 $\pm$ 4.03		25.99 $\pm$ 6.50	
18.5–23.9	566 (58.41)	6.56 $\pm$ 0.99		32.34 $\pm$ 4.05		27.42 $\pm$ 7.32	
$\geq 24$	259 (26.73)	6.58 $\pm$ 0.93		33.21 $\pm$ 4.10		26.85 $\pm$ 7.38	

experiences in order to improve their physical literacy (A9). However, 44.78% of them strongly agree or agree that the situation of the epidemic and the school closure has prevented them from concentrating on their course of study (A4), and about 47.06% of them strongly agree or agree that In the time of COVID-19 school closure and with the recurrence of the epidemic, they felt confused about future development (A7) (Table 3).

**Table 2 Knowledge**

Knowledge	Correctness N(%)
K1. Physical literacy refers to the comprehensive cultural development of an individual's innate inclination towards physical and spiritual pursuits, which gradually evolves through genetic factors and practical experiences influenced by family, school physical education, and the social environment.	926 (95.56)
K2. In most relevant frameworks, physical literacy encompasses physical, behavioral, emotional, and cognitive dimensions.	926 (95.56)
K3. Physical literacy significantly influences the physical and mental well-being of college students, particularly during the COVID-19 pandemic.	967 (99.79)
K4. Physical literacy has a negligible impact on the physical and mental health of college students.	967 (99.79)
K5. Physical literacy encompasses the "motivation and confidence" required to engage in physical activities and serves as a means to emphasize the spiritual orientation towards school sports.	897 (92.57)
K6. Physical literacy solely encompasses physical health aspects and does not pertain to mental health.	935 (96.49)
K7. Physical literacy stimulates and reinforces the inclination to participate, and improving physical literacy can further enhance students' motivation in their lives, resulting in a more profound positive impact.	941 (97.11)
K8. During the COVID-19 school closure, enhancing physical literacy in both physical and mental aspects can facilitate positive emotional interactions among students.	943 (97.32)
K9. Competitive team sports (eg, football, basketball) do not contribute to the development of competitive synergy and social interaction within the physical literacy of college students.	796 (82.15)

**Table 3 Attitudes**

	Strongly Agree n (%)	Agree n (%)	Neutral n (%)	Disagree n (%)	Strongly Disagree n (%)
A1. You recognize the significance of physical literacy in maintaining the physical and mental well-being of college students during the COVID-19 pandemic.	551 (56.86)	384 (39.63)	31 (3.20)	1 (0.10)	2 (0.21)
A2. Throughout the period of school closure, you aim to enhance your physical literacy by engaging in diverse forms of exercise, such as aerobic/resistance training and participating in group athletics on campus.	406 (41.90)	390 (40.25)	146 (15.07)	26 (2.68)	1 (0.10)
A3. Amidst the COVID-19 situation, you possess complete confidence in the school's implemented measures to prevent the spread of the epidemic.	356 (36.74)	389 (4.14)	189 (19.50)	24 (2.48)	11 (1.14)
A4. You believe that the prevailing epidemic situation and the school closure have hindered your ability to focus on your academic pursuits.	173 (17.85)	261 (26.93)	335 (34.57)	151 (15.58)	49 (5.06)
A5. Given the circumstances brought about by COVID-19, you deem it necessary to provide appropriate training and lectures on mental health topics.	336 (34.67)	435 (44.89)	170 (17.54)	21 (2.17)	7 (0.72)
A6. You are in agreement with the importance of conducting psychological screening for college students during the school closure.	318 (32.82)	453 (46.75)	181 (18.68)	11 (1.14)	6 (0.62)
A7. With the recurrence of the epidemic and the ongoing school closure due to COVID-19, you find yourself uncertain about your future development.	156 (16.10)	300 (30.96)	316 (32.61)	153 (15.79)	44 (4.54)
A8. You believe that the school closure environment has posed challenges in carrying out certain sporting activities.	222 (22.91)	472 (48.71)	201 (20.74)	56 (5.78)	18 (1.86)
A9. In the unique context of the COVID-19 school closure, you emphasize the importance of college students actively assessing their own conditions and reflecting on their experiences in order to improve their physical literacy through effective self-management.	328 (33.85)	511 (52.73)	123 (12.69)	4 (0.41)	3 (0.31)

