

## Impact of fitness live streaming on public engagement in physical activities: A cross-sectional study

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### Abstract:

Will there be sustained engagement in live fitness broadcasts after the COVID-19 pandemic? Despite being viewed as a passing trend, fitness live streaming is believed to have a limited impact on long-term public interest in sports. This study seeks to explore the attitudes, participation rates, and underlying factors related to fitness live streaming, focusing on observations from China. A cross-sectional survey was conducted involving 408 respondents, utilizing a custom-designed questionnaire to evaluate participation in fitness live streaming. Participation in live fitness broadcasts was found to be shaped by a combination of objective circumstances and personal preferences. Furthermore, individuals displayed varied levels of involvement influenced by age, education, and occupation, affecting their cognitive engagement, preferred activities, workout durations, and overall outcomes. Notably, women exhibited greater emotional engagement and activity levels than men. Factors like exercise effectiveness, flow experience, and cognitive engagement significantly influenced individuals' intentions to exercise, leading to increased behavioral participation. This iterative process of enhancing exercise intentions and actual participation underscored the positive impact of live fitness broadcasts on public engagement in physical activities. Flow state and peer effects were not significant factors influencing participation in fitness live broadcasts. This absence of influence may be attributed to internet connectivity limitations and exercise preference variations, rendering the peer effect negligible in online fitness contexts. Additionally, willingness to engage in fitness activities does not always translate into actual participation, highlighting a potential gap between intention and action in fitness engagement. Participation in live fitness activities positively correlated with individuals' perceived proficiency and effectiveness in exercise. Emotional engagement, flow experience, and a readiness to engage in physical activities positively affected sports participation. Post-epidemic, the internet remains a significant factor in shaping the fitness industry, giving rise to innovative models. Integrating online and offline exercise methods is increasingly poised to be embraced as a mainstream approach.

**Key Words:** fitness live streaming, online fitness, internet sports industry, sports participation, willingness to participate

### Introduction

In the early 2020s, the onset of the COVID-19 epidemic had a significant impact on people's lifestyles, including ways of exercise. To prevent a widespread outbreak of COVID-19, the World Health Organization (WHO), governments, healthcare institutions, and media urged for the reduction of avoidable contact (Bagińska et al., 2023). During this period, individuals were mandated to remain at home as a precautionary measure, resulting in a significant alteration to their usual lifestyle (Caroppo et al., 2021; Di Renzo et al., 2020; Rawat et al., 2021). Several studies have shown that prolonged periods of time spent at home can have a detrimental effect on an individual's physical and mental health (Kumari et al., 2020; Marano et al., 2021), particularly on the mental health of adolescents (Marano et al., 2021; Mutz & Gerke, 2021).

The mandatory postponement of in-person fitness events at public venues prompted the emergence of online fitness, dependent on the internet, as a substitute to address the growing need for exercise (Schmidt et al., 2020; Kaur et al., 2020). The World Health Organization recommends deploying "online resources" to sustain daily physical activity during outbreaks, leading to the integration of online fitness into domestic exercise routines. Fitness apps, videos, online sign-ins, live broadcasts, and other digital methods have become primary avenues for exercise. "Live fitness" has emerged as a prominent trend and China's online buzzword of 2022 among these methods. Live fitness streaming, providing interactive viewing, communication, and shared experiences, has ignited a surge in public interest in fitness (Fearnbach et al., 2021). The use of punch cards in exercising is popular among both the general public and social media celebrities (School of Journalism, RUC, 2023). Consequently, there has been a rise in the popularity of fitness discussions on social media, facilitating broader dissemination of sports-related information (Zhou, 2022; Ochoa Siguencia et al., 2017). In 2019, the

global online fitness industry was valued at around \$6.04 billion USD. By 2021, it experienced a remarkable 77.33% year-on-year growth, reaching a valuation of \$10.71 billion USD(Freeman et al., 2015).

However, despite the popularity of fitness livestreaming in the online fitness industry, some still question its effectiveness in promoting mass sports participation. It has been suggested by certain researchers that fitness livestreaming is solely an option for offline fitness during specific periods(Mutz & Gerke, 2021), and that their involvement declines once the community resumes normalcy(Mutz et al., 2021); fitness livestreaming is only a reflection of the populace's reliance on the Internet while being homebound(Yang et al., 2019). Other scholars have posited that fitness live streaming falls short of providing an appropriate fitness environment and sense of community(Luguetti et al., 2022). Instead, it is viewed as more of an exercise routine(Lambert et al., 2023) and lacks the fostering of sportsmanship and physical education(Varea et al., 2022; Cruickshank et al., 2021; Howley, 2022). Such shortcomings can greatly skew students' perceptions of sports, willpower, and other aspects of education(Andricieva et al., 2022). The integration of technology in fitness live streaming presents an array of obstacles(Trent, 2016), including software usage and live streaming techniques(Guo & Fussell, 2022). The quality of live fitness streaming is constrained by the need for interactivity while participants face the screen, the ability to evaluate the exercise, and the timing of feedback. Such constraints may affect the intuitive experience of participants(O'Brien et al., 2020; Emery, 2017). Some researchers suggest that the general public's involvement in fitness live streaming is primarily driven by its entertainment and social aspects(Sokolova & Perez, 2021). They also argue that live streaming is nothing but a novel form of socialization(Skjuve & Brandtzaeg, 2019; Hudders et al., 2021), and that online exercise behaviours do not generate any motivation to exercise among viewers(Yu & Jee, 2020). Conversely, the viewers' motivation to exercise could be undermined by a negative experience while watching live streams(Ozamiz-Etxebarria et al., 2020; Yarmand et al., 2021).

Previous research primarily focused on discussing the mechanisms and impacts of live-streaming fitness, with scholars evaluating multiple facets of this emerging exercise trend. However, less attention has been given in previous studies to the engagement of live-streaming fitness and exploration of its influencing factors. While surveys and case studies abound for Europe and the United States, there has been relatively little discussion on live streaming fitness in Asian countries, notably China.

This study aims to uncover the mechanism through which live streaming influences the public's willingness to participate in sports, utilizing survey data. Through analyzing participants' backgrounds, motives for participation, experiences, and fitness outcomes in live streaming fitness, this study investigates its impact on public sports participation willingness and identifies scenarios conducive to new models of public sports engagement. Consequently, this study formulates hypotheses and research designs to verify them using cross-sectional data gathered from online surveys.

