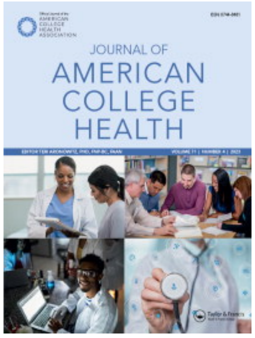

Journal of American College Health

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/vach20

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To cite this article: Buwen Yao, Sandy C. Takata, Wendy J. Mack & Shawn C. Roll (2023) Modeling extracurricular activity participation with physical and mental health in college students over time, Journal of American College Health, 71:4, 1232-1240, DOI: 10.1080/07448481.2021.1926263

To link to this article: https://doi.org/10.1080/07448481.2021.1926263

Published online: 09 Jul 2021.

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JOURNAL OF AMERICAN COLLEGE HEALTH
2023, VOL. 71, NO. 4, 1232–1240
https://doi.org/10.1080/07448481.2021.1926263

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Modeling extracurricular activity participation with physical and mental health in college students over time

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ABSTRACT

Objective: To describe extracurricular activity participation and explore its relationship with college students' health. **Participants:** 159 college students majoring in dental hygiene or occupational therapy. **Methods:** Data were collected prospectively at baseline, one- and two-year follow-ups. Self-reported participation in extracurricular activities over the past six months was grouped into eight categories: Fitness, Sports, Creative arts, Leisure, Social, Work, Caregiving, and Animal care. Physical and mental health were measured using SF-36, a valid tool measuring general health. **Results:** Participation in fitness, sports, creative arts, and work significantly decreased at one-year and two-year follow-ups ($p < 0.01$). Work/volunteer activity participation was associated with poorer physical health ($\beta = -1.4$, 95% CI: (−2.2, −0.5), $p < 0.01$), but a change from nonparticipation to some participation in work/volunteer activity was associated with better mental health ($\beta = 2.6$, 95% CI (0.3, 4.9), $p = 0.04$). **Conclusions:** Educators should consider the potential impact of maintaining extracurricular activities on college students' health when designing academic courses.

ARTICLE HISTORY
Received 5 August 2020
Revised 13 April 2021
Accepted 2 May 2021

KEYWORDS
College student; extracurricular activity; health; SF-36; well-being

Introduction

The adjustment from high school to university is a challenging transition.[1] First-year students are at high risk of attrition from college,[2] and about a quarter of those students do not return for a second year.[3] This major life transition is accompanied by a change in social roles and contexts, both of which can adversely impact the health and well-being of college students.[4,5] In this transition from adolescence to adulthood, more responsibility is required, identity is explored, and decisions are made independently.[6] The change in demands is challenging,[7] and the ability to cope with and adjust to this new environment is important.[7,8]

During this time of transition, participation in extracurricular occupations may counteract these effects and positively support health, well-being, and overall quality of life. Occupational scientists have examined human occupation, which is defined as various kinds of life activities in which people engage, noting that engagement in purposeful occupations can be both health-maintaining and health-regenerating and are thus necessary for the achievement of health, well-being, and ultimately survival.[9–12] Multiple studies demonstrate that involvement in extracurricular activities is related to a better adjustment to college life.[7,8] Specifically, participation in activities such as volunteering, athletics, and the arts plays an important role in coping with the stresses typically brought on by these life transitions,[8] as participation in these activities are positively associated with university student achievement.[13]

While positive associations of academic achievement and life satisfaction have been identified, studies that focus on college students' occupations rarely relate extracurricular activities to overall physical and mental health status. Moreover, most studies focus on adjustment by first-year college students, and little is known about activity participation and health status in later years or within graduate students. Understanding the relationship of activity participation and health status in established college students and how these relationships change over time is necessary to identify potential areas of concern or opportunities to leverage support that will ensure that students can remain healthy throughout their academic endeavors. Thus, the purpose of this study was to describe how graduate college students participate in extracurricular activities, characterize how activity participation changes over time in their graduate program, and analyze if the amount of participation or changes in participation rates relate to overall physical and mental health.