Regarding practices, the results indicate that approximately 58.31% of the college students always/often improve the quality of your friendships with your classmates by actively communicating with them during the time of school closure (P7), while 33.74% of them always/often assess their psychological state, consciously recognize problems, and take appropriate measures during the time of school closure (P10). Only around 8.87% of them always/often talk to friends or the school doctor for psychological support during the time of COVID-19 school closure (P5), 11.87% of them always/often participate in group training or competitions (P3) and 13.83% of them always/often perform resistance training (P2) (Table 4).

The multivariate logistic regression analysis showed that bachelor's degree in reading (OR = 4.05, 95% CI: 1.10–14.91,  $P = 0.035$ ), sophomore (OR = 1.51, 95% CI: 1.04–2.19,  $P = 0.031$ ) were associated with sufficient knowledge (Table 5). The knowledge (OR = 2.01, 95% CI: 1.52–2.66,  $P < 0.001$ ), urban residence (OR = 0.59, 95% CI: 0.39–0.91,  $P = 0.016$ ), sophomore (OR = 0.43, 95% CI: 0.28–0.66,  $P < 0.001$ ) and having exercise habits in daily life (OR = 1.85, 95% CI: 1.33–2.57,  $P < 0.001$ ) were associated with active attitudes (Table 6). The attitudes (OR = 1.17, 95% CI: 1.12–1.22,  $P < 0.001$ ), female (OR = 0.59, 95% CI: 0.41–0.86,  $P = 0.006$ ), Father's education level of high school and technical secondary school (OR = 0.58), 95% CI: 0.37–0.93,  $P = 0.023$ ) and having exercise habits in daily life (OR = 3.88, 95% CI: 2.72–5.55,  $P < 0.001$ ) were associated with proactive practices (Table 7).

**Table 4** Practices

	Always n (%)	Often n (%)	Sometimes n (%)	Occasionally n (%)	Never n (%)
P1. How frequently did you engage in aerobic exercises such as jogging, cycling, tai chi, and other related activities?	121 (12.49)	196 (20.23)	369 (38.08)	241 (24.87)	42 (4.33)
P2. How often did you perform resistance training exercises such as push-ups, dumbbell lifts, and similar activities?	65 (6.71)	69 (7.12)	177 (18.27)	312 (32.20)	346 (35.71)
P3. How frequently did you participate in group training sessions or competitions such as football, volleyball, and other similar sports?	47 (4.85)	68 (7.02)	151 (15.58)	298 (30.75)	405 (41.80)
P4. How often did you utilize advanced methods such as sports bracelets and sports apps to manage your exercise routine and monitor your physical condition?	128 (13.21)	157 (16.20)	257 (26.5)	217 (22.39)	210 (21.67)
P5. How often did you seek psychological support from friends or the school doctor during the period of COVID-19 school closure?	39 (4.02)	47 (4.85)	154 (15.89)	268 (27.66)	461 (47.57)
P6. How frequently did you employ meditation and reading as means to regulate your emotions during the period of COVID-19 school closure?	70 (7.22)	96 (9.91)	234 (24.15)	298 (30.75)	271 (27.97)
P7. How often did you actively communicate with your classmates to enhance the quality of your friendships during the school closure?	275 (28.38)	290 (29.93)	253 (26.11)	118 (12.18)	33 (3.41)
P8. How frequently did you engage in social activities (eg, participating in student councils, clubs) to maintain your social connections during the school closure?	143 (14.76)	162 (16.72)	287 (29.62)	245 (25.28)	132 (13.62)
P9. How often did you assess your physical condition, consciously identify any issues, and take appropriate measures during the school closure?	107 (11.04)	193 (19.92)	369 (38.08)	227 (23.43)	73 (7.53)
P10. How frequently did you assess your psychological state, consciously identify any problems, and take appropriate measures during the school closure?	123 (12.69)	204 (21.05)	345 (35.60)	195 (20.12)	102 (10.53)