H 1: Gender, education, and professional background are factors that influence participation in live fitness.

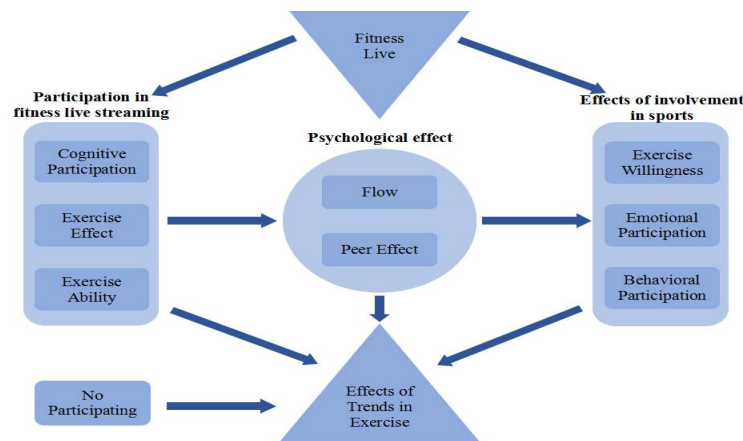
H 2: Participation in live fitness broadcasts is influenced by both objective conditions and subjective willingness.

H 3: The decision to participate in live-streamed fitness is influenced by the role of peers.

H 4: There is a positive correlation between the willingness to participate in live fitness broadcasts and the presentation of exercise ability and its effects.

For operationalizing the hypotheses, Hypothesis 1 can be analyzed by initially assessing participation levels and then correlating them with the basic information gathered from the questionnaire's initial section. Hypothesis 2 can be investigated using data concerning subjective and objective factors collected in the questionnaire's second section to determine their influence on live fitness participation. Hypothesis 3 was primarily assessed through three sub-questions in question 21, exploring whether respondents exhibited increased exercise willingness due to peer support. However, the operationalization of this question may have been hindered by insufficient data. Hypothesis 4, conversely, evaluated the relationship between exercise participation willingness and exercise effectiveness data by measuring both factors.

Figure 1: Hypothetical model of the study design



**Material & methods**

*Questionnaire development*

The survey was divided into three sections: basic Information, participation in fitness live and the feedback on fitness live.

Basic information was collected through eight questions, including the investigator's basic situation, physical activity level, and attitude towards fitness live, such as "number of sports activities per week". Fitness Live participation was obtained through 8 questions, which focus on the investigator's cognitive and behavioral participation in fitness live, exercise program, and flow phenomenon, such as "Have you personally participated in, or experienced, a Fitness Live workout? " The fitness live exercise effect is evaluated through 5 questions, each containing 3-4 sub-questions underneath. This part examine the investigator's actual experience of fitness live workouts, including emotional participation, exercise willingness, and exercise effect. The peer effect section comprises a total of three questions, these questions aim to gather the investigators' perceptions of their fitness levels with regards to the influence of peers and social support. A 5-point scale from 1 (Strongly Disagree) to 5 (Strongly Agree) was used to measure their actual experience and exercise of behaviour in all aspects of the process.

Furthermore, the survey acknowledges that not all staff members participate in fitness live streaming. The second part of the questionnaire assessed participation levels. Respondents who did not partake in fitness livestreams were queried solely about reasons for non-participation and perceived peer effects of exercise.

Prior to the main survey, a pre-test was conducted, and the questionnaire was refined based on the test results to enhance its reliability. The questionnaire underwent review by twelve field experts, who provided feedback and proposed modifications to its design. Subsequently, questions deemed repetitive or garnering low response rates were eliminated from the questionnaire.

*Participants*

Quantitative research methods were used to collect data from college students, office workers, middle-aged, and elderly participants via online questionnaires. The questionnaires were distributed by using China's professional research platform "Questionnaire Star" (<https://www.wjx.cn/newwjx/design/sendqstart.aspx?activityid=211151338>). It is the most authoritative online anonymous survey platform in China, by importing questionnaire contents and then distributing them. The survey was carried out over 10 consecutive days, starting from March 8, 2023, when the online survey platform became available.

Participants were invited to participate in the online survey using the snowball sampling technique. Questionnaires were distributed to various groups including students, office workers, and retired individuals. Their retweets were utilized to broaden the sample size. These groups represent diverse segments of the population, each exhibiting distinct exercise habits and attitudes toward live fitness. The study did not impose specific criteria for questionnaire participation, allowing individuals not engaged in fitness live to also complete it. Individuals with limited knowledge and involvement in fitness live will be surveyed regarding their reasons for non-participation and the factors driving negative feedback. Prior to the survey, informed consent was obtained from all participants. All participants volunteered and received no compensation for their involvement. The survey included 408 respondents from 24 Chinese provinces, all of whom were Chinese citizens. Despite the modest sample size, our findings may have broader applicability.

**Table 1.** Basic information of the respondents frequency

Items	Categories	N	Percent (%)
Gender	Male	111	32.55
	Female	230	67.45
Age	Under 18 years old	18	5.28
	18-24years old	135	39.59
	24-30years old	52	15.25
	30-40years old	63	18.48
	40-50years old	25	7.33
	Over 50 years old	48	14.08
Occupational status	Student	149	43.70
	Office worker	132	38.71
	Other	60	17.60
Education level	Junior high school and below	10	2.93
	High school	40	11.73
	Junior college	244	71.55
	Graduate or above	47	13.78
Total		341	100.0

Initially, we gathered details on the genders, ages, professions and educational levels of those who responded. Table 1 displays the female percentage as 67.45% (n=230) and the male percentage as 32.55% (n=111). In regards to age grouping, 39.59% were aged 18-24 years old, 18.48% were aged 30-40 years old, with the remaining 15.25% (24-30 years old), 14.08% (over 50 years old), 7.33% (40-50 years old), and 5.28% (under 18 years old). In regard to job status, there were more "students" in the survey, making up 43.70% (n=149) of the participants, followed by office workers at 38.71% (n=132), and other occupations at 17.6% (n=60). As for education level, 71.55% (n=244) had completed "Junior college, undergraduate (or equivalent)" and 13.78% had attained Graduate or higher.