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Methods

This prospective longitudinal cohort study was conducted from July 2016 to June 2019. Students who matriculated into a masters-level occupational therapy (OT) or a bachelors-level dental hygiene (DH) program at one of two universities were recruited at the beginning of their respective academic programs. Participants were excluded if they had a history of any significant injury or on-going medical condition that limited the functional use of their hands. After obtaining written informed consent, participants were enrolled in the study and followed until the end of their two-year professional training.

Data were collected with each participant through self-reported surveys within two weeks of the initiation of their academic programs and at the conclusion of each of the two successive academic years. Demographic data such as age, gender, and ethnicity/race were obtained at baseline. An activity survey was created by integrating relevant items from published interest checklists to record participation in a variety of extracurricular activities.[14,15] The activity survey included a total of 62 activities grouped into eight occupational categories (Table 1). These occupational categories represent eight groups of common extracurricular activities in which people engage. Participants were asked to recall the previous six months and indicate the number of months (i.e., 0–6) and the average number of hours per week that they typically participated in each activity. We reviewed all free responses provided in "other" responses, categorized them into the eight categories, and included them in the final analysis.

Table 1. Occupational category groupings for the individual activities (n = 62) reported by participants.

Category (n)	Activity
Fitness (11)	Weightlifting, Exercise Classes, Running, Cycling, Swimming, Hiking, Rollerblading/Roller-Skating, Yoga, Tai Chi, Qi Gong, Other
Sports (29)	ATV Driving, Badminton, Baseball, Basketball, Bowling, Boxing, Darts, Fencing, Football, Frisbee, Golf, Gymnastics, Hockey, Handball, Martial Arts, Pool/Billiards, Rock Climbing/Bouldering, Rowing, Rugby, Sailing, Skiing, Soccer, Softball, Squash, Surfing, Table Tennis/Ping Pong, Tennis, Volleyball, Other
Creative arts (8)	Playing a Musical Instrument, Performing Arts (e.g., Acting, Singing, Dancing), Visual Arts (e.g., Drawing, Painting, Photography), Culinary Arts (other than basic meal prep), Esthetic Arts (e.g., Fashion, Makeup, Design), Small Crafts (e.g., Pottery, Leatherwork, Model Building), Large Crafts (e.g., Woodworking, Furniture Building), Other
Leisure (6)	Do-It-Yourself Projects (e.g., Home Improvement, Car Repair), Gardening and Yardwork, Computer Use (e.g., Internet browsing, Gaming), Console Gaming, Entertainment (e.g., Watching TV, Board/Card Games, Reading), Other
Social (3)	Social Outings (e.g., Concerts, Theater, Cinema, Dining, Nightclubs), Religious Activities, Other
Work (2)	Paid Work, Volunteer Work
Caregiving (2)	Childcare, Eldercare
Animal Care (1)	Taking care of animals

We used responses to the activity survey to calculate multiple measures of extracurricular activity participation. The total hours participating in each activity over the 6-month period immediately prior to data collection was calculated by multiplying the average hours per week by the total number of weeks (i.e., reported number of months in a given activity 4.33 weeks/month). The total hours of participation in each occupational category were then calculated by adding hour totals for each activity within the category. Changes in participation within each category were calculated separately for each follow-up time point by taking the hours reported at the 1-year and 2-year follow-up and subtracting the total hours reported at baseline. A trustworthiness check was conducted to exclude untrustworthy responses from the statistical analysis; such responses included those that did not allocate any time to the item "computer use for schoolwork" or any responses exceeding a total of 3,640 hours across all activities, as it was assumed that more than 20 hours/day of activity participation every day for six months was unreasonable.

Physical and mental health were measured using the RAND 36-item Short Form survey (SF-36), a widely used, valid, and reliable measurement of health status.[16,17] The SF-36 Physical Component Summary (PCS) and Mental Component Summary (MCS) scores were used in our analysis, which are measured on a scale of 0 to 100 with 50 representing the average, 10 representing the standard deviation in the general US population, and higher scores representing better physical or mental health levels.[18] The mean alpha reliability across the SF-36 scales is 0.8493 and test-retest reliability generally exceeds 0.80.[16,19] In addition to recording the individual PCS and MCS scores at each time point, each score was categorized into one of three categories using age- and gender-based normative data from the general population: Same or above average, Below average, and Well below average.[20,21] All scores and categorizations were generated using PRO CoRE software (version 1.4, Optum, Inc, Johnston, R.I.).