**Table 5** Multivariate Logistic Regression Analysis of Knowledge

Factors	Univariate Logistic Regression		Multivariate Logistic Regression	
	OR (95% CI)	P	OR (95% CI)	P
<b>Gender</b>				
Male	Ref.		Ref.	
Female	1.117 (0.842 1.482)	0.444	1.157 (0.812 1.649)	0.420
<b>Age</b>	1.502 (0.905 1.223)	0.510	0.956 (0.798 1.146)	0.627
<b>The only child</b>				
Yes	1.148 (0.866 1.521)	0.337	1.168 (0.842 1.621)	0.352
No	Ref.		Ref.	
<b>Residence</b>				
Rural	Ref.		Ref.	
Urban	0.931 (0.662 1.312)	0.684	0.800 (0.527 1.214)	0.294
<b>Monthly per capita income of Families (CNY)</b>				
<2000	Ref.		Ref.	
2000–5000	1.666 (0.957 2.903)	0.071	1.706 (0.961 3.030)	0.068
5000–10,000	1.586 (0.922 2.727)	0.096	1.611 (0.901 2.878)	0.108
10,000–20,000	1.554 (0.880 2.746)	0.129	1.630 (0.873 3.046)	0.125
>20,000	1.174 (0.615 2.241)	0.626	1.262 (0.610 2.610)	0.531
<b>Education level</b>				
Junior College	Ref.		Ref.	
Bachelor's degree in reading	3.949 (1.106 14.104)	0.034	4.053 (1.102 14.908)	0.035
<b>Father's education level</b>				
Middle School and below	Ref.		Ref.	
High school and Technical secondary school	1.091 (0.752 1.582)	0.647	1.075 (0.694 1.664)	0.747
Junior College and Bachelor's degree	1.020 (0.721 1.444)	0.911	0.947 (0.575 1.560)	0.831
Master's degree and above	0.665 (0.319 1.386)	0.276	0.601 (0.220 1.645)	0.322

(Continued)



**Table 5** (Continued).

Factors	Univariate Logistic Regression		Multivariate Logistic Regression	
	OR (95% CI)	P	OR (95% CI)	P
<b>Mother's education level</b>				
Middle School and below	Ref.		Ref.	
High school and Technical secondary school	0.968 (0.683 1.374)	0.857	0.976 (0.630 1.512)	0.913
Junior College and Bachelor's degree	1.044 (0.737 1.480)	0.809	1.127 (0.678 1.873)	0.645
Master's degree and above	0.804 (0.377 1.717)	0.573	1.225 (0.428 3.511)	0.705
<b>Academic grade</b>				
Freshman	Ref.		Ref.	
Sophomore	1.403 (1.039 1.896)	0.027	1.508 (1.037 2.192)	0.031
Junior	0.214 (0.039 1.178)	0.076	0.198 (0.034 1.165)	0.073
Senior and above	0.672 (0.256 1.762)	0.419	0.670 (0.252 1.785)	0.423
<b>Major</b>				
Literature	Ref.		Ref.	
Science	0.924 (0.508 1.680)	0.796	0.940 (0.492 1.796)	0.852
Engineering	0.938 (0.593 1.483)	0.783	0.920 (0.545 1.553)	0.755
Other	1.163 (0.683 1.979)	0.578	1.116 (0.643 1.936)	0.697
<b>Having exercise habits</b>				
Yes	1.136 (0.853 1.513)	0.382	1.238 (0.912 1.680)	0.171
No	Ref.		Ref.	
<b>BMI (kg/m<sup>2</sup>)</b>				
<18.5	Ref.		Ref.	
18.5–23.9	1.028 (0.685 1.542)	0.894	1.015 (0.664 1.552)	0.944
≥24	1.054 (0.670 1.659)	0.820	1.072 (0.666 1.727)	0.774