*Data Collection*

An online survey was conducted, yielding 408 responses in total. After excluding 67 unrelated questionnaires, we reviewed 341 valid responses. Data analysis was performed utilizing the SPSSAU analysis platform (<https://spssau.com/>). Basic demographic information was analyzed using simple statistics. Subsequently, correlation and regression analyses were employed to investigate the impact of age, education, and occupation on participation in live fitness streaming and exercise behavior.

We assessed the reliability and validity of the questionnaire first. Cronbach's alpha was selected to assess the consistency of the questionnaire content, with each item analyzed accordingly. Most items (39/41) exhibited Cronbach's alpha reliability coefficients exceeding 0.9, indicating high data reliability suitable for further analysis. Factor analysis methods were employed to verify the validity of the data. Examination of Table 1 reveals that all research items have commonality values exceeding 0.4, indicating effective extraction of information from these items. Furthermore, the KMO value of 0.940 exceeds the threshold of 0.6, affirming the effective extraction of information from the data. Following variance rotation of 5 factors, the cumulative variance interpretation rate exceeds 50% at 96.235%. Thus, the research items contain effectively extractable information. Table 2 presents the reliability and validity assessment of the questionnaire.

**Table 2.**Reliability and validity of the questionnaire

Items	Factor Loadings					Communalities
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	
PE	0.621	0.237	0.288	0.241	0.629	0.978
EE	0.783	0.267	0.273	0.283	0.298	0.929
EA	0.814	0.257	0.243	0.256	0.281	0.933
EW	0.746	0.312	0.409	0.323	0.124	0.941
SPLS	0.670	0.294	0.530	0.340	0.112	0.944
FLB	0.443	0.337	0.720	0.276	0.267	0.975
PLS	0.348	0.328	0.245	0.826	0.167	0.999
PE	0.306	0.852	0.255	0.303	0.154	1.000
Eigenvalues (Initial)	6.485	0.528	0.280	0.236	0.169	-
% of Variance (Initial)	81.062%	6.599%	3.504%	2.953%	2.116%	-
% of Cum. Variance (Initial)	81.062%	87.662%	91.165%	94.119%	96.235%	-
Eigenvalues (Rotated)	3.080	1.324	1.308	1.274	0.713	-
% of Variance (Rotated)	38.501%	16.549%	16.347%	15.920%	8.918%	-
% of Cum. Variance (Rotated)	38.501%	55.050%	71.397%	87.316%	96.235%	-
KMO	0.940					-
Bartlett's Test of Sphericity (Chi-Square)	3466.915					-
df	28					-
p value	0.000					-

Note: Blue indicates that the absolute value of loading is greater than 0.4, and red indicates that the communality is less than 0.4.

**Data analysis results**

*Descriptive analysis*

**Table 3.**Descriptive analysis of the questionnaire sections

Items	M±SD	Variance	Median	Std. Error
Peer effect	3.674±0.967	0.935	4.000	0.052
Exercise effect	3.589±0.978	0.957	3.750	0.053
Exercise ability	3.646±1.000	1.001	4.000	0.054
Exercise willingness	3.513±1.041	1.085	3.667	0.056
Emotional Participation	3.543±1.068	1.142	3.667	0.058
Flow	3.591±1.067	1.138	3.667	0.058
Behavioral Participation	2.640±1.154	1.332	2.333	0.063
Cognitive Participation	3.738±0.907	0.822	3.750	0.049

From Table 3 data, the average scores for each factor are: PE 3.674, EE3.589, EA3.646, EW3.513, EP 3.543, FLOW 3.591, BP 2.640, and CP 3.738. Overall, all factors, with the exception of BP, had mean values greater than 2.5. This suggests that the participants had a positive attitude towards their participation in fitness live streaming. The average score for behavioral participation is 2.64, which is similar to the mean value of the questionnaire, i.e., 2.5. This reflects a certain gap between the public's actual exercise behavior and their willingness to participate. The cognitive participation mean value reaches its peak at 3.738. The factor comprises knowledge of fitness live streaming, watching, participation, and interaction. Additionally, the higher mean value suggests that fitness live streaming has gained significant public awareness. The previous related research reinforces that fitness live streaming is a new phenomenon for public fitness participation(Bratland-Sanda et al., 2021; Sokolova & Perez, 2021).

Participation in live fitness programs varied among occupational backgrounds. Students tended to prefer aerobics (56.3%), physical fitness (36.2%), and yoga (32.9%), while office workers inclined towards aerobics (65.1%), dance (30.3%), and physical fitness (28%). Respondents from other occupations preferred martial arts (51.6%), calisthenics (28.3%), and other activities (23.3%). Varied exercise styles appealed to survey respondents from different professions, with popular programmes drawing more attention from students and office workers, while complex programmes, like traditional health maintenance, were more favoured among other occupational groups. When it comes to the duration of exercise, students tend to exercise for longer periods of time, with their primary focus being on options exceeding 60 minutes (38%). In contrast, office workers primarily focus on durations of 11-30 minutes (28.4%), 31-45 minutes (21.8%). For other occupational statuses, just under half of the respondents exercised for more than an hour at a time (50.8%). The evidence suggests that individuals studying and occupying roles in other industries engage in athletic activities for extended durations, while individuals working in office environments tend to utilise their leisure time for athletic activities. The data displays a gender difference in participation in live fitness broadcasts. Women account for a higher percentage in "in line with" (30.9%) and "very much in line with" (36.4%) options, while the corresponding figures for men are 21.9% and 23.2%. These results suggest that women participate in fitness live broadcasts more frequently than men. We also looked at how optimistic people of different ages were about the future of fitness live streaming. The results of the questionnaire show that most respondents are optimistic about the future of fitness live streaming, with middle-aged and older people being more optimistic about its prospects, over 50 years old (4.78/5) and 40-50 years old (4.27/5), while young people are relatively rational, 30-40 years old (3.47/5) and 18-24 years old (3.65/5). We also collected data from respondents who had 'never participated in fitness livestreaming' to understand their reasons for not participating in fitness live streaming. There were four main reasons, namely 'live fitness is too monotonous for me'(Monotonous), 'I prefer real-life workouts' (real-life), 'live workouts don't allow for good communication and learning of movements', 'live workouts don't allow for good communication and learning of movements' and 'live workouts are not good for me'. "People over 50 and under 24 voted most often for real-life. This suggests that the limitations of technology, scenarios, feedback and other mechanisms prevent people used to traditional fitness methods from adapting to using cloud fitness(Giannakos & Vlamos, 2013). Non-participants preferred real-life exercise scenarios.In the option Monotonous, 24-30 years old (3), 18-24 years old (2.84), under 18 years old (2.67), with the lowest mean value of 2.761, indicating that the public still has a certain interest in live fitness, although they do not participate in the fitness live broadcast, but in the new media information dissemination to understand the relevant information, and have a certain degree of recognition of the form of fitness live broadcast.

