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INTERPRETING EXERCISE-TYPE DIFFERENCES IN PSYCHOLOGICAL RESILIENCE: A DOSE-STRATIFIED ANALYSIS OF FITNESS AND BODYBUILDING WITH OTHER ACTIVITIES AMONG CHINESE UNDERGRADUATES

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Abstract:

Background: Exercise-type differences in psychological resilience may be difficult to interpret when activity type is confounded with exercise dose. **Objective:** To examine whether resilience differences between fitness and bodybuilding participants and participants in other physical activities persisted within exercise-dose strata, and whether exercise motivation was independently associated with resilience. **Methods:** This cross-sectional survey included 205 Chinese undergraduates classified into a fitness and bodybuilding group (n = 107) or an other-activity group (n = 98). Exercise dose was derived from intensity, duration, and frequency using the PARS-3 scoring procedure. Dose-stratified Welch t tests, Mann–Whitney U sensitivity tests, Spearman correlations, and multivariable linear regression with HC3 robust inference were conducted. **Results:** Internal consistency was high for resilience and exercise motivation (α = .960 and .945). In the low-dose stratum, the fitness and bodybuilding group had higher resilience than the other-activity group (mean difference = 17.93, 95% CI [11.20, 24.66], $p < .001$). A similar difference was observed in the moderate-dose stratum (mean difference = 21.93, 95% CI [9.81, 34.06],

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p = .003). In the high-dose stratum, the difference was not statistically significant and was imprecisely estimated (mean difference = 3.09, 95% CI [−10.94, 17.12], p = .620). The multivariable model accounted for 77.7% of the variance in resilience (R^2 = .777, adjusted R^2 = .771), and exercise motivation showed the largest independent standardized association with resilience (β = .696, p < .001). **Conclusion:** Resilience differences between exercise types varied across exercise-dose strata. Fitness and bodybuilding participation was associated with higher resilience at low and moderate doses, whereas the high-dose estimate was inconclusive. Exercise motivation showed the largest independent standardized association with resilience. These cross-sectional findings do not establish causal effects.

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Keyword:

Exercise Dose; Exercise Motivation; Exercise-Type Differences; Fitness and Bodybuilding; Psychological Resilience; Structured Exercise Context; University Students

Introduction

Psychological resilience refers to positive adaptation in the context of stress, adversity, or developmental challenge (Masten, 2007). For university students, resilience is relevant to academic demands, social adaptation, health behavior, and emotional regulation. Physical activity has increasingly been examined as a behavioral resource associated with resilience and mental health. Recent evidence indicates that physical activity is positively related to psychological resilience in youth populations (Qiu et al., 2025), and physical exercise may be associated with reduced student burnout through resilience-related mechanisms (Deng et al., 2025).

Fitness and bodybuilding participation was examined in this study not because it was assumed to be superior to other activities, but because it provides a salient example of structured exercise participation. Gym-based fitness, bodybuilding, and other resistance-oriented training often involve planned routines, progressive overload, body- and performance-related goals, training records, and visible feedback. These characteristics are consistent with established resistance-training principles, in which progression, specificity, and planned variation are central to training adaptation (American College of Sports Medicine, 2009). An uncontrolled longitudinal barbell-training study reported improvements in perceived competence and self-efficacy, while motivation-related measures were associated with selected training outcomes (Martinez Kercher et al., 2024). Because that study lacked a control group, its findings provide only preliminary evidence that structured resistance training may involve these psychological processes.

Despite this contextual relevance, studies comparing exercise types face a basic methodological problem: activity type is often confounded with exercise dose. Exercise dose includes intensity, duration, and frequency, which are central components of common physical activity rating approaches and public-health guidelines (Liang, 1994; World Health Organization, 2020). Observed resilience differences between fitness and bodybuilding participants and participants in other activities may partly reflect differences in training intensity, session duration, or frequency rather than activity context alone.

Exercise dose may not fully capture contextual characteristics of fitness and bodybuilding participation that could be psychologically relevant. Planned repetition, progressive overload, clear goals, visible bodily and performance feedback, and self-monitoring may support perceived competence and internalized regulation, which are central to self-determination theory (Deci & Ryan, 2000; Teixeira et al., 2012). Clear goals, immediate feedback, and progressive challenge are also compatible with conditions proposed to support flow experiences (Csikszentmihalyi, 1990; Jackson & Marsh, 1996).