**Table 6** Multivariate Logistic Regression Analysis of attitudes

Factors	Univariate Logistic Regression		Multivariate Logistic Regression	
	OR (95% CI)	P	OR (95% CI)	P
<b>Knowledge</b>	1.871 (1.423 2.444)	<0.001	2.011 (1.521 2.660)	<0.001
<b>Gender</b>				
Male	Ref.		Ref.	
Female	0.783 (0.589 1.040)	0.091	0.930 (0.644 1.345)	0.701
<b>Age</b>	0.716 (0.601 0.853)	<0.001	0.926 (0.736 1.161)	0.504
<b>The only child</b>				
Yes	0.936 (0.706 1.240)	0.643	1.065 (0.756 1.500)	0.719
No	Ref.		Ref.	
<b>Residence</b>				
Rural	Ref.		Ref.	
Urban	0.700 (0.505 0.970)	0.032	0.593 (0.387 0.908)	0.016
<b>Monthly per capita income of Families (CNY)</b>				
<2000	Ref.		Ref.	
2000–5000	1.101 (0.598 2.027)	0.756	1.101 (0.565 2.149)	0.777
5000–10,000	1.310 (0.722 2.376)	0.375	1.425 (0.726 2.800)	0.304
10,000–20,000	1.296 (0.697 2.408)	0.413	1.410 (0.687 2.895)	0.349
>20,000	1.417 (0.704 2.851)	0.328	1.598 (0.704 3.628)	0.262
<b>Education level</b>				
Junior College	Ref.			
Bachelor's degree in reading	–	–		

(Continued)

**Table 6** (Continued).

Factors	Univariate Logistic Regression		Multivariate Logistic Regression	
	OR (95% CI)	P	OR (95% CI)	P
<b>Father's education level</b>				
Middle School and below	Ref.		Ref.	
High school and Technical secondary school	0.885 (0.611 1.281)	0.516	0.913 (0.577 1.444)	0.697
Junior College and Bachelor's degree	0.933 (0.660 1.320)	0.696	1.005 (0.595 1.700)	0.984
Master's degree and above	1.451 (0.697 3.023)	0.320	1.367 (0.489 3.823)	0.551
<b>Mother's education level</b>				
Middle School and below	Ref.		Ref.	
High school and Technical secondary school	0.864 (0.607 1.228)	0.415	0.868 (0.547 1.378)	0.547
Junior College and Bachelor's degree	0.946 (0.670 1.335)	0.753	0.919 (0.542 1.556)	0.752
Master's degree and above	1.335 (0.635 2.806)	0.447	1.022 (0.357 2.925)	0.967
<b>Academic grade</b>				
Freshman	Ref.		Ref.	
Sophomore	0.444 (0.324 0.609)	<0.001	0.429 (0.280 0.657)	<0.001
Junior	0.387 (0.045 3.334)	0.387	0.690 (0.071 6.629)	0.748
Senior and above	0.553 (0.180 1.701)	0.301	0.559 (0.171 1.831)	0.337
<b>Major</b>				
Literature	Ref.		Ref.	
Science	1.622 (0.900 2.922)	0.107	1.559 (0.802 3.029)	0.190
Engineering	1.151 (0.722 1.837)	0.554	1.005 (0.583 1.735)	0.985
Other	0.893 (0.519 1.536)	0.683	0.975 (0.549 1.732)	0.931
<b>Having exercise habits</b>				
Yes	1.889 (1.402 2.573)	<0.001	1.846 (1.328 2.567)	<0.001
No	Ref.		Ref.	
<b>BMI (kg/m<sup>2</sup>)</b>				
<18.5	Ref.		Ref.	
18.5–23.9	0.945 (0.625 1.427)	0.787	0.822 (0.527 1.283)	0.388
≥24	1.315 (0.839 2.062)	0.233	1.255 (0.769 2.050)	0.363