*Correlation analysis*

1) Correlation Analysis of Behavioural Participation in Live Streaming Fitness with Gender, Education and Occupational Background

**Table 4.** Correlation analysis of behavioural participation in live streaming fitness

Category		N	M±SD	F	P
Gender	Male	111	2.48±1.22	3.055	0.081
	Female	230	2.72±1.11		
Age	Below 18	18	3.26±1.38	17.082	0.000*
	18-24 years old	135	2.23±0.89		
	24-30 years old	52	2.85±1.16		
	30-40 years old	63	2.44±1.13		
	40-50 years old	25	2.36±1.13		
	Above 50	48	3.72±0.98		
Education level	Junior high school and below	10	3.37±1.23	5.576	0.001*
	High school (junior college, vocational high school, etc.)	40	3.21±1.13		
	Specialized, undergraduate (and equivalent)	244	2.53±1.10		
	Graduate students and above	47	2.59±1.29		
Occupational status	Students	149	2.31±1.00	16.723	0.000*
	Office workers	132	2.72±1.16		
	Other	60	3.27±1.21		

\*  $p < 0.05$  \*\*  $p < 0.01$

From the data in Table 4, although the average value of 2.72 for females is higher than 2.48 for males, there is no statistical difference when  $p > 0.05$ . There is a statistically significant difference in  $p < 0.01$  among different age groups, which indicates that different age groups have different attitudes toward participating in fitness live streaming. Second, from the perspective of different educational level and professional status, there are significant differences in  $p < 0.01$ .

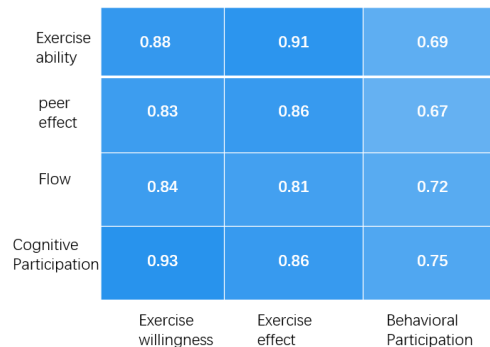
2) Analysis of Fitness Live Streaming Participation Influenced by Objective Conditions and Subjective Intentions

**Table 5.** Pearson correlation coefficient analysis of fitness live streaming participation

	Behavioral Participation	Exercise willingness	Flow in streaming	live Sports activity level	Exercise ability
Behavioral Participation	1				
Exercise willingness	0.748**	1			
Flow	0.718**	0.836**	1		
Sports activity level	0.475**	0.308**	0.309**	1	
Exercise ability	0.692**	0.876**	0.795**	0.314**	1

\*  $p < 0.05$  \*\*  $p < 0.01$

The table above shows that the Pearson correlation coefficient analyses how participation in fitness live streaming is influenced by subjective and objective factors. The subjective factors are shown as the participant's willingness to participate and Flow; the objective factors are the participant's exercise level and physical ability. The analysis shows that the correlation coefficient value between Behavioral Engagement and Willingness to Exercise is 0.748 and shows significance at the 0.01 level, indicating a significant positive correlation. Significance at the 0.01 level is shown between behavioral participation and flow, between behavioral participation and exercise level, and between behavioral participation and exercise ability. This also indicates that fitness live streaming is still influenced by subjective and objective factors, although it has advantages such as convenience and ease of use.



**Figure 2.** Pearson correlation coefficients between factors

From the table above, correlation analysis was used to investigate the correlation between Exercise willingness, Exercise effect, Behavioural participation and Exercise ability, Peer effect, Flow in Live streaming, Emotional participation respectively using Pearson's correlation coefficient to indicate the strength of the correlation. Pearson's correlation coefficient was used to indicate the strength of the correlations. From the data, the correlation coefficients between EW and the other 4 items are all significant, and the values of the correlation coefficients are 0.876, 0.834, 0.836, 0.925, and the values of the correlation coefficients are greater than 0, which means that the correlations between Exercise willingness and Exercise ability, peer effect, flow in live streaming, emotional participation, and the total of 4 items are all significant. The above data can prove that: firstly, the active fitness willingness has a positive guiding effect on the fitness activity itself, and it should be focused on stimulating the public's fitness willingness to promote their initiative, so that the fitness activity can be "active" and avoid the boring and dull exercise methods. Secondly, the correlation between fitness willingness and emotional involvement is the highest, reaching 0.93, which also indicates that fitness live streaming as a new type of fitness mode, this kind of live streaming, interactive form can well stimulate the public's fitness willingness (Guo & Fussell, 2022). Third, the correlation between exercise effect and exercise capacity is high, reaching 0.91, which also indicates that the participation process of fitness live streaming also has the same offline fitness effect and role (Chang et al., 2021). Fourth, behavioral participation and the other four items also showed a positive correlation, but its correlation coefficient is lower than the value of exercise willingness and exercise effect, which also indicates that "moving" is still an important factor that bothers the public to

participate in sports, especially in the Internet, the physical barrier between people has contributed to the weakening of the peer effect.