Exercise motivation is theoretically relevant because it is associated with how physical activity is valued, sustained, and integrated into self-regulatory routines. Recent research among college students shows that different exercise motives have shown differential associations with mental health (Li et al., 2024), and that exercise motivation has also been associated with self-efficacy and mental toughness, with leisure satisfaction examined as a potential mediating factor (Yu et al., 2024). Goal setting, activity enjoyment, and recording physical activity have also been associated with college students' physical activity levels (Taylor et al., 2025).

Although previous studies have linked physical activity with psychological resilience, fewer studies have examined whether apparent differences between exercise types persist after accounting for exercise dose and whether exercise motivation is independently associated with resilience beyond exercise type and dose. Rather than treating fitness and bodybuilding as an inherently superior activity type, the present cross-sectional study uses it as a case for examining how the interpretation of exercise-type differences changes when exercise dose and motivation are considered. The research questions were: (1) How are fitness and bodybuilding participants and other-activity participants distributed across low-, moderate-, and high-exercise-dose strata? (2) Within comparable dose strata, do the groups differ in psychological resilience? (3) Is exercise motivation independently associated with resilience after accounting for exercise type, continuous exercise volume, gender, and grade?

Methods

Study Design, Ethics, and Participants

This study used a privacy-protected cross-sectional questionnaire design. The survey was conducted among undergraduates from a university in China. Before data collection, permission to conduct the study was obtained from the relevant academic department at the participating university, and institutional ethics approval was obtained from the researcher's home institution. Participants were informed of the study purpose, the voluntary nature of participation, confidentiality protections, and the research use of the data. Informed consent was obtained before questionnaire completion.

A total of 235 questionnaires were administered through online and offline formats. After invalid or low-quality responses were excluded, 205 valid questionnaires were retained for analysis, representing 87.2% of the questionnaires distributed. Data auditing identified no missing values in the core analytic variables, and no exact duplicate records were retained in the analytic dataset. Potentially identifying metadata, including submission time, IP address, school name, and department-specific information, were removed or generalized before analysis.

The analytic sample comprised 107 students who identified fitness and bodybuilding as their primary exercise activity and 98 students who identified walking, running, ball games, swimming, or other activities as their primary exercise activity. The sample included 114 men (55.6%) and 91 women (44.4%). Grade distribution was first year (n = 64), second year (n = 44), third year (n = 37), and fourth year or above (n = 60). Because of the small number of fifth-year students, the fifth-year response category was combined with the fourth-year category to form a fourth year-or-above category for analysis.

Measures

Exercise volume was assessed using the Physical Activity Rating Scale-3 (PARS-3; Liang, 1994). Intensity was scored from 1 to 5. The exported duration code (1–5) was recoded to the standard PARS-3 duration metric (0–4). Frequency was coded from 1 to 5 in ascending order of exercise frequency: ≤1 time/month = 1, 2–3 times/month = 2, 1–2 times/week = 3, 3–5 times/week = 4, and approximately daily = 5. Exercise volume was calculated as intensity × duration × frequency, yielding scores from 0 to 100. Scores were subsequently classified into low (0–19), moderate (20–42), and high (43–100) exercise-dose strata.

Psychological resilience was assessed using the 25-item Chinese version of the Connor–Davidson Resilience Scale (CD-RISC; Connor & Davidson, 2003; Yu & Zhang, 2007). For scoring, exported response codes of 1–5 was recoded to the standard 0–4 metric, yielding a total score ranging from 0 to 100, with higher scores indicating greater psychological resilience. Exercise motivation was assessed using the 15-item simplified Chinese version of the Motives for Physical Activity Measure-Revised (MPAM-R; Chen et al., 2013). The instrument comprises five dimensions with three items per dimension. Items were rated on a 5-point scale and averaged across the 15 items to obtain an overall exercise-motivation score ranging from 1 to 5, with higher scores indicating stronger exercise motivation.

Primary exercise type was self-reported. Participants who identified fitness and bodybuilding as their primary exercise activity were classified as the fitness and bodybuilding group; those reporting walking, running, ball games, swimming, or other activities were classified as the other-activity group.