**Table 7** Multivariate Logistic Regression Analysis of practices

Factors	Univariate Logistic Regression		Multivariate Logistic Regression	
	OR (95% CI)	P	OR (95% CI)	P
<b>Knowledge</b>	1.074 (0.926 1.245)	0.346	0.951 (0.804 1.124)	0.556
<b>Attitude</b>	1.188 (1.145 1.234)	<0.001	1.171 (1.122 1.221)	<0.001
<b>Gender</b>				
Male	Ref.			
Female	0.532 (0.404 0.702)	<0.001	0.590 (0.405 0.860)	0.006
<b>Age</b>	0.803 (0.686 0.940)	0.006	0.896 (0.709 1.133)	0.359
<b>The only child</b>				
Yes	1.096 (0.838 1.434)	0.504	1.022 (0.723 1.444)	0.902
No	Ref.		Ref.	
<b>Residence</b>				
Rural	Ref.		Ref.	
Urban	1.140 (0.822 1.582)	0.431	1.384 (0.893 2.144)	0.146

(Continued)



Table 7 (Continued).

Factors	Univariate Logistic Regression		Multivariate Logistic Regression	
	OR (95% CI)	P	OR (95% CI)	P
<b>Monthly per capita income of Families (CNY)</b>				
<2000	Ref.		Ref.	
2000–5000	0.904 (0.516 1.585)	0.724	0.818 (0.434 1.544)	0.536
5000–10,000	1.068 (0.617 1.847)	0.814	0.818 (0.432 1.550)	0.538
10,000–20,000	1.058 (0.597 1.875)	0.846	0.824 (0.417 1.630)	0.578
>20,000	1.355 (0.710 2.587)	0.358	1.223 (0.552 2.708)	0.620
<b>Education level</b>				
Junior College	Ref.		Ref.	
Bachelor's degree in reading	1.163 (0.299 4.528)	0.828	0.564 (0.128 2.484)	0.449
<b>Father's education level</b>				
Middle School and below	Ref.		Ref.	
High school and Technical secondary school	0.725 (0.507 1.037)	0.078	0.584 (0.367 0.929)	0.023
Junior College and Bachelor's degree	1.041 (0.752 1.443)	0.807	0.704 (0.416 1.191)	0.191
Master's degree and above	0.738 (0.340 1.600)	0.441	0.463 (0.152 1.408)	0.175
<b>Mother's education level</b>				
Middle School and below	Ref.		Ref.	
High school and Technical secondary school	1.063 (0.61 1.486)	0.721	1.124 (0.703 1.796)	0.626
Junior College and Bachelor's degree	1.136 (0.817 1.579)	0.449	1.084 (0.633 1.857)	0.769
Master's degree and above	0.762 (0.343 1.689)	0.503	0.656 (0.206 2.090)	0.476
<b>Academic grade</b>				
Freshman	Ref.		Ref.	
Sophomore	0.627 (0.471 0.835)	0.001	0.920 (0.599 1.413)	0.703
Junior	0.851 (0.155 4.686)	0.853	1.236 (0.180 8.517)	0.829
Senior and above	1.083 (0.414 2.836)	0.871	1.132 (0.402 3.188)	0.815
<b>Major</b>				
Literature	Ref.			
Science	1.135 (0.636 2.025)	0.669	0.694 (0.349 1.384)	0.300
Engineering	1.282 (0.823 1.998)	0.272	0.780 (0.447 1.361)	0.381
Other	0.882 (0.527 1.476)	0.633	0.901 (0.504 1.609)	0.725
<b>Having exercise habits</b>				
Yes	5.091 (3.651 7.099)	<0.001	3.883 (2.718 5.546)	<0.001
No	Ref.		Ref.	
<b>BMI (kg/m<sup>2</sup>)</b>				
<18.5	Ref.			
18.5–23.9	1.093 (0.741 1.613)	0.653	1.006 (0.642 1.578)	0.978
≥24	0.906 (0.585 1.403)	0.657	0.799 (0.478 1.333)	0.390

Abbreviation: KAP, knowledge attitudes and practices.

## Discussion

College students had sufficient knowledge, moderate attitudes and negative practices towards physical literacy. It is imperative to implement educational programs and interventions to improve college students' understandings of physical literacy and encourage their involvement in sports during COVID-19 school closures and future public health breaks.