*Regression analysis*

**Table 6.** Regression analysis of willingness to live stream fitness and various factors  
Parameter Estimates (n=341)

	Unstandardized Coefficients		Standardized Coefficients	t	p	Multicollinearity	
	B	Std. Error	Beta			VIF	tolerance
Constant	-0.297	0.104	-	-2.845	0.005**	-	-
Peer effect	0.206	0.048	0.191	4.255	0.000**	4.144	0.241
Exercise effect	0.460	0.052	0.432	8.890	0.000**	4.861	0.206
Flow	0.243	0.042	0.249	5.861	0.000**	3.717	0.269
Cognitive Participation	0.141	0.038	0.123	3.726	0.000**	2.227	0.449
R <sup>2</sup>	0.836						
Adj R <sup>2</sup>	0.834						
F	F (4,336)=429.495,p=0.000						
D-W	1.994						

Dependent Variable: Exercise willingness

\* p<0.05 \*\* p<0.01

In order to investigate the relationship between exercise willingness and other factors, linear regression analysis was conducted by taking PE, EE, Flow, Cognitive Engagement as the independent variables and EW as the dependent variable, the model equation is: Exercise willingness = -0.297 + 0.206 \* peer effect + 0.460 \* exercise effect + 0.243 \* flow in Live streaming + 0.141 \*cognitive engagement, and the R-square value of the model is 0.836, which means that peer effect, exercise effect, flow in live streaming, and cognitive engagement can explain 83.6% of the exercise willingness. willingness as the cause of 83.6% change in willingness. The F-test of the model was conducted and it was found that the model passed the F-test (F=429.495, p=0.000<0.05), which means that at least one of the peer effect, exercise effect, flow in live streaming, and cognitive engagement will have an effect on exercise willingness. Finally, from the data analysis, we can know that the regression coefficients of the four factors are PE 0.206 (t=4.255), EE 0.460 (t=8.890), FLB 0.243 (t=5.861), and cognitive involvement 0.141 (t=3.726) p=0.000<0.01, which are all with a significant positive influence relationship.

We have three findings through regression analysis. First, fitness live streaming, a new type of fitness, is a form of participation in fitness through the Internet, and compared with traditional fitness, its participation willingness is influenced by Internet factors, such as interactive communication in live streaming, the infectious power of the anchor, and platform publicity(Godefroy, 2020). Second, through correlation analysis, it can be seen that there is a positive correlation between exercise effectiveness, peer effect, flow, cognitive participation, and exercise intention. This also indicates that exercise intention in online live streaming is influenced by multiple factors, with greater randomness and temporality in exercise. Of course, this also has some impact on the persistence and periodicity of fitness exercise, and there may be situations such as overtraining or low frequency. Third, the flow phenomenon and exercise effects in live streaming continuously stimulate the participants' willingness to exercise, enrich the fun of fitness activities, and enhance the cognitive experience of the public's fitness knowledge.

**Table 7.:** Linear regression analysis of live streaming behavioral participation

	Unstandardized Coefficients		Standardized Coefficients	t	p	VIF
	B	Std. Error	Beta			
Constant	-0.517	0.159	-	-3.247	0.001**	-
Exercise willingness	0.301	0.109	0.272	2.761	0.006**	8.098
Emotional involvement	0.309	0.111	0.286	2.781	0.006**	8.856
Flow in Live streaming	0.224	0.078	0.207	2.869	0.004**	4.344
peer effect	0.054	0.078	0.045	0.696	0.487	3.544
R <sup>2</sup>	0.598					
Adj R <sup>2</sup>	0.593					
F	F (4,336)=124.886,p=0.000					
D-W	1.888					

Dependent Variable: behavioral involvement, Parameter Estimates (n=341), \* p<0.05 \*\* p<0.01

The above table reflects the results of our linear regression analysis with exercise willingness, emotional involvement, flow in Live streaming, peer effect as independent variables and behavioral involvement as dependent variable. From the above table, we can see that the model equation is: behavioral involvement = -0.517 + 0.301 \* exercise willingness + 0.309 \* emotional involvement + 0.224 \* flow in Live streaming + 0.054 \* peer effect, and the model R-square value is 0.598, which means that exercise willingness, emotional involvement, flow in live streaming, peer effect can explain 59.8% of the variation in behavioral involvement. The final analysis reveals that Exercise willingness and emotional participation will have a significant positive influence relationship on behavioral participation.

Through the above analysis, we have two findings. On the one hand, the sense of live participation, exercise willingness, and flow have a positive effect on behavioral participation in fitness live streaming, the network effect pays more attention to the sensory experience when participating (Skjuve & Brandtzaeg, 2019), and the fitness live broadcast is even more to use the experience of the participants' flow when watching the live broadcast, so that the participants are actively integrated into the live broadcast of exercise behavioral participation.

Compared with offline fitness, when doing the psychological preparation, equipment preparation, about time, about partners, warm-up and other cumbersome links, fitness live is more convenient, so the famous fitness live streaming has a certain degree of challenge to the offline fitness industry, and will inspire the transformation of the offline fitness industry.

On the other hand, the peer effect does not have a significant effect on practice participation. This is different from previous studies in which the peer effect was considered as an important influencing factor for adolescents and has an impact on the surrounding peers (Shi & Sun, 2022; Zhang & Li, 2022), but in live fitness it does not have an impact. Behaviors such as partner encouragement and team training during exercise are commonly perceived as the fun part of offline exercise and a good way to promote team friendship and enhance peer bonding.

*Mediating effects*

**Table 8.** Mediating effects of live fitness participation  
Summary of intermediation test results

Items	c total effect	a	b	a*b median effect value	a*b effect (Boot SE)	a*b (z)	a*b (p)	a*b (95% BootCI)	c' direct effect	Test Conclusion
BP=>FLOW=>EW	0.189**	0.243**	0.239**	0.058	0.021	2.725	0.006	0.029 0.111	~ 0.131**	Partial mediating effect
EA=>=>EW	FLOW 0.400**	0.296**	0.239**	0.071	0.035	2.004	0.045	0.014 0.150	~ 0.329**	Partial mediating effect
EE=>=>EW	FLOW 0.407**	0.403**	0.239**	0.096	0.034	2.840	0.005	0.035 0.166	~ 0.311**	Partial mediating effect

\* p<0.05 \*\* p<0.01

There were three models involved in the mediation effect analysis, which were  $EW = 0.094 + 0.189 * Behavioral\ Involvement + 0.400 * EA + 0.407 * EE$ ;  $Flow = 0.426 + 0.243 * BP + 0.296 * EA + 0.403 * EE$ ; and  $EW = -0.007 + 0.131 * Behavioral\ Involvement + 0.329 * EA + 0.311 * EE + 0.239 * Flow$

From the data, a and b are significant and c' is significant and a\*b with the same sign as c' is partially mediated. flow shows partial mediation in all three models, and partial mediation describes one part of the relationship of the independent variable x influencing the dependent variable Y through the mediating variable M, and the other part of the influence of the independent variable X on Y directly.