Data Analysis

Cronbach's α was used to evaluate internal consistency. Within each dose stratum, group means were compared using Welch's independent-samples *t* test to accommodate unequal subgroup sizes and potential heterogeneity of variances. Mean-difference confidence intervals were calculated using the Welch standard error, and 95% confidence intervals for Cohen's *d* were estimated using 20,000 percentile bootstrap resamples with a fixed reproducibility seed. Mann–Whitney *U* tests were conducted as nonparametric sensitivity analyses. Spearman's rank

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correlations were used to examine associations involving ordinal variables or continuous variables showing substantial departures from normality.

In the multivariable linear regression model, continuous variables were standardized before analysis to facilitate comparison of effect estimates. The model estimated the independent associations of fitness and bodybuilding participation, exercise volume, and exercise motivation with resilience after adjustment for gender and grade. Multicollinearity was assessed using variance inflation factors (VIFs) and tolerance values. Because the Breusch–Pagan test indicated heteroskedasticity, HC3 robust covariance estimates were used for coefficient-level inference and the overall Wald F test. Two additional sensitivity models were examined: one excluding the high-dose stratum and one adding an exploratory participation-by-volume interaction term.

Results

Data Audit, Reliability, and Dose Distribution

The audited dataset included 205 valid cases. The core analytic variables had no missing values, and all values were within their expected ranges. The resilience and exercise motivation scales demonstrated high internal consistency (α = .960 and .945, respectively). Using the predefined exercise-dose scoring and classification procedure described in the Methods, the low-, moderate-, and high-dose strata included 104, 38, and 63 participants, respectively.

Table 1. Distribution of Exercise Type Across Exercise-Dose Strata

Dose stratum	Fitness and bodybuilding, n (%)	Other activities, n (%)	Total, n
Low dose	23 (22.1)	81 (77.9)	104
Moderate dose	29 (76.3)	9 (23.7)	38
High dose	55 (87.3)	8 (12.7)	63
Total	107 (52.2)	98 (47.8)	205

Note. Values are presented as n (row %). Percentages were calculated within each exercise-dose stratum and may not sum to exactly 100.0 because of rounding.

Dose-Stratified Comparisons

In the low-dose stratum, the fitness and bodybuilding group $n = 23, M = 66.61, SD = 11.45$ scored higher than the other-activity group $n = 81, M = 48.68, SD = 21.44$, mean difference = 17.93, 95% CI [11.20, 24.66], Welch t (68.85) = 5.32, p < .001, d = 0.91, 95% bootstrap CI [0.56, 1.33]. In the moderate-dose stratum, the fitness and bodybuilding group $n = 29, M = 76.38, SD = 7.19$ scored higher than the other-activity group $n = 9, M = 54.44, SD = 15.59$, mean difference = 21.93, 95% CI [9.81, 34.06], Welch t (9.08) = 4.09, p = .003, d = 2.26, 95% bootstrap CI [1.32, 4.09]. In the high-dose stratum, no statistically significant difference was detected between the fitness and bodybuilding group $n = 55, M = 75.96, SD = 5.52$ and the other-activity group $n = 8, M = 72.88, SD = 16.75$, mean difference = 3.09, 95% CI [−10.94, 17.12], Welch t(7.22) = 0.52, p = .620, d = 0.40, 95% bootstrap CI [−1.08, 2.37]. Mann–Whitney U sensitivity tests yielded the same significance pattern (low and moderate p < .001; high p = .102).

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Table 2. Dose-Stratified Resilience Differences by Exercise Type

Dose stratum	Groups: *n*, M (*SD*)	Mean difference [95% CI]	Welch *t*(df)	*p*	Cohen's *d* [95% bootstrap CI]
Low dose	Fitness 23: 66.61 (11.45); Other 81: 48.68 (21.44)	17.93 [11.20, 24.66]	5.32 (68.85)	< .001	0.91 [0.56, 1.33]
Moderate dose	Fitness 29: 76.38 (7.19); Other 9: 54.44 (15.59)	21.93 [9.81, 34.06]	4.09 (9.08)	.003	2.26 [1.32, 4.09]
High dose	Fitness 55: 75.96 (5.52); Other 8: 72.88 (16.75)	3.09 [−10.94, 17.12]	0.52 (7.22)	.620	0.40 [−1.08, 2.37]

Note. Positive differences indicate higher resilience in the fitness and bodybuilding group. Mean-difference confidence intervals use Welch standard errors. Cohen's *d* confidence intervals are percentile bootstrap intervals based on 20,000 resamples. The high-dose other-activity cell contained eight participants, and the corresponding confidence intervals were wide.

Correlations and Regression Models

Exercise volume was positively correlated with resilience (ρ = .592) and exercise motivation (ρ = .520), and exercise motivation was positively correlated with resilience (ρ = .738); all p < .001. In the multivariable model, exercise motivation showed the largest independent standardized association with resilience.

Table 3. Spearman Correlations Among Key Variables

Variable	Resilience	Exercise motivation
Exercise volume	.592	.520
Exercise motivation	.738	—
Competence motivation	.714	.833
Social motivation	.699	.850
Health motivation	.645	.844

Note. N = 205. Values are Spearman's rank-order correlation coefficients (ρ). All reported correlations were positive and statistically significant at p < .001 (two-sided). The overall exercise motivation score is a composite of the three motivation dimensions; therefore, correlations between the overall score and its dimensions are part–whole correlations. The em dash indicates an omitted self-correlation.

The multivariable linear regression model accounted for 77.7% of the variance in resilience (R^2 = .777, adjusted R^2 = .771). An HC3 heteroskedasticity-robust Wald F test indicated that the set of predictors was jointly associated with resilience, $F(5, 199) = 185.66$, p < .001. Among the predictors, exercise motivation showed the largest adjusted standardized association with resilience (β = .696, HC3 SE = .060, HC3 95% CI [.579, .814], p < .001).

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Table 4. Standardized Multivariable Linear Regression Predicting Psychological Resilience

Predictor	*β*	HC3 SE	*t*	*p*	HC3 95% CI	VIF	Tolerance
fitness and bodybuilding participation	.221	.064	3.44	< .001	[.094, .348]	1.876	.533
Exercise volume	.095	.039	2.44	.016	[.018, .172]	1.703	.587
Exercise motivation	.696	.060	11.68	< .001	[.579, .814]	1.605	.623
Gender	−.067	.033	−2.05	.042	[−.132, −.003]	1.065	.939
Grade	−.075	.042	−1.76	.080	[−.158, .009]	1.428	.700

Note. The outcome and all predictors, including the coded group and covariate variables, were z-standardized before model estimation. Because the Breusch–Pagan test indicated heteroskedasticity, HC3 robust standard errors, *t* tests, and 95% confidence intervals are reported. *β* = standardized regression coefficient; SE = standard error; CI = confidence interval; VIF = variance inflation factor; tolerance = 1/VIF.

In a sensitivity analysis excluding the high-dose stratum ($n = 142$), the model yielded $R^2 = .749$ and adjusted $R^2 = .739$. Adding an exploratory interaction between fitness and bodybuilding participation and exercise volume to the full-sample model produced little change in model fit ($R^2 = .778$, adjusted $R^2 = .772$; $\Delta R^2 = .001$). The interaction term was not supported by HC3 robust inference ($\beta = .116$, HC3 SE = .130, HC3 95% CI [−.141, .372], $p = .374$). Given the unequal dose-stratum cell sizes, these analyses were interpreted as exploratory sensitivity checks rather than confirmatory tests.

Discussion

This dose-stratified reanalysis indicates that exercise-type differences in psychological resilience require dose-sensitive interpretation. In the final dose classification, the low-dose stratum included 23 fitness and bodybuilding participants and 81 other-activity participants, whereas the moderate-dose stratum included 29 and 9 participants, respectively. Higher resilience was observed in the fitness and bodybuilding group in both strata. In the moderate-dose stratum, however, the standardized difference was large ($d = 2.26$) but imprecisely estimated, as reflected by the wide bootstrap 95% CI [1.32, 4.09] and the small other-activity subgroup (n = 9). These are exploratory within-stratum associations, not causal effects.

One possible contextual interpretation is theoretically plausible, but it remains untested in the present cross-sectional data. Fitness and bodybuilding training often involves clear goals, progressive challenge, repeated practice, self-monitoring, and visible feedback. These features may support perceived competence and more autonomous forms of motivation, which are central to self-determination theory (Deci & Ryan, 2000; Teixeira et al., 2012). A recent review of systematic reviews identified competence, intrinsic regulation, and identified regulation as recurring factors associated with physical activity, supporting their relevance to sustained participation (Xu et al., 2025). The same contextual features may also create conditions compatible with flow by pairing clear goals and feedback with progressive challenge (Csikszentmihalyi, 1990; Jackson & Marsh, 1996). Recent exercise research has assessed flow alongside physiological responses during physical activity, reinforcing flow as a testable exercise-process construct rather than a demonstrated mechanism in the present study (Kania et al., 2024). These processes may provide one theoretical account of why structured exercise contexts could be associated with more favourable psychological experiences. However, perceived competence, regulation quality, and flow were not measured in the present study; these proposed pathways therefore remain hypotheses for future longitudinal or intervention research.

Exercise motivation showed the strongest independent standardized association with resilience in the fitted model ($\beta = .696$). This pattern is consistent with evidence linking exercise motives with college students' mental health (Li et al., 2024) and motivation-related processes with self-efficacy and mental toughness (Yu et al., 2024). However, the cross-sectional data do not establish that motivation causes resilience or mediates an effect of exercise type. The relatively high model fit ($R^2 = .777$, adjusted $R^2 = .771$) also warrants cautious interpretation. The small difference between R^2 and adjusted R^2 and the low VIF values provide little indication of severe model overparameterization or multicollinearity. Model fit also remained high after exclusion of the high-dose stratum ($R^2 = .749$), whereas adding the participation-by-volume interaction produced negligible improvement ($\Delta R^2 = .001$). Nevertheless, exercise motivation and resilience were strongly correlated ($\rho = .738$), and both were assessed by self-report. Conceptual proximity, shared method variance, and reciprocal relationships may therefore have contributed to the observed association and high in-sample model fit.

The high-dose stratum included 55 fitness and bodybuilding participants and eight other-activity participants. The mean difference was not statistically significant (mean difference = 3.09, 95% CI [−10.94, 17.12], Welch $p = .620$), and the standardized effect was highly imprecise ($d = 0.40$, 95% bootstrap CI [−1.08, 2.37]). The wide confidence intervals and small other-activity subgroup preclude any conclusion of equivalence or absence of an exercise-type difference. Larger and more balanced high-dose samples are required.

For university health promotion, the findings suggest that exercise dose and motivational characteristics warrant consideration alongside exercise type when interpreting psychological resilience. Program features such as progressive goal setting, exercise enjoyment, training records, feedback, and supportive peer environments merit further investigation as potential correlates of psychologically beneficial exercise participation (Taylor et al., 2025). Future intervention studies should directly test whether competence-supportive exercise environments confer psychological benefits beyond those associated with exercise dose alone.

Limitations and Future Research

Several limitations should be noted. First, the cross-sectional design precludes causal or directional conclusions. Second, the dose-stratified cells remained uneven: the moderate-dose other-activity group included nine participants, and the high-dose other-activity group included eight, resulting in limited precision for the corresponding estimates. Third, all core variables were self-reported, and shared method variance, recall bias, social desirability, and the conceptual proximity between exercise motivation and resilience may have contributed to the high model fit. In addition, the reported R^2 reflects in-sample model fit; no out-of-sample

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validation was conducted, and it should not be interpreted as predictive accuracy in new samples. Fourth, the Breusch–Pagan test indicated heteroskedasticity; HC3 robust covariance estimates were therefore used for regression inference. Nonparametric sensitivity analyses were also conducted for the dose-stratified group comparisons to assess the robustness of the observed pattern. Fifth, the single-university sample limits generalizability. Future studies should use larger and more balanced multi-site samples, longitudinal or intervention designs, objective exercise records, independent validation samples, and preregistered models of motivational and experiential processes.

Conclusion

Observed differences in psychological resilience between exercise types varied across exercise-dose strata. Within the low- and moderate-dose strata, fitness and bodybuilding participation was associated with higher resilience, whereas no statistically significant difference was detected in the high-dose stratum, where the estimate was imprecise. Exercise motivation showed the largest independent standardized association with resilience in the multivariable model. These cross-sectional findings support a dose-sensitive interpretation of exercise-type differences but do not establish causal effects.

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