

Physical Activity, Mental-Health Symptoms, and Educational and Socioeconomic Context Among Students in Chinese Private Universities: A Structured Narrative Review and Evidence-Gap Analysis

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ABSTRACT:

Physical activity and mental-health symptoms are interconnected concerns in university populations, while students in private higher-education institutions may face distinctive financial, academic, institutional, and labour-market conditions. This structured narrative review and evidence-gap analysis examined what is known about physical activity and mental-health symptoms among students in Chinese private or non-public universities and how educational and socioeconomic context should inform interpretation. Sources from publisher pages, indexed full-text databases, institutional repositories, and government publications were classified into four evidence tiers: direct private-university evidence, broader Chinese student evidence, mechanistic and directional evidence, and intervention evidence. Direct evidence was sparse and institution-specific, and no identified study jointly measured physical activity and mental-health symptoms in this sector. Broader Chinese evidence generally indicated a small-to-moderate inverse association between physical activity and depressive symptoms, whereas findings for anxiety were less consistent. Measurement heterogeneity, self-report, cross-sectional designs, and pandemic context substantially limited comparability. Current evidence justifies studying this population but does not support a private-university-specific prevalence or causal estimate. Multi-institution, longitudinal, and intervention studies using comparable and preferably device-based measures are needed.

Keywords: physical activity, mental health, university students, private higher education, China

Introduction

1.1 Mental-health symptoms in university populations

University students occupy a developmental period in which academic demands, financial

concerns, social adjustment and employment expectations converge. Depression, anxiety, stress and broader psychological distress are commonly assessed with self-report screening instruments, and estimates have accumulated rapidly. A survey of 746,217 students from 108

Chinese institutions during the early COVID-19 outbreak reported probable acute stress in 34.9%, depressive symptoms in 21.1% and anxiety symptoms in 11.0% (Ma et al., 2020). A meta-analysis of 32 cross-sectional studies comprising 93,679 Chinese university students reported a pooled depression prevalence of 34.70%, with heterogeneity of 99.5% (Lin et al., 2025), whereas a nationally distributed survey of 41,620 students from 106 institutions across 31 provincial-level divisions reported depression in 9.8% and anxiety in 15.5% (Han et al., 2025).

These figures cannot be reconciled as estimates of the same quantity, and the discrepancy is instructive rather than incidental. Screening instruments identify individuals warranting further assessment; they do not estimate the population frequency of a diagnosis. Individual participant data meta-analysis has shown that a Patient Health Questionnaire-9 cut-off of 10 or more yields a pooled prevalence of 24.6% against a structured-interview prevalence of 12.1% in the same participants (Levis et al., 2020). More generally, where true prevalence sits at 10% or below, the share of a sample screening positive runs to double that figure or more, and the inflation is proportionally worst in exactly the low-prevalence groups that students represent. Screening outcomes are therefore described throughout as symptoms or risk indicators rather than disorders.

1.2 Physical activity as a modifiable factor

The case for studying physical activity rests on more than cross-sectional correlation. A meta-analysis of 15 prospective cohorts comprising 191,130 participants and 28,806 incident depression cases reported that, relative to no activity, half the recommended adult volume carried a relative risk of 0.82 (95% CI 0.77 to 0.87) and the full recommended volume a relative risk of 0.75 (95% CI 0.68 to 0.82); 11.5% (95% CI 7.7% to 15.4%) of cases were estimated to be preventable had all inactive adults reached recommended levels. A meta-analysis of 49 prospective cohorts comprising 266,939 participants and 1,837,794 person-years reported an adjusted odds ratio of 0.83 (95% CI 0.79 to

0.88) comparing high with low activity, with no detectable heterogeneity (Schuch et al., 2018).

Two features matter here. The dose-response relationship is curvilinear, and risk falls most sharply across the interval between no activity and a modest amount, so populations starting from a low base have the most to gain from small increases. And the protective association is weakest in the youngest stratum, at an adjusted odds ratio of 0.90 (95% CI 0.83 to 0.98) in youth against 0.78 in adults (Schuch et al., 2018), so evidence from middle-aged cohorts should not be transposed to students without qualification. Activity remains attractive as a target because it is modifiable, inexpensive, deliverable within existing campus structures and comparatively free of stigma; but opportunities for it depend on timetables, facilities, financial resources, social norms, academic pressure and institutional support, all of which vary systematically across institutional types.

1.3 Private higher education in China as an institutional context

China has the largest private higher-education student population in the world. The national education statistical bulletin for 2023 recorded 789 private institutions, 25.67% of all higher-education institutions, enrolling 9,943,800 undergraduate and vocational students, or 26.34% of all students at those levels. Sector expansion followed the enrolment expansion of the late 1990s and was actively encouraged as a means of widening provision without proportionate public expenditure.

The sector is not a single institutional form. Independent colleges, founded by public universities but privately financed, account for the majority of private bachelor-level registrations, while minban colleges have concentrated on shorter vocational programmes. Management fees transferred from independent colleges to parent public universities have been documented at 15% to 40% of tuition income, and although separation was ordered in 2008, more than half of approximately 480 such colleges had not completed it by the end of 2020. The governing framework was established by

the national law on the promotion of non-governmental education, promulgated in 2002 and revised in November 2016 to distinguish non-profit from for-profit private schools, with implementing regulations adopted in April 2021.

Several features are directly relevant to both exposure and outcome. Private institutions receive minimal public funding and depend heavily on tuition, are predominantly vocationally oriented, and have been characterised as recruiting mainly disadvantaged students while charging higher fees and providing lower teaching quality, a combination described as widening rather than narrowing socioeconomic gaps; quality-assurance practice in the sector has been characterised as still partly procedural in character, operating under resource constraints and difficulty in recruiting senior academic staff. In the labour market, a stratified random survey of 40,911 graduating students from 90 institutions found preference for state-sector employment essentially identical between elite and non-elite graduates, but 61% of elite-institution graduates secured state-sector positions against 46% of non-elite graduates, indicating that institutional tier rather than aspiration shapes outcomes. Across East Asia, private institutions account for more than 35% of enrolment and face intensifying financial pressure from demographic contraction, borne directly by tuition-dependent institutions.

In Guangdong Province, the provincial bulletin for 2024 recorded 179 higher-education institutions, of which 53, or 29.61%, were private: 23 regular undergraduate schools including 5 independent colleges, 2 vocational undergraduate schools, 27 higher vocational colleges and 1 adult institution. Private regular and vocational programmes enrolled 938,500 students, 34.92% of the provincial total at those levels. These figures establish institutional scale. They do not establish that students in private institutions differ from those in public institutions on any health outcome, and this review does not treat them as doing so.

1.4 Review questions

Published Chinese student studies have used the DASS-21, PHQ-9, GAD-7, CES-D, K10, SCL-90, SDS and SAS for mental-health outcomes, and the IPAQ, IPAQ-SF, GPAQ, PARS-3 and accelerometry for activity; percentages derived under different measurement rules are not interchangeable, a point developed in Section 3.2.1. Against that background, this review addressed one primary question: what is known about the relationship between physical activity and mental-health symptoms among students in Chinese private or non-public universities, and how should financial, family, academic and institutional context modify interpretation of that evidence? Secondary questions concerned the extent of direct evidence, the transferability of broader Chinese research, the contribution of mechanistic and longitudinal evidence, and the prioritisation of remaining gaps.

1.5 Conceptual framework

The review is organised around a multilevel framework in which activity and symptoms are jointly conditioned by individual, interpersonal, organisational and policy factors. This structure is empirically motivated: a synthesis of 43 articles published between 2020 and 2025, supplemented by provincial datasets of 58,472 and 176,373 students, organised the determinants of campus fitness engagement in Chinese universities along these levels and found the greatest barrier-facilitator asymmetry at the environmental level, with 14 barriers against 9 facilitators and facility accessibility the dominant constraint. Organisational barriers included the reduction of physical education to an elective in later years and the absence of professional guidance; policy-level barriers included the separation of sport from education and explicit resource inequality between institutions.

The framework matters because institutional type is not an individual attribute. Any difference between private and public students in activity or symptoms would be expected to operate through organisational and policy levels, that is through facilities, staffing, curriculum requirements, fee burden and labour-market signalling, and

through the socioeconomic composition of intake. Two consequences follow. Studies adjusting for individual covariates alone cannot isolate an institutional effect. And the absence of any identified study comparing activity by institutional type in China, discussed in Section 4.2, is a gap at exactly the level where this review's central hypothesis sits.

On the pathway from activity to symptoms, the framework draws on the mediation evidence reviewed in Section 3.3.2, in which the mediators with the strongest support are psychosocial rather than physiological. Each of those mediators is plausibly shaped by the institutional and socioeconomic conditions above, which is the substantive reason for treating context as integral rather than as nuisance covariates.

2. Methodology

2.1 Design and rationale

This manuscript is a structured narrative review and evidence-gap analysis, neither a reconstruction of an unavailable primary survey nor a new meta-analysis. No participant-level data were available, so no original prevalence estimates, correlations, regression coefficients, confidence intervals or *p* values were calculated. A narrative approach was chosen because the relevant evidence is distributed across incommensurable designs, instruments, languages and evidence types, and because the aim is to establish what the literature can and cannot support rather than to pool an effect. Reporting was guided by the SANRA domains, which assess justification of importance, statement of aims, description of the literature search, referencing, and presentation of the level of evidence and of endpoint data (Baethge et al., 2019).

2.2 Evidence identification and four-tier classification

Sources were identified from publisher pages, indexed full-text databases, institutional repositories and government publications. Search concepts combined the population (Chinese university, college, undergraduate or junior-college students; private, minban, non-public or

independent institutions), the exposure (physical activity, exercise, physical fitness, sedentary behaviour, screen time), the outcomes (depression, anxiety, stress, psychological distress) and contextual domains (tuition, financial strain, family socioeconomic background, academic pressure, campus facilities). Chinese-language and English-language sources were both eligible. Because this is a narrative review, no claim of exhaustive retrieval is made. Two access limitations affected retrieval: several Chinese-language records were available only as incomplete bibliographic entries, preventing extraction of detailed results, and certain official statistical pages were not directly retrievable, with any figure read from a mirrored reproduction identified as such in the reference list.

Evidence was classified into four tiers, with estimates attributed to their source studies rather than presented as estimates generated here. Direct evidence comprises empirical studies in an identifiable Chinese private, minban or non-public institution; contextual Chinese evidence, studies of Chinese students without a separable private-public comparison; mechanistic and directional evidence, mediation syntheses, prospective cohorts, dose-response meta-analyses and genetic-instrument studies, largely generated outside student populations; and intervention evidence, syntheses of activity interventions among college students. The tiers are ordered by directness to the review question, not by methodological quality: the later tiers contain the strongest designs but the weakest population match, and the first tier the reverse.

2.3 Appraisal and interpretive rules

Systematic reviews and meta-analyses were considered against the AMSTAR 2 critical domains, which include protocol registration, search adequacy, justification of exclusions, risk-of-bias assessment, appropriateness of meta-analytical methods, and assessment of publication bias. Where a synthesis reported a formal certainty assessment, that assessment is reproduced rather than substituted; GRADE terminology is used only where a source applied it and is not imposed on cross-sectional

evidence, for which it was not designed. Four interpretive rules were applied consistently: cross-sectional associations were not read as causal; screening outcomes were described as symptoms, not diagnoses; pandemic-period studies were treated as context-specific, since restrictions may have influenced activity and symptoms simultaneously and thereby inflated their observed association; and where a source's abstract and full text report different values, the value used is identified explicitly, so a reader checking a citation against an abstract does not mistake a correctly reported full-text figure for an error.

3. Results

3.1 Direct evidence from Chinese private universities

3.1.1 Mental-health screening in a private university

Wang and colleagues examined mental-health status among first-year students at Wenhua College, a private university in Wuhan. The study analysed 5,282 students according to its Chinese abstract, methods and tables. Its English abstract states that the Symptom Checklist-90 was administered to 6,340 freshmen and then, in the next sentence, refers to 5,282 participants. This inconsistency is present in the source rather than in its citation here; 5,282 corresponds to the analytic sample used throughout the Chinese text and tables, and the discrepancy should be resolved with the authors before any figure from this study is treated as definitive.

The study reported that 1,118 students, 21.17% of those assessed, required attention, comprising 494 classified as high risk (9.35%) and 624 as moderate risk (11.81%). Higher symptom scores were reported among students experiencing financial difficulty, academic pressure or poorer dormitory relations, and the mean total score was higher among financially disadvantaged students. These findings bear directly on the framework in Section 1.5, indicating that financial and academic for further study. Data were collected between May 2004 and January 2005 and neither activity nor mental-health symptoms were measured; the study's value here is contextual and historical,

context is associated with screening outcomes in at least one private-university setting.

The study cannot establish national prevalence. It was conducted at a single institution, used cross-sectional screening without a diagnostic reference standard, and offered no verified public-sector comparison. The SCL-90 is a symptom inventory rather than a diagnostic instrument, and its risk categories are not equivalent to caseness. The findings are therefore institution-specific evidence of an association between contextual disadvantage and screening scores, not evidence about the prevalence of disorder among Chinese private-university students generally.

3.1.2 Exercise-related evidence

A Chinese-language study of exercise characteristics and promotion strategies among students in private higher-education institutions reported 1,440 questionnaire respondents. The accessible record confirms the topic and the journal, year and issue, but exposes neither the participating institutions, the sampling design, the instrument, the activity distribution nor any effect estimate, and the sample size itself could not be independently verified; its status is recorded in the reference list. It should be cited as evidence that private-university exercise research exists, not used to report an activity prevalence. The near-absence of retrievable private-sector activity data is itself a finding; the exposure distribution in the population of interest is unknown, so any claim that private-university students are more or less active than their public-sector peers is unsupported in either direction.

3.1.3 Educational and socioeconomic context

A study of 3,624 students from five private universities in Xi'an examined family background, educational stratification and intentions to continue studying, reporting that parental education, occupation and family income were related to educational-track membership and to intentions

establishing that socioeconomic stratification of intake in the sector was documented empirically two decades ago.

A single-institution survey at Xi'an Eurasia University analysed 6,941 valid undergraduate questionnaires on satisfaction with the study experience and found education value and price the lowest-rated dimension among those reported. This is relevant to the perceived value and financial context of private higher education

and converges with the sector-level characterisation of higher fees against contested quality. The study estimated no mental-health or activity outcome, and the publication is internally circulated material without an ISSN or DOI, a status recorded in the reference list.

Table 1. Direct evidence from Chinese private or non-public universities

Study	Setting and sample	Main measure	Main reported finding	Directness and limitations
Wang et al. (2025)	One private university, Wuhan; 5,282 first-year students per methods and tables	SCL-90 and contextual questions	1,118 (21.17%) required attention: 494 high risk (9.35%), 624 moderate risk (11.81%); higher scores among financially disadvantaged students and those reporting academic or dormitory difficulties	Direct; single institution; cross-sectional; no diagnostic reference standard; denominator inconsistency between the Chinese and English abstracts
Zhang & Zhong (2022)	Private higher-education institutions; 1,440 respondents as reported	Exercise questionnaire (instrument not specified in the accessible record)	Examined exercise characteristics and promotion strategies; no extractable distribution or effect estimate	Direct in topic; detailed results and the sample size itself could not be verified from the accessible record
Shen & Yan (2006)	Five private universities, Xi'an; 3,624 valid questionnaires of 4,000 distributed	Family background and educational-track questionnaire	Parental education, occupation and family income were related to educational-track membership and intentions for further study	Direct contextual evidence; data collected 2004-2005; no mental-health or physical-activity outcome
Zhou et al. (2026)	One private university, Xi'an; 6,941 valid undergraduate questionnaires	Student-experience satisfaction survey	Education value and price was the lowest-rated dimension among those reported	Direct institutional-context evidence; no mental-health or physical-activity outcome; internally circulated publication

SCL-90, Symptom Checklist-90. Findings are attributed to the source studies and are not estimates generated by this review.

3.2 Contextual evidence among Chinese university students

3.2.1 Mental-health symptoms and the instrument problem

Large Chinese student surveys show that symptom estimates vary substantially with instrument, threshold, sampling frame and study period. Ma and colleagues analysed 746,217 valid responses from 108 institutions during the early COVID-19 outbreak, reporting acute stress in 34.9%, depressive symptoms in 21.1% and anxiety in 11.0% using the IES-6, PHQ-9 and GAD-7; recruitment was concentrated in Guangdong and Jiangxi during an acute public-health event, so it is not a baseline estimate for any subpopulation. Three further surveys illustrate the spread: 6,032 students assessed with the DASS-21 yielded anxiety complaints in 33.4%, 24,678 students assessed with the GAD-7 yielded anxiety in 7.3% (Guan et al., 2021), roughly one-fifth of the former, and 3,390

students assessed with K10 categories yielded suboptimal mental health in 24.54%. Each sample was geographically or academically restricted, and each measured a different construct under a different rule.

The most instructive comparison is internal to this literature. A meta-analysis of 32 cross-sectional studies comprising 93,679 students, in which the SDS and PHQ-9 were the most frequent instruments, reported a pooled depression prevalence of 34.70% (95% CI 30.27% to 39.26%) with heterogeneity of 99.5%. A multi-stage stratified cluster survey of 41,620 valid respondents from 106 universities across 31 provincial-level divisions, using the CES-D at a threshold of 16 or more, reported depression in 9.8%. These describe the same national population in overlapping years and differ approximately 3.5-fold. Neither is wrong; they estimate different quantities under different measurement rules.

Two features deserve emphasis. First, the meta-analysis reporting the higher figure presents subgroup analyses by institutional character, sample size, region, sex and pandemic timing, but none stratified by instrument or threshold, so its near-total heterogeneity is reported without interrogating the most obvious candidate explanation. Second, the methodological literature indicates the direction and approximate magnitude of the bias: a PHQ-9 threshold of 10 or more yields a pooled prevalence of 24.6% against a structured-interview prevalence of 12.1% in the same participants, while a threshold of 14 or more and the PHQ-9 diagnostic algorithm come closest to interview-based prevalence, with mean study-level absolute differences of 4.8% and 5.6%. Diagnostic accuracy at that threshold is nonetheless

acceptable, with pooled sensitivity of 0.88 and specificity of 0.85 against semi-structured interviews. An instrument can therefore be adequate for screening and unfit for prevalence estimation, a distinction routinely elided here. A student illustration exists: among medical students, screening-based studies reported depression in 27% against 9% in the only study using a diagnostic interview. Comparable threshold-comparison evidence for the DASS-21, K10, SCL-90 and the Zung scales could not be located, a gap of practical consequence given that the SDS drives the highest pooled Chinese estimate; for anxiety, the GAD-7 has been subjected to diagnostic meta-analysis, but its pooled operating characteristics were not retrievable here and are not quoted.

Table 2. Instruments used in the reviewed Chinese student literature and their implications for comparability

Instrument	Construct	Threshold used in the cited studies	Implication for cross-study comparison
PHQ-9 (Ma et al., 2020)	Depressive symptoms	Not stated in the cited report; 10 or more is conventional	At 10 or more, pooled prevalence is approximately twice interview-based prevalence; a threshold of 14 or more approximates it more closely (Levis et al., 2020)
CES-D (Han et al., 2025; Li et al., 2024)	Depressive symptoms	16 or more	Yields the lowest depression estimate among the cited Chinese studies; not interchangeable with SDS- or PHQ-based figures
SDS and SAS (Han et al., 2023)	Depression and anxiety (Zung)	Not standardised across studies	One of the two dominant instruments in the highest pooled Chinese estimate; no verified threshold-comparison evidence was located
DASS-21 (Yu et al., 2022)	Depression, anxiety, stress	Subscale severity bands	Produced an anxiety estimate roughly five times the GAD-7 estimate in a comparable population
GAD-7 (Han et al., 2025; Guan et al., 2021)	Anxiety symptoms	Clinical screening cut-off; more than 9 in one study	Yields substantially lower anxiety estimates than DASS-21 bands
K10 (Fan et al., 2024)	General psychological distress	Category-based	Measures distress rather than disorder-specific symptoms; not comparable with depression prevalence
SCL-90 (Wang, F., et al., 2025)	General symptom inventory	Institutional risk categories	Risk categories are not equivalent to caseness and are institution-specific

PHQ-9, Patient Health Questionnaire-9; CES-D, Center for Epidemiologic Studies Depression Scale; SDS, Self-Rating Depression Scale; SAS, Self-Rating Anxiety Scale; DASS-21, 21-item Depression Anxiety Stress Scales; GAD-7, Generalized Anxiety Disorder-7; K10, Kessler Psychological Distress Scale; SCL-90, Symptom Checklist-90.

3.2.2 Physical activity levels and campus determinants

No meta-analysis pooling the prevalence of physical inactivity specifically among Chinese university students was identified, and this absence should be stated rather than filled by extrapolation from school-age or adult estimates. The available evidence comes from national fitness surveillance and single-site surveys.

An analysis of five waves of national survey data collected between 2019 and 2023, comprising 58,892 students aged 16 to 21 from 31 provincial-level divisions, reported that thinness declined from 13% to 8.3% while overweight and obesity rose from 21.5% to 28.6%, and that the median physical fitness index fell from -0.1 to a nadir of -2.2 in 2022 before recovering to -1.0 by 2023. Critically for the socioeconomic argument here,

provinces in the east began from a higher fitness baseline and lost less ground, whereas in the west the decline exceeded a full standard deviation, so the gap between regions widened. This measures fitness rather than activity volume and should not be presented as an activity prevalence figure, but it establishes that population trends in this age group have been unfavourable and unevenly distributed.

Two Guangdong surveys provide distributions using standardised instruments. Among 406 students in Zhuhai assessed with the IPAQ-SF, 17.24% were classified as low activity, 43.35% moderate and 39.41% high; low activity was associated with significantly lower physical health-related quality of life among male students, but no meaningful association was found with the mental-health component, which the authors attributed to academic pressure acting independently. Among 253 students at a Guangdong university, 80.6% were sedentary as defined by sitting seven or more hours daily, with mean daily sitting exceeding ten hours in most subgroups and a disciplinary gradient from 71.7% in medicine to 84.9% in science and engineering. Both are single-institution studies with modest samples, cited as illustrative rather than as prevalence estimates.

On determinants, the multilevel synthesis introduced in Section 1.5 identified self-efficacy as the strongest individual facilitator and academic pressure as the primary barrier, and found that mandatory physical education curricula raised the probability of independent exercise by 20.2%. A qualitative study of 21 second-year undergraduates identified 27 barriers and 36 facilitators, with opportunity and motivation most influential; barriers included inadequate facilities and equipment, gender-related discomfort in exercise settings and academic workload disrupting routine consistency, while facilitators included accessible facilities, credit-based rewards and mandatory activity policies. A systematic review of 15 studies found students held back principally by competing academic demands on their time, by what facilities are actually available to them, and by the absence of qualified instruction. These

sources converge, and every constraint they name, namely facilities, timetable, curriculum status and professional staffing, is institutional rather than individual, and is therefore precisely the kind of factor on which private and public institutions might differ.

3.2.3 Physical activity and mental-health symptoms

Li and colleagues conducted the most directly relevant of the broader Chinese studies, surveying 30,475 valid respondents at 104 institutions across 31 provincial-level divisions and assessing activity with the IPAQ-SF and symptoms with the CES-D and GAD-7 (Li et al., 2024). Low activity predominated. After adjustment, moderate and vigorous activity were associated with lower odds of depressive symptoms relative to light activity: in the fully adjusted model, which entered activity together with sleep duration and sleep quality, the odds ratio was 0.560 (95% CI 0.484 to 0.645) for moderate and 0.694 (95% CI 0.581 to 0.825) for vigorous activity. Activity category was not independently associated with anxiety. The corresponding estimates in the study's abstract, from a less fully adjusted model, are 0.596 (95% CI 0.519 to 0.683) and 0.697 (95% CI 0.588 to 0.824); the fully adjusted values are used here and the distinction is stated so the citation can be checked without apparent contradiction.

These findings support plausibility but provide no private-university-specific estimate, since institutional type was not separated. The study was cross-sectional, relied on self-reported activity, was conducted during the COVID-19 period and included students who had returned to campus, so residual confounding and reverse causation remain possible. The divergence between the depression and anxiety results indicates that associations vary by outcome and should not be summarised as a single effect across depression, anxiety and stress.

Two independent meta-analyses converge on magnitude. One analysed 36 studies, with 30 contributing to a correlation analysis of 30,307 participants, reporting a pooled Pearson correlation of -0.19 (95% CI -0.28 to -0.11) with

heterogeneity of 94.4%, falling to -0.114 (95% CI -0.209 to -0.016) after trim-and-fill adjustment; in its binary analysis, physical activity was not significantly associated with depression (OR 0.53, 95% CI 0.27 to 1.07) whereas sedentary behaviour was (OR 1.60, 95% CI 1.26 to 2.04). The other analysed 38 studies comprising 28,540 students and reported a pooled correlation of -0.238 (95% CI -0.307 to -0.173) with heterogeneity of 97.45%, with the strongest subgroup association at moderate rather than the highest intensity (-0.428). A China-specific meta-analysis of ten moderate-quality pandemic-period studies likewise reported that higher activity was associated with reduced risk of both depression and anxiety, concluding that strengthening university physical education provision could raise participation.

Two points follow. The convergence of two independent meta-analyses on a correlation between approximately -0.19 and -0.24 is reassuring as to direction and indicates a small-to-moderate rather than a large association, and the strongest association appearing at moderate intensity is a corrective to a dose-maximising reading, consistent with the curvilinear dose-response described in Section 3.4.1. But the authors of the first synthesis state that their evidence base is geographically skewed toward Chinese samples, with most included studies incompletely controlling confounders, so their pooled values are better read as indicating the direction of an average association than as an effect size that would hold in any particular sample. That candour cuts both ways: the evidence is unusually relevant to a Chinese population and unusually weak in internal validity.

Smaller studies report the same direction: 376 students at a Shanghai sports university during school confinement and 251 students at one college in Jinan both showed inverse associations between activity and depression and anxiety. Both are limited by single-institution or convenience sampling under exceptional pandemic conditions, and a sports-university sample is unlikely to represent activity distributions elsewhere.

3.2.4 Sedentary behaviour as a distinct exposure

Sedentary behaviour warrants separate treatment because it is not simply the absence of activity, and because sedentary distributions reported in Chinese student samples are extreme. A meta-analysis of 12 prospective studies comprising 128,553 participants reported an overall relative risk of depression of 1.10 (95% CI 1.03 to 1.19), but the risk was confined to specific forms: television viewing carried a relative risk of 1.18 (95% CI 1.07 to 1.30) and mentally passive sedentary behaviour 1.17 (95% CI 1.08 to 1.27), whereas computer use (0.99, 95% CI 0.79 to 1.23) and mentally active sedentary behaviour (0.98, 95% CI 0.83 to 1.15) were not significantly associated. This distinction is directly consequential for students, whose sedentary time is dominated by study and screen-based academic work that would generally classify as mentally active, and it cautions against inferring that prolonged sitting is harmful per se.

A meta-analysis of 19 studies comprising 232,581 participants reported an odds ratio of 1.28 (95% CI 1.17 to 1.39) for screen-time sedentary behaviour and depression, rising to 1.46 (95% CI 1.25 to 1.71) at two or more hours daily, with a significant association among female but not male participants. That the estimate at two or more hours exceeded the estimate at four or more is not a monotonic gradient and probably reflects differing study sets; with heterogeneity of 89%, the pooled value is indicative only.

The most useful evidence on joint effects comes from a dose-response meta-analysis of 51 studies comprising 1,318,687 participants, which reported an odds ratio of 1.09 (95% CI 1.05 to 1.13) for the highest versus lowest sedentary category and 0.91 (95% CI 0.86 to 0.96) for moderate-to-vigorous activity, with risk rising approximately 4% per additional daily hour of sedentary time. Decisively, after mutual adjustment the sedentary association was no longer significant (OR 1.02) while activity remained protective independent of sedentary time. Read alongside the mentally passive and active distinction, this suggests that sedentary time matters for mental health chiefly as a marker

of displaced activity rather than as an independent exposure. The caveat is substantial: that population comprised adults and older adults

rather than students, so the mutual-adjustment finding is an extrapolation.

Table 3. Contextual evidence from Chinese university students

Study	Sample and setting	Activity measure	Mental-health measure	Main reported result	Key limitation
Li et al. (2024)	30,475 valid responses, 104 institutions, 31 provincial-level divisions	IPAQ-SF	CES-D and GAD-7	Moderate activity OR 0.560 (0.484-0.645) and vigorous 0.694 (0.581-0.825) for depressive symptoms in the fully adjusted model; no independent association with anxiety	Cross-sectional; self-report; institutional type not separated; pandemic period
Wang et al. (2026)	36 studies; 30,307 participants in the correlation analysis	Mixed (PARS-3, IPAQ, GPAQ, accelerometry)	Mixed (BDI, PHQ-9, SDS, CES-D, DASS)	Pooled r -0.19 (-0.28 to -0.11), I-squared 94.4%; sedentary behaviour OR 1.60 (1.26-2.04) where activity OR was non-significant	Extreme heterogeneity; evidence base skewed to Chinese samples; incomplete confounder control in most studies
Huang et al. (2025)	38 studies; 28,540 college students	Mixed	Mixed	Pooled r -0.238 (-0.307 to -0.173); strongest at moderate intensity (-0.428)	I-squared 97.45%; cross-sectional dominance; Asian-concentrated samples
Sun & Cheng (2026)	58,892 students aged 16-21, five waves 2019-2023, 31 provincial-level divisions	Physical fitness index (not activity volume)	Not assessed	Overweight and obesity rose from 21.5% to 28.6%; fitness declined, with sharper falls in western regions	Measures fitness, not activity; no mental-health outcome
Tao et al. (2025a)	406 students, Zhuhai	IPAQ-SF	SF-12 mental component	Low 17.24%, moderate 43.35%, high 39.41%; no meaningful association with the mental-health component	Single city; modest sample; not a prevalence estimate
Tao et al. (2025b)	253 students, one Guangdong university	CSBQ	Not assessed	80.6% sedentary at 7 or more hours daily; medicine 71.7% versus science and engineering 84.9%	Single institution; small sample; illustrative only
Ma et al. (2020)	746,217 students, 108 colleges, early COVID-19 outbreak	Not the primary exposure	IIES-6, PHQ-9, GAD-7	Acute stress 34.9%, depressive symptoms 21.1%, anxiety 11.0%	Pandemic-specific; recruitment concentrated in Guangdong and Jiangxi
Yu et al. (2022)	6,032 students, four economic regions	IPAQ	DASS-21	Depression 27.3%, anxiety 33.4%, stress 12.0%	Rehabilitation-related majors; online sampling
Lin et al. (2025)	32 cross-sectional studies; 93,679 students	Not applicable	Mixed, chiefly SDS and PHQ-9	Pooled depression prevalence 34.70% (30.27-39.26%)	I-squared 99.5% with no subgroup analysis by instrument or threshold
Han et al. (2025)	41,620 valid responses, 106 universities, 31 provincial-level divisions	Not the primary exposure	CES-D (16 or more) and GAD-7	Depression 9.8%, anxiety 15.5%, comorbidity 6.5%	Cross-sectional; institutional type reported but not analysed as an exposure

IPAQ-SF, International Physical Activity Questionnaire Short Form; GPAQ, Global Physical Activity Questionnaire; PARS-3, Physical Activity Rating Scale-3; BDI, Beck Depression Inventory; SF-12, 12-Item Short Form Health Survey; CSBQ, Chinese Sedentary Behaviour Questionnaire. Other abbreviations as in Table 2.

3.3 Mechanisms of plausibility

3.3.1 Biological pathways

The most studied biological candidate is brain-derived neurotrophic factor. A systematic review spanning 100 manuscripts and two decades reported that circulating concentrations rose after acute exercise or short-term training in 76% of the studies it examined, across modalities and in

healthy and clinical populations. The same review reported a negative finding of equal importance: acute and short-term studies failed to establish a direct association between reduction in depression severity and change in peripheral concentrations, partly because levels return towards baseline rapidly after exercise ceases. The factor is thus a demonstrated response to exercise but not a demonstrated mediator of symptom

change, and cross-study comparison is complicated further by the substantial difference between plasma and serum measurement. Broader reviews describe additional candidates, including skeletal-muscle signalling and tryptophan metabolism, the irisin axis, modulation of hypothalamic-pituitary-adrenal axis function, hippocampal neurogenesis, increased monoamine availability, and reductions in pro-inflammatory cytokines. These accounts are narrative rather than quantitative and are cited for mechanistic architecture rather than effect magnitude, with the tissue source of irisin and blood-brain barrier transit for muscle-derived factors both unresolved.

3.3.2 Psychosocial pathways

The best-evidence synthesis of 247 mediation and moderation studies comprising 2,436,311 participants reached a conclusion with direct bearing on how this literature should be read: mediators with strong supporting evidence are predominantly psychological and social rather than physiological. Twelve met the strong-evidence threshold, including affect, self-esteem, self-efficacy, physical self-worth, body-image satisfaction, resilience, social support and social connection, with mediation supported in 100% of eight effects for self-esteem and 94% of seventeen for self-efficacy. Inflammation reached only moderate evidence and evidence for sleep was insufficient or conflicting. The authors note that no meta-analysis was possible, that most included studies were cross-sectional, and that publication bias is likely because non-significant mediation results often go unpublished. A two-wave longitudinal study of 1,350 Chinese university students over three months quantified this pathway in the population of interest, finding that psychological resilience mediated 34.78% of the total effect and social support 13.04%; that study was conducted at a public university, so it supports the mechanism without speaking to private-sector specificity.

3.3.3 Why mechanisms matter for the institutional argument

If the operative mediators are self-efficacy, self-esteem, resilience and social support, the

institutional and socioeconomic conditions described in Section 1.3 are not confounders to be adjusted away but plausible determinants of the mediators themselves: financial strain, weaker labour-market signalling and constrained facilities could each depress self-efficacy and social connection while simultaneously reducing opportunities for activity. Hence a study reporting a single activity coefficient net of individual covariates may miss the phenomenon of interest, and an intervention effect obtained in a well-resourced public institution cannot be assumed to transfer to a tuition-dependent private one.

3.4 Dose-response and the direction of effect

3.4.1 Dose-response

Dose-response evidence is more informative for practice than a binary contrast of active against inactive. The prospective meta-analysis introduced in Section 1.2 found that most of the modelled risk reduction had accrued by the point at which participants reached the recommended adult minimum, beyond which the curve flattened and the confidence intervals widened. A prospective cohort of 74,715 adults followed for a median of 7.9 years, using accelerometer-derived activity and recording 3,089 incident depression cases, reported a hazard ratio of 0.67 (95% CI 0.60 to 0.74) at 280 minutes per week of moderate-to-vigorous activity and an optimum around 875 minutes per week (HR 0.54, 95% CI 0.46 to 0.63), with each additional minute counting for most within the first four to five hours of the week; a concentrated weekend pattern (HR 0.72) and a regularly distributed one (HR 0.75) performed almost identically, which points to how much activity is accumulated rather than to how it is spread across the week. The dose-response meta-analysis discussed in Section 3.2.4 converges on this shape, reporting roughly a 20% reduction in risk per additional five minutes per day below 35 minutes of moderate-to-vigorous activity.

Three implications follow. Where baseline activity is low, small absolute increments plausibly carry disproportionate benefit, favouring low-threshold provision over intensive

programming. That pattern matters less than volume is relevant to students whose activity is concentrated into physical education blocks or weekends. And the association being strongest at moderate rather than maximal intensity is consistent with this shape. All these estimates derive from adult cohorts assessed against WHO thresholds ; none was generated in a student sample.

3.4.2 Direction of effect

Three lines of evidence bear on directionality and do not agree in a simple way. Prospective cohort evidence establishes temporal precedence, with activity measured before incident depression across a mean follow-up of 7.4 years and an adjusted odds ratio of 0.83, though with the weakest estimate in the youngest stratum. A two-sample Mendelian randomisation study using a combined sample of 611,583 individuals found an asymmetric rather than bidirectional relationship: genetically predicted accelerometer-based activity was associated with lower odds of major depression (inverse-variance weighted OR 0.74, 95% CI 0.59 to 0.92), whereas genetic liability to depression did not predict reduced activity (beta -0.08, 95% CI -0.47 to 0.32). Crucially, the protective estimate appeared only for accelerometer-based activity and not for self-reported activity (OR 1.28, 95% CI 0.57 to 3.37), a direct warning about the self-report instruments dominating the Chinese student literature. The authors note that the MR-Egger estimate was non-significant, so horizontal pleiotropy is not fully excluded, and that samples were predominantly of European ancestry and adult age.

Against this, the two-wave longitudinal study in Chinese university students found genuine bidirectionality with near-symmetric coefficients: depressive symptoms at baseline predicted lower exercise three months later (beta -0.07) and exercise at baseline predicted lower depressive symptoms (beta -0.08), both significant. The coefficients are small, the interval short, and the design single-institution and entirely self-reported. The reasonable reading is that a protective effect is supported by the strongest available designs, that reverse causation is

plausible and has been observed over short intervals in this population, and that the two are not mutually exclusive. For a cross-sectional study in Chinese private universities, an observed inverse association should therefore be reported as consistent with, but not evidence of, a protective effect.

3.5 Intervention and systematic-review evidence

Three intervention-focused syntheses reported reductions in depressive symptoms among college or undergraduate students. A systematic review and meta-analysis of 59 undergraduate studies reported, in its 14-study depression synthesis, a standardised mean difference of -0.73 (95% CI -1.00 to -0.47) with heterogeneity of 49.66%, alongside -0.88 (95% CI -1.23 to -0.52) for anxiety across 20 studies and -0.61 (95% CI -0.94 to -0.28) for stress across 10 studies. A second reported -0.75 (95% CI -0.98 to -0.53) across ten studies drawn from eight articles and comprising 495 participants (Zhang et al., 2024). A third reported -0.63 (95% CI -0.80 to -0.46) for depressive mood and -0.58 (95% CI -0.71 to -0.44) for anxiety across randomised trials of college students.

These are reported results from the source reviews, not pooled or recalculated here. The reviews differ in eligibility criteria, modalities, outcome instruments, populations and study quality, and their constituent primary studies probably overlap, so their apparent agreement is not three independent replications. The most comprehensive of them rated 47 of its 59 included studies as weak on the Effective Public Health Practice Project appraisal and assigned very low GRADE certainty to every outcome . Against the AMSTAR 2 critical domains, the recurring weaknesses are incomplete justification of exclusions and limited consideration of risk of bias when interpreting pooled results.

A recent synthesis in the adjacent age band offers a corrective to the apparent size of these effects. A meta-analysis of 24 studies of activity interventions in children and adolescents, contributing 38 effect estimates, reported a pooled standardised mean difference of only 0.19

(95% CI 0.09 to 0.30) with heterogeneity of 48%. Effects differed significantly by intervention type: mind-body interventions achieved 0.32 (95% CI 0.15 to 0.49) and multicomponent behavioural interventions 0.18 (95% CI 0.01 to 0.35), whereas sports and games (0.09) and conventional aerobic or fitness training (0.05) were not statistically significant. Benefit was concentrated among participants at higher baseline risk (0.31, 95% CI 0.14 to 0.48) compared with general-population samples (0.16, 95% CI 0.07 to 0.25) (Liu, Q., et al., 2026). If this pattern holds in tertiary populations, intervention modality and targeting strategy matter more than activity volume alone, and universal aerobic provision may be the least effective available option.

Two further reviews contribute contextual rather than effect evidence. The systematic review of physical exercise among Chinese college students located the main obstacles in competing academic demands, in facility availability and in whether qualified instruction is provided but provided no private-versus-public subgroup synthesis. A systematic review of 49 mental-health intervention studies among Chinese undergraduates studying in China similarly found heterogeneous approaches and no verified private-public subgroup analysis. Both are useful for identifying intervention domains and research gaps, not for estimating a private-university-specific effect.

Table 4. Previously published systematic reviews and meta-analyses

Review	Population and evidence base	Reported estimate	Interpretation for private universities
Huang et al. (2024)	59 undergraduate studies; intervention and non-randomised designs	Depression SMD -0.73 (-1.00 to -0.47), 14 studies, I-squared 49.66%; anxiety -0.88 (-1.23 to -0.52), 20 studies; stress -0.61 (-0.94 to -0.28), 10 studies	Suggests potential benefit, but quality was weak in 47 of 59 studies and GRADE certainty very low for every outcome; direct private-sector relevance not established
Zhang et al. (2024)	10 studies from 8 articles; 495 college students	Depression SMD -0.75 (-0.98 to -0.53), I-squared 36%	Small evidence base and heterogeneous scales; not private-university-specific
Huang, Wang, & Zhang (2023)	Randomised trials of college students	Depressive mood SMD -0.63 (-0.80 to -0.46), I-squared 63%; anxiety -0.58 (-0.71 to -0.44), I-squared 36%	Supports intervention plausibility but includes heterogeneous Chinese and international college samples
Liu, Q., et al. (2026)	24 studies in children and adolescents; 38 effect estimates	Overall SMD 0.19 (0.09 to 0.30); mind-body 0.32, multicomponent 0.18, sports and games 0.09 (ns), aerobic 0.05 (ns); higher baseline risk 0.31 versus general population 0.16	Adjacent age band; indicates that modality and targeting may matter more than volume, and that universal aerobic provision may be least effective
Pan et al. (2022)	15 studies of Chinese college students	Descriptive synthesis of activity patterns and barriers	Useful for contextualising facilities, timetable and guidance constraints; no private-public subgroup synthesis
Shan et al. (2022)	49 mental-health intervention studies among Chinese undergraduates	Qualitative synthesis without a pooled estimate	Useful for intervention context; no private-public subgroup synthesis

SMD, standardised mean difference; ns, not statistically significant; GRADE, Grading of Recommendations Assessment, Development and Evaluation.

. Discussion

4.1 Integrated synthesis

Six conclusions emerge from the four tiers of evidence.

Direct evidence from Chinese private universities exists but is concentrated in single institutions with heterogeneous designs and

outcomes, and no identified direct study measured activity and symptoms in the same sample. It is therefore insufficient to estimate the prevalence of depression, anxiety, stress or physical activity in this sector, or their association within it.

Broader Chinese evidence generally supports an inverse association between higher activity and depressive symptoms. The largest IPAQ-based study reported lower odds of depression with moderate or vigorous activity after full adjustment, and two independent meta-analyses converge on a pooled correlation of approximately -0.19 to -0.24. The same large study found no independent association with anxiety, indicating that associations vary by outcome and cannot be summarised as a universal effect across depression, anxiety and stress.

Mechanistic, dose-response and longitudinal evidence strengthens plausibility while constraining how cross-sectional Chinese findings may be read. Prospective and Mendelian randomisation evidence supports a protective direction, the dose-response relationship is curvilinear and its gradient is sharpest where activity is lowest, and the operative mediators appear predominantly psychosocial. But the protective genetic estimate appeared only for device-measured activity, the prospective association is weakest in the youngest stratum, and bidirectionality has been observed over three months in Chinese students.

Intervention reviews report reductions in depressive symptoms, but with heterogeneity, weak study quality, probable overlap between reviews and very low certainty. Evidence from the adjacent age band suggests pooled effects may be small and concentrated in mind-body and multicomponent modalities and in higher-risk participants rather than in universal aerobic provision. These syntheses justify studying activity promotion; they do not establish that a particular programme would work in Chinese private universities.

Measurement heterogeneity is a first-order determinant of reported findings rather than a peripheral caveat. Depression estimates among Chinese university students differ approximately 3.5-fold between a meta-analysis dominated by the SDS and PHQ-9 and a national survey using the CES-D at 16 or more, and screening thresholds routinely yield at least twice the

interview-based prevalence in low-prevalence populations. Any new study must report its instrument and threshold prominently and refrain from comparing its percentages with figures obtained under different rules.

Financial, academic, family and institutional factors recur as plausible contextual modifiers, and the mechanistic evidence explains why. Direct private-university studies link screening outcomes or educational experience to financial hardship, academic pressure, dormitory relations, family background and perceived education value, and the campus-determinants literature locates the principal barriers at organisational and policy levels. No verified joint model links private-university status, activity, socioeconomic context and symptoms.

4.2 Evidence gaps and research agenda

Three gaps identified here are structural, in that they cannot be closed by adding further studies of the existing design. The first is the absence of any identified study comparing physical activity by institutional type in China: none compares private with public institutions, or stratifies by institutional resource level, on any activity outcome. The closest proxies are the regional fitness inequality in national surveillance and the identification of resource inequality as a policy-level barrier. This gap sits at precisely the level where this review's central hypothesis is located.

The second is the absence of any identified study quantifying the private-public institutional resource gap on measures such as staff-student ratio, expenditure per student, sports facility provision or opening hours. The sector-level literature supports claims of lower teaching quality and higher fees and documents asymmetric funding flows from independent colleges to parent institutions, but no verified study converts this into comparable institutional indicators. Without them, institutional type remains a label rather than a measured exposure. The third is the absence of verified threshold-comparison evidence for the instruments that dominate the Chinese literature: the PHQ-9 has been evaluated against structured interviews, but no equivalent evidence was located for the

DASS-21, K10, SCL-90 or the Zung scales, despite the SDS driving the highest pooled Chinese estimate. Until such evidence exists, prevalence figures generated with these instruments cannot be calibrated against any diagnostic standard.

On design, future research should recruit from multiple private and public institutions, identify institutional type explicitly, report sampling in enough detail for representativeness to be assessed, use comparable measures, report denominators and missing data transparently, and distinguish screening symptoms from diagnoses. Given that the protective genetic estimate appeared only for device-measured activity, device-based measurement in at least a validation subsample should be a priority rather than a refinement. Longitudinal work is needed to clarify temporal ordering, since the existing Chinese longitudinal evidence spans only three months within a single institution; a prospective design could test whether baseline activity predicts later symptoms, whether symptoms predict subsequent reductions in activity, or whether both track time-varying academic and

financial stress. Intervention studies should pre-specify dose, monitor adherence, report adverse events and include implementation outcomes relevant to private institutions, and in light of the modality differences in the adjacent age band should compare mind-body and multicomponent approaches against conventional aerobic provision rather than against no intervention alone.

Measurement of context should be a substantive requirement rather than a set of nuisance covariates. Future studies should measure tuition burden and financial strain, family socioeconomic background, academic pressure, sleep, social support, facility availability and opening hours, and access to psychological services. Because the strongest-evidenced mediators are psychosocial, self-efficacy, self-esteem, resilience and social support should be measured as candidate mediators rather than assumed. Their inclusion would let institutions evaluate whether activity promotion should be combined with financial, academic and mental-health support rather than delivered alone.

Table 5. Evidence-gap matrix and research priorities

Domain	What is established	What is missing	Priority design
Prevalence of symptoms in private universities	Institution-specific screening data from one private university (Wang, F., et al., 2025)	Any multi-institution estimate; any estimate calibrated against a diagnostic standard	Multi-institution survey with a single pre-specified instrument and threshold, plus a diagnostic-interview subsample
Physical activity in private universities	That research on the topic exists (Zhang & Zhong, 2022)	The activity distribution itself; any private-public comparison	Multi-institution survey with IPAQ-SF plus device-based measurement in a validation subsample
Association of activity with symptoms	Inverse association with depression in Chinese students generally (Wang et al., 2026; Li et al., 2024; Huang et al., 2025); no independent association with anxiety in the largest study	Any within-private-sector estimate; any outcome-specific explanation of the depression-anxiety divergence	Cross-sectional multi-institution study powered for institution-type interaction, followed by a prospective wave
Institutional context as exposure	Sector-level characterisation of fees, funding and intake (Liu et al., 2022; Xu, 2021; Li, H., et al., 2024); organisational and policy barriers (Fang & Liu, 2026)	Comparable institutional indicators (staff-student ratio, expenditure per student, facility provision and opening hours)	Linkage of student-level survey data to institution-level administrative indicators
Mechanism	Psychosocial mediators carry the strongest evidence (White et al., 2024); resilience and social support mediate in Chinese students (Hou et al., 2025)	Whether institutional and financial conditions shape those mediators	Multilevel longitudinal mediation model with institution as a level

Intervention	Reductions in depressive symptoms across three college-student syntheses, at very low certainty (Huang et al., 2024; Zhang et al., 2024; Huang, Wang, & Zhang, 2023)	Any trial conducted in a Chinese private institution; head-to-head modality comparison	Pragmatic cluster-randomised trial across private institutions with implementation outcomes
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4.3 Strengths and limitations of the present review

The principal strength of this review is its explicit separation of direct private-university evidence from contextual, mechanistic and intervention evidence, which reduces the risk of presenting general student results as though specific to private institutions and makes the basis of each claim auditable. Measurement heterogeneity is treated as a substantive finding supported by a contrast internal to the reviewed literature, and verification status is reported at the level of the individual reference.

The limitations are important. This is a narrative rather than a systematic review: no protocol was registered, retrieval was not exhaustive, and selection was not performed in duplicate, so selection bias cannot be excluded. The evidence is heterogeneous in population, instrument, threshold, period and design, and much of it is cross-sectional and self-reported. Several studies were conducted during the COVID-19 period, limiting comparison with ordinary campus conditions and potentially inflating observed associations. Direct private-sector evidence is sparse and often institution-specific, and some Chinese-language studies were accessible only as incomplete records. The systematic reviews included here may overlap in their constituent primary studies, so their agreement overstates the independence of the evidence. Much of the strongest mechanistic and directional evidence derives from middle-aged adult cohorts of predominantly European ancestry, so transfer to Chinese students is an assumption rather than a

demonstration. Finally, the raw survey data originally intended to support this line of work were unavailable; this review cannot validate or recover the numerical results originally planned, and makes no attempt to do so.

4.4 Implications

The evidence supports cautious, multi-component campus strategies rather than single-component activity promotion. Private universities may consider extending accessible activity opportunities, improving facility provision and opening hours, and providing professional guidance, while integrating these with academic-stress support, financial assistance and mental-health screening with clear referral pathways. Three features of the evidence shape the specifics. Because the dose-response gradient is steepest at the lowest volumes, low-threshold provision that moves the least active students should yield more benefit per unit of institutional effort than intensive programming for the already active. Because total volume appears to matter more than weekly distribution, provision concentrated where timetables permit is not inherently inferior. And because effects in the adjacent age band were significant for mind-body and multicomponent interventions but not for aerobic or sports provision, and were concentrated among higher-risk participants, targeted and modality-diverse provision merits consideration over universal aerobic programming.

Two cautions apply. The barriers documented in this literature are institutional, namely facility accessibility and opening hours, the elective status of physical education in later years, and the availability of professional guidance, so interventions addressed to individual motivation alone are unlikely to suffice. And none of these recommendations rests on evidence generated in a Chinese private institution: they are implementation hypotheses to be evaluated, not proof that physical activity alone prevents depression or anxiety in this population.

5. Conclusion

Available evidence indicates that physical activity is associated with fewer depressive symptoms

among Chinese university students, that the association is small to moderate and heterogeneous, and that it is not consistently observed for anxiety. Prospective, dose-response and genetic-instrument evidence supports a protective direction whose gradient is sharpest at the lowest levels of activity, but derives almost entirely from adult populations and, for the strongest estimate, only from device-measured activity; reverse causation has been observed over short intervals in Chinese students. Intervention syntheses report reductions in depressive symptoms at very low certainty, with effects that may be concentrated in specific modalities and in higher-risk participants. Direct evidence from Chinese private universities remains sparse,

institution-specific and predominantly cross-sectional, and no identified study has measured activity and symptoms together in this sector or compared activity by institutional type. The literature therefore does not justify a private-university-specific causal estimate or a nationally representative prevalence figure. Multi-institution, longitudinal and intervention studies that identify institutional type, measure socioeconomic and academic context, use comparable and preferably device-based measures, and report transparent denominators are needed to determine how physical activity interacts with the financial, academic, family and institutional conditions of private higher education.

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8. Author Declaration

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