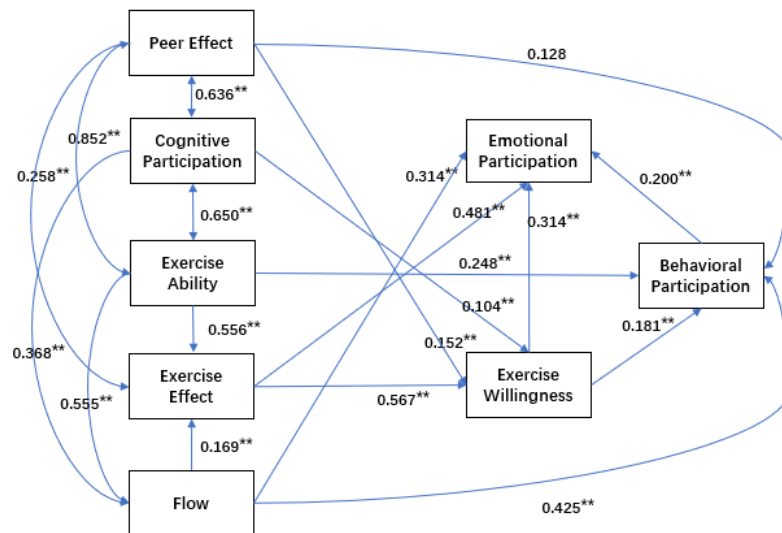
First, Flow in behavioral engagement on fitness intention plays partially mediating role. This suggests that in sports as a practical content, unlike online games, live shopping and other viewing content, more actual movements of the participants need to be involved in the process of flow and behavioral participation in this process are present in the exercise willingness to have an impact.

Second, flow plays a partial mediating role in the effect of exercise ability on exercise intention. This suggests that, Fitness live streaming also plays a role in influencing exercise willingness, and the flow phenomenon in participating in live streaming also plays a role.

Once again, the partial mediating role of flow in the analysis of the mediating effect of exercise effect on the willingness to exercise. As a new type of fitness method, it includes aspects such as psychological pleasure, interactive communication, and partial participation feelings during participation, which form the flow phenomenon in fitness live streaming and affect participants' willingness to continue participating in exercise.

*Pathways*





**Figure 3.** Path analysis of live fitness engagement

From the above table, it can be seen that the peer effect, exercise effect, cognitive participation and other aspects of the live emotional participation, behavioral participation and willingness to participate between the path relationship. When flow for BP influence, the standardized path coefficient value is  $0.425 > 0$ , and this path presents a significance at 0.01 level ( $z=7.115, p=0.000 < 0.01$ ). This indicates that the phenomenon of flow has a significant effect on actual participation, which also verifies that the experience of flow in live streaming has a guiding effect on participants' continued attention and participation in fitness live streaming, which is the way of attracting traffic to short videos, live streaming, and other activities in the Internet.

The standardized path coefficient value is  $0.248 > 0$  when EA influences on BP, and this path presents a significance at the 0.01 level ( $z=3.076, p=0.002 < 0.01$ ), thus suggesting that EA will have a significant positive influence on BP. EE has a standardized path coefficient value of  $0.567 > 0$  when it influences on EW, and this path presents a significance at the 0.01 level of significance ( $z=13.232, p=0.000 < 0.01$ ). It is worth mentioning that this path does not present significance when PE is influential on BP ( $z=1.843, p=0.065 > 0.05$ ), thus indicating that pE does not have an influential relationship on BP.

The path exploration found that behavioral participation on emotional participation and exercise willingness to behavioral participation are presented 0.01 significant effect, indicating that the participation process of the public recognition of fitness live participation form and content, aerobics as most people preferred project, presenting the simplicity of the fitness live as well as "Liu Genghong" as a representative of the live broadcast mode let participants to enhance exercise willingness, the sense of participation in live exercise (Guo, 2023). Exercise effect on the willingness to exercise, the sense of participation in the live broadcast showed a significant effect of 0.01, which also indicates that the live broadcast has the effect of offline exercise, but from the survey, the actual participation in the average value of 2.64, also indicates that the participants in the process of not only physical participation, but also to participate in a more mentally engaging way to alleviate the sense of physical and mental anxiety.

## Discussion

### *The effect of fitness live streaming on the willingness to exercise*

Fitness live streaming has revolutionized home fitness (Guo & Fussell, 2022). Our survey indicated that the average score of EW and EE reached more than 3.5, which also shows that the public likes and recognizes fitness live streaming. However, the average score for behavioral participation (BP) stood at a modest 2.5, indicating a tendency for passive viewing rather than active engagement among viewers. Participants often utilize fitness live streaming as a platform for social interaction, leveraging discussions around fitness to showcase positive lifestyle choices within their social circles. Analysis of participants' professional backgrounds revealed that 53% of students prefer offline exercise, underscoring the pragmatic emphasis of physical education courses among this demographic. This aligns with previous studies indicating low enthusiasm and motivation for online physical education courses among students (Nyenhuis et al., 2020; Varea et al., 2022). In terms of gender, women tend to exhibit higher levels of participation in sports-related activities, particularly in dance and calisthenics classes, while men show greater interest in strength training and complex exercises. Consequently, relevant sports knowledge and concepts can be acquired and practiced both online and offline, highlighting the versatility of fitness live streaming and similar cloud fitness platforms. The dissemination of health concepts and exercise methods through fitness live streaming has led to increased participation in physical activity among the

general public(Ozamiz-Etxebarria et al., 2020), as evidenced by the positive and significant impact of fitness willingness on exercise participation.

Fitness live streaming transforms the conventional exercise experience, eliciting novel sensations and emotions (Guo & Fussell, 2022). Both the effectiveness of exercise and the experience of flow during physical activity contribute to exercise willingness, thereby influencing both physical and mental well-being. Consequently, fitness live streaming enables participants to achieve comparable exercise outcomes to traditional offline fitness regimens(Chang et al., 2021).