The discrepancy between sufficient knowledge and negative practice among college students was clearly observed. One possible explanation is the impact of COVID-19 pandemic and associated lockdown measures. During the COVID-19 school closure, limited access to sports facilities and social distancing guidelines can undermine the engagement in physical activity.<sup>3</sup> Moreover, psychological factors, such as motivation and self-efficacy, may also play a role in shaping health behaviors. College students may lack the motivation to translate knowledge into action, especially in the face of external barriers and uncertainties associated with the pandemic.<sup>15</sup>

The study found that participants showed high accuracy in understanding physical literacy. Most students acknowledged the significance of physical literacy for their physical and mental well-being, especially during the COVID-19 pandemic. However, there was a lower accuracy rate for knowledge about the effects of competitive team sports on aspects like competitive synergy and social interaction within physical literacy. This suggests a potential knowledge gap that requires further attention and education among college students. Previous research suggested that team sports could promote social network formation and bonding, leading to improved team performance and personal growth.<sup>16,17</sup> The lack of recognition might be due to the misconception that competitive team sports only benefit athletes and not the general student population.

Positive attitudes were identified towards physical literacy among the majority of participants. A large majority of students emphasized the significance of physical literacy for their well-being during the COVID-19 school closure. Many recognized the importance of self-management and reflection to improve physical literacy during this period. However, a considerable number of students expressed concerns about the pandemic's impact on their studies and future development, possibly due to communication issues or dissatisfaction with the implemented measures. It should be noted that educational institutions have the potential to explore alternative approaches in promoting physical activity and physical literacy during the pandemic.<sup>18</sup> This can be achieved by offering online resources and classes,<sup>19</sup> encouraging outdoor activities that enable physical distancing,<sup>20</sup> and emphasizing individual exercise routines.

During the COVID-19 school closure, college students exhibited differing levels of engagement in various sports-related behaviors. While many focused on enhancing friendships and assessing their mental well-being, fewer sought psychological support or participated in group training or competitions. Social support has been identified as a critical factor in promoting mental health and resilience during stressful situations.<sup>21,22</sup> The low inclination mentioned above may be attributed to several potential factors, such as stigma, insufficient awareness regarding available resources, or fear of judgment or retribution.<sup>23</sup> Therefore, educational institutions can address these obstacles and promote students' use of mental health resources during the pandemic. Alongside fostering social connections, institutions should provide mental health support services, such as virtual counseling, online self-help resources, and mental health awareness campaigns.<sup>24</sup>

There are several limitations in this study. Firstly, the utilization of self-reported data may introduce a bias associated with self-reporting. The participants' responses concerning their knowledge, attitudes, and practices might be influenced by social desirability or their subjective interpretation of the questions. Secondly, another limitation pertains to the potential lack of generalizability of the findings to a broader population. Specifically, the study's scope concentrated solely on college students during the COVID-19 school closure, thereby restricting the applicability of the results to other age groups or educational settings. Thirdly, study period fell within the post-COVID phase rather than the active COVID period. As a result, the data may not fully capture the immediate impacts and responses to the challenges posed by the COVID-19 pandemic on physical literacy behaviors among college students. However, the study still offers insights into the longer-term effects of the pandemic on physical activity behaviors and perceptions among college students.

## Conclusion

College students had sufficient knowledge, moderate attitudes and negative practices towards physical literacy during COVID-19 school closure. The findings hold significant potential for developing educational programs, fostering healthier lifestyles and promoting mental well-being among college students during public health outbreaks. Efforts should be made to encourage a wider range of sports-related practices, including seeking social support and engaging in structured physical activities.

## Data Sharing Statement

All data generated or analysed during this study are included in this article.

## Ethics Approval and Consent to Participate

This study was ethically approved by the Committee on Ethics of Medicine, Shanghai Gongli Hospital and written informed consent was obtained from the participants. All methods were performed in accordance with the relevant guidelines and regulations and complies with the Declaration of Helsinki.

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## Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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## Disclosure

The authors report no conflicts of interest in this work.

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