Descriptive statistics were calculated for all variables, and a Shapiro-Wilk test for normality was performed on all continuous variables. Continuous data that were normally distributed were expressed as mean ± standard deviation (SD). Two-sample independent t-tests, chi-squared tests, and Fisher's exact tests were performed to examine the demographic differences between OT and DH students. Due to the non-normal distribution of total hours of extracurricular activity participation, Friedman-Kendall-Smith tests were performed to examine the difference in participation among the three time points. Furthermore, due to a large degree of skew and a large number of zeros in the total number of hours in work, caregiving, and animal care, these categories were considered as binary variables in association modeling to differentiate those who participated from those who did not. Repeated measures analyses of covariance

(ANCOVA) and Friedman's test were used to examine the difference in the continuous and ordinal categorical PCS and MCS measures derived from SF-36 among the three time points. A post-hoc Bonferroni test was performed to test for pairwise differences between times.

Mixed effects linear models were used to assess the association between extracurricular activity participation (independent variable) and SF-36 scores (dependent variable). Mixed effects linear models were chosen in order to account for the longitudinal design of the three visits and to statistically account for the clustering of observations from three repeated measurements collected from the same participants. All models were estimated with the maximum likelihood method and an independent covariance structure of the random effects. A random intercept at the individual level was used in the models to account for the repeated measures within individual. First, mixed effects linear models were conducted to separately examine the associations between each extracurricular activity participation and PCS and MCS, while controlling for academic program and follow-up time. To improve interpretability, the extracurricular activities variables (i.e., fitness, sports, arts, leisure, social activity) were modeled as every ten hours per week (10 hours of activity participation per week = total hours/26 weeks/10 hours). The estimated regression coefficient for these variables therefore is interpreted as the mean difference in the dependent variable per 10 hours of weekly extracurricular activity participation. Then, two separate multivariable mixed effects linear models were built to examine the relationship of jointly-modeled extracurricular activity participation to PCS and MCS. The process of building the multivariable mixed effects linear models was as follows: (1) An empty model with only the random intercept was built for each dependent variable (PCS, MCS). (2) Fixed effects of assessment time (indicator variables for 1-year and 2-year follow-up, with baseline as the referent time period) and group (OT, DH) were included; independent activity variables with p-value < 0.30 in initial association were entered as fixed effects. Assessment time was treated as indicator variables since no assumption of a continuous relationship between time and PCS or MCS was made. (3) Activity variables in the full model with p-value > 0.05 were removed from the model one by one. (4) Preliminary models were identified when only the remaining activity variables were all significant ($p < 0.05$). (5) Random slopes for time were added to the preliminary model, and a Likelihood Ratio test was performed to compare the random slope model with the preliminary model. If the random slope model did not significantly improve the preliminary model, the preliminary model was then chosen to be the main effects model. (6) Interactions of activity and time were added to the main effects model to test if activity association with PCS or MCS differed by follow-up times. The interaction was left in the final model only if it significantly improved the main effects model ($p < 0.05$). (7) After the final model was determined, assumptions of normality, homoscedasticity, and linearity of the residuals were assessed using the scatter plot of the prediction values against residuals.

To examine the effect of change in extracurricular activity participation to the change in PCS/MCS, two additional multivariable mixed effects linear models were built. The model building process was the same as the previously described for PCS/MCS models. The only difference was that the dependent variables were the change of PCS/MCS and the independent variables were the change of activity participation at 1-year follow-up and 2-year follow-up compared to measures at baseline. STATA (version 15.1) was used for statistical analysis, and p-values <0.05 were considered statistically significant.

Results

Of a total of 159 participants who enrolled in the study, 144 participants had complete data from all three time points. Responses from eight participants were excluded following the trustworthiness check of the data, resulting in the inclusion of data from 136 participants in the final analysis. Demographic data comparing students between the OT ($n = 51$) to DH ($n = 85$) programs are shown in Table 2. The frequency of Hispanic participants was higher in the DH cohort than in the OT cohort (30.6% vs. 13.7%, $p = 0.03$), but no other statistically significant differences were observed. When combined, all participants had a mean age of 24.5 years, and the majority were female (86.0%).

The median and lower/upper quartile of the total hours spent in each occupational category for the previous six months at baseline, 1-year, and 2-years are shown in Table 3. Baseline activity participation was significantly higher than at the 1-year and 2-year follow-up for fitness, sports, creative arts, and work

Table 2. Descriptive statistics of participants included in the study (n = 136).

	DH (n = 85)	OT (n = 51)	**Total**[a]	**p-value**[b]
Age, years	24.2 (3.7)	24.9 (2.6)	24.5 (3.3)	0.19
Gender, male	13 (15.3)	6 (11.8)	19 (14.0)	0.57
Race				
American Indian/ Alaska Native	2 (2.4)	0 (0)	2 (1.5)	0.05
Asian	26 (30.6)	27 (52.9)	53 (39.0)	
Black	1(1.2)	2 (3.9)	3 (2.2)	
Native Hawaiian/ Pacific Islander	1 (1.2)	0 (0)	1 (0.7)	
White	42 (49.4)	18 (35.3)	60 (44.1)	
Other	13 (15.3)	4 (7.8)	17 (12.5)	
Ethnicity, Hispanic	26 (30.6)	7 (13.7)	33 (24.3)	0.03

[a]Mean (SD) were calculated for continuous data and frequency (%) are reported for categorical data.

[b]Two sample t-test was conducted to compare the age difference between (dental hygiene students) DH and (occupational therapy students) OT. Chi-square test was conducted to compare the difference of gender and ethnicity between DH and OT. Fisher's exact test was conducted to compare the difference of race between DH and OT.

($p < 0.01$). No significant changes were noted in participation in social, leisure, animal care, or caregiving occupations across the 2-year program. The average and classifications of PCS and MCS scores across the three assessment times are shown in Table 4. The vast majority of participants were at or above average in both PCS and MCS scores throughout the 2-year program. Within the DH group, PCS scores increased over time (57.0, 58.0, 58.8, $p < 0.01$) and MCS scores decreased (51.8, 48.5, 48.0, $p < 0.0001$); whereas, the PCS scores (58.8, 57.9, 57.1, $p = 0.06$) and the MCS scores (47.9, 46.5, 47.8, $p = 0.40$) remained similar across time within OT students.

The results of analyses evaluating the associations between each separate extracurricular activity participation and PCS/MCS are summarized in Table 5. The only significant association was between work/volunteer activity participation and PCS ($p = 0.002$). No other significant associations were found between activity participation and PCS/MCS. The results of multivariable mixed effects linear models evaluating the association between multiple extracurricular activity participation and health scores are presented in Table 6. The random slope of time did not significantly improve the model, nor did the interactions. Thus, both the random slope of time and interaction terms were eliminated from the final model. The only significant activity participation association was off-campus work or volunteer activities in the PCS model. After adjusting for other independent variables in the model, work or volunteer activity participation was associated with a lower PCS score ($\beta = -1.35$, 95%CI: (−2.22, −0.48); $p < 0.01$). As for the MCS model, no significant activity was found to be significantly associated. After controlling for group (DH or OT), the PCS was not significantly different from baseline at 1-year ($p = 0.99$) or 2-year follow-up ($p = 0.59$). In contrast, the MCS scores were significantly lower at 1-year follow-up ($\beta = -2.93$, 95%CI: (−2.47, −1.60); $p < 0.001$) and 2-year follow-up ($\beta = -2.10$, 95%CI: (−3.44, −0.77); $p < 0.01$) compared to baseline.

The results of the multivariable mixed effects linear models investigating the association between the change of extracurricular activity participation and the change of health scores are presented in Table 7. The random slope of time and the interactions did not significantly improve the model and were eliminated from the final model. The change from no animal care activity to some animal care activity was associated with a 1.62 (95%CI: (0.12, 3.12); $p = 0.03$) decrease in PCS score. The change from nonparticipation to some participation in work/volunteer activities