The peer effect did not influence perceptions of live-streaming participation, diverging from previous research on the peer effect(Shi & Sun, 2022) in actual participation. However, the peer effect significantly impacted willingness to exercise, the flow phenomenon, and exercise effectiveness, suggesting that public discussions, sharing, and overall effects in fitness live broadcasts were positively influenced by peer interactions. This indicates a trend where more viewers prefer to watch live streams rather than actively engage in workouts. Why did the peer effect fail to manifest as expected? We propose two perspectives. Firstly, participants in fitness live broadcasts often join as fans of the anchor, primarily focusing on following the anchor's lead in exercising or interacting with them. Thus, their participation is more individualized rather than group-oriented, as they recognize the potential to interact with fans nationwide at any given moment, thereby diminishing the influence of peer factors. Secondly, live fitness activities occur within a context of physical isolation, functioning as a virtual form of participation and gathering, which undermines the supportive nature of the peer effect. The study suggests that this phenomenon is tied to participant identities and the virtual nature of internet engagement, wherein participants, as fans of the anchor, prioritize encouragement, companionship, and support from the anchor over peer influence. Consequently, the peer effect in live fitness broadcasting predominantly manifests during post-broadcast discussions and interactions, characterized by a certain delay and a focus on following the anchor's workout routines. This collective sense of camaraderie reduces reliance on immediate peer companionship(Bramoullé et al., 2020) and bolsters public willingness to exercise.

*Fitness live streaming represents a new mode of mass sports participation*

Here are three reasons for the rise of fitness live streaming. Firstly, it is considered a form of digital sports, involving live video streaming of physical exercise activities via social media and internet platforms. This burgeoning industry has ignited a fitness frenzy in China and globally, propelled by factors such as epidemic control measures, technological advancements, and the rise of new media(Thompson, 2021). Strict quarantine policies, coupled with the health risks associated with public fitness venues, have spurred a surge in home fitness, accelerating the development of online fitness modalities, including digital sports and fitness live streaming(Stragier et al., 2016). Secondly, epidemics serve as health alarms, prompting heightened public awareness of health importance(Piech & Zalech, 2022). Online fitness has emerged as a crucial avenue for individuals to access fitness knowledge, guidance, and companionship(Mutz & Gerke, 2021; Bratland-Sanda et al., 2021). Live fitness caters to the psychological needs of this demographic, particularly amidst the "live streaming +" trend integrating fitness with shopping, entertainment, and social interactions(Bratland-Sanda et al., 2020). Additionally, the proliferation of fitness live streaming rooms has surged year-on-year, complemented by the influence of network fitness stars. Notably, prominent fitness influencers in China, such as Liu Genghong, Pamela Reif, and Snow Aerobic Fitness, boast massive followings exceeding 100 million. Similar trends have emerged globally, with various countries witnessing the introduction of live fitness programs(Nyenhuis et al., 2020).

Fitness live is the product of the stage of Internet integration into the depth of life, the current fitness assistance software has become a necessity of life, so the smart phone has become the key to enter the network classroom, so that fitness is simple, entertaining and beneficial. The rise of fitness live broadcast, but also represents a new way to exercise independently, easy to experience, refusing to take exercise seriously(Ochoa Siguencia et al., 2017) offline fitness in the pain, stage fright experience replaced by fitness live broadcast to become a release, joy(Pink, 2011; Terry et al., 2020). In short, the combination of fitness live streaming and advanced technology has driven more and more people to try sport.

From our survey data, willingness to exercise, flow, live participation sense on the actual participation behavior have shown significant correlation, which also indicates that the form of fitness live broadcast on the participants' exercise behavior has a positive impact on the ability to guide the viewer to participate in many ways, and fitness live broadcast on the effect of exercise has a positive impact on the participants to achieve psychological satisfaction at the same time, it is easier to stimulate the participants of the actual exercise behavior. We believe that this is mainly caused by two major factors: the availability of fitness anchors and the external environment. On the one hand, the influencer effect in the fitness live broadcast stimulates public sports participation. Influencer as a synonym for the new era of network celebrities(Pan, 2017), its celebrity effect will drive followers and favorites to participate in the relevant live broadcasts hosted by them. Transform it into a form of empathy with the anchor and participate in interactive ritual chains(Zheng, 2022). This also contributes to the reason why fitness live streaming is different from aspects such as workout APPs and smart devices, which are dominated by people, emotional communication, fan support, and workout card gathering place. It is not just a single workout. It is also the reason why fitness live streaming still retains a huge participation population after the epidemic(Zhang et al., 2022).

On the other hand, the social environment is an important external factor that influences the way and willingness of the public to participate in sports. China's Internet infrastructure construction provides convenient technical conditions for the public to participate in webcasting fitness. In the Internet era, China has high-quality Internet, advanced infrastructure and more than 1 billion Internet users (China Internet Network Information Center, 2023). The public has been using the Internet for a long time (Zhou et al., 2023), and has become accustomed to the modes of online shopping, live broadcast interaction, and so on. Moreover, since most of the live fitness courses in China are free and open to the public, the public is free to choose an "approved" trainer and follow his/her training, which promotes the fairness of the training and reduces the economic burden of the public, which has also gradually formed a "pure" fitness program. This is also gradually formed a "pure" fitness way, make exercise easy, away from the gym to buy a card mode. This is different from the single-pay live broadcast method in Europe and the United States, China has formed a shopping, dating, exercise and other diversified as one of the fitness live broadcast model, in the live broadcast environment more to promote the public's willingness to exercise to improve. In addition, the 2020-2022 COVID-19 epidemic sealing and control policy is the rise of webcasting fitness can not be ignored factors.

*Theoretical and practical significance of fitness live streaming*

From the study of fitness live streaming, live streaming promotes more diversified fitness. Fitness live streaming of digital sports mode allows more people to pay attention to the live streaming form of sports activities, so that the cloud fitness way become a new mode of mass home fitness, and fitness live streaming become hot to promote the public's willingness to exercise and cultivate exercise behavior habits have a revealing effect.

First of all, the psychological effect of live participation has an important impact. The way of live streaming has an important impact on the audience's psychological feelings, affecting the participants' participation feelings, attention, continuity and other aspects, and it is more reflective of the transfer of psychological skills previously used in online games, webcasting shopping, etc., to fitness live streaming. Therefore, many researchers have explored the psychological effects in fitness live streaming from the aspects of binge theory, interactive ritual society, immersion theory, decentralization and flow (Terry et al., 2020). This psychological phenomenon is a point of attraction for participants to enjoy, actively participate and engage both physically and mentally, and also plays an important reference role for the future development of digital sports models. Second, fitness live streaming has an impact on the public's willingness to exercise. Our survey results show that in fitness live streaming, the role of anchor, exercise atmosphere, habit cultivation, interactive mode and other aspects have attracted the attention and participation of many participants, thus promoting the public's willingness to exercise.

Again, the fitness live streaming on the sports economy plays a role in promoting the development. Some scholars who study the "fan economy" believe that the current fans are mainly divided into practical consumption users and emotional consumption users, in the process of fitness live fitness live fitness effects, sports value, buy sports goods are practical users, and due to the star effect, entertainment, anchor charm are emotional users (Tang, 2020). Internet era live fans are more closely connected than previous fans, in the fans also gradually emphasize the upgrade of its consumption mode and the extension of brand value, such as in the purchase will tend to anchor recommended fitness products (yoga mats, fascia guns, etc.), to participate in the relevant offline training camps and so on. Due to the fans' recognition and appreciation of the anchor's spiritual level, the fans will transfer their emotions to the products recommended by the anchor in order to achieve the way of supporting the anchor and maintaining the fans' loyalty, so it is inevitable that there will be blind obedience, support and comparison in the purchase of products (Song, 2022; Tang et al., 2022).

*Strengths and limitations*

First of all, this study in the investigator's participation in fitness live streaming there is time variability. This study is a cross-sectional study, only a certain time cross-section of the mass population's participation in fitness live streaming, responding to the behavioral and emotional state of the mass participation at that time, there may be a lack of long-term observation and comparative study in the investigation, if the interval of a period of time to observe the experience and effect of fitness live streaming participants, there may be a more comprehensive discovery.

Secondly, there is a phenomenon that the survey population is too concentrated on certain age groups, which may ignore the real participation of a certain age group, such as the population under 18 years old due to the fact that most of them are junior and senior high school students, whose own use of mobile phones is less due to school requirements and academic tasks, so there is a certain degree of difficulty in the survey of them. Second, this survey in April 2023, in the normal state of life and study, the public is in the participation of live fitness after the peak, so the time and normalized life will have an impact. Although there is a certain impact, but from the study, the data covers 24 provinces and cities can basically reflect the public's willingness to participate in live fitness. 2023 April survey is only to respond to the public's views and recognition of the live fitness after the epidemic, as well as feedback on the actual experience and willingness of participants. The openness and control of the epidemic have different effects on the public's fitness, but this study analyzes the data on fitness willingness and peer effect on exercise behavior in the research, which shows that the public's fitness willingness has a positive impact on exercise behavior and participation.

Finally, this study is a research on fitness live streaming in China, and its results may be different from other countries, which is mainly due to the influence of China's convenient environment, such as smartphones and 5G networks.

### Conclusion

Fitness live streaming has emerged as a novel trend amid the epidemic, motivating individuals to engage in physical activity within the confines of their own spaces via electronic screens. Particularly in China, it serves not only as a novel exercise modality but also as a catalyst for the innovative growth of the "influencer economy" and sports industry, ushering in a new social and cultural paradigm. Nevertheless, there are lingering doubts among many regarding whether this exercise format genuinely fosters engagement in sports, prompting concerns about its future trajectory. We devised a research protocol and formulated four hypotheses, which underwent examination through questionnaires and subsequent data analysis.

Initially, our study demonstrated that gender, education level, and occupational background exert significant influences on participation in live-streaming activities. Participation in live streaming fitness exhibits variability across different age groups, educational backgrounds, and occupational categories. Particularly, women demonstrate higher emotional engagement and activity levels compared to men, while behavioral engagement peaks among individuals aged over 50. In contrast to the elderly and adolescents, office workers experience fragmented exercise schedules and are more inclined to utilize their leisure time for physical activity. The integration of online and offline exercise modalities garners broader recognition among the public. Aerobics and other trendy programs are favored by younger individuals, whereas older adults prefer health-oriented gymnastics programs. Live-streaming exercise behavior varies with age; notably, the 18-24-year-old student demographic did not exhibit a higher propensity for exercise, contrasting with their active engagement in microblogging communities, where they primarily seek entertainment and discussion. Non-participants tend to favor offline physical activities due to their belief that intensity is uncontrollable and not conducive to skill acquisition. Additionally, their average influence on peer participation in live broadcasts is lower, indicating diverse fitness needs and a lack of significant peer effect influence.

Secondly, our Pearson correlation analysis revealed that participation in fitness live broadcasts is influenced by both subjective and objective factors. Subjective factors include participants' willingness to participate and their streaming experience, while objective factors encompass their exercise level and physical ability. Our survey revealed that integrating online and offline approaches is optimal for public exercise participation, with cloud fitness and fitness live modes effectively promoting exercise willingness and catering to diverse exercise needs. Peer effect, exercise effectiveness, flow, and cognitive participation significantly influenced exercise intention, which in turn positively affected behavioral participation, ultimately enhancing exercise intention and actual participation among the population.

Thirdly, the correlation between willingness to participate in live fitness and the peer effect was found to be insignificant. The peer effect was observed to have an insignificant impact on exercise participation, partially contradicting Hypothesis 3 and deviating from prior research findings. Many individuals were observed to solely watch live streams and engage in verbal interactions without actively participating in the exercise. Despite a strong willingness to exercise, the public did not demonstrate a correspondingly high level of actual exercise behavior, contrasting with the popular discourse surrounding live-streaming fitness on the Internet. Thus, physical activity remains a crucial factor influencing public participation in sports.

Fourthly, willingness to participate in live fitness exhibits a positive correlation with exercise ability and effectiveness. Live fitness enables individuals to acquire new fitness knowledge and concepts, thereby motivating their participation in such activities. Concurrently, enhancements in physical fitness attained through live fitness contribute to achieving fitness goals and effectively alleviate psychological pressures associated with home quarantine during the epidemic. This process fosters a virtuous cycle, motivating participants to engage in exercise. Furthermore, the partial mediating role of flow in fitness live streaming indicates its influence on the phenomenon, albeit alongside the impact of anchors and training content due to the specificity of sports.

In conclusion, the proliferation of fitness live streaming amid the epidemic has incontrovertibly influenced public engagement in sports, with lasting implications for both individual fitness regimens and the sports industry. As the epidemic subsides, a resurgence of individuals returning to public stadiums for exercise has been observed. Despite a waning fervor, prominent fitness personalities maintain a robust online presence, commanding substantial followings. Notably, live fitness has transitioned towards an integrated "online + offline" paradigm (Emery, 2017), appealing to diverse fitness preferences and requirements.

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### Conflicts of interest

The authors declare no conflicts of interest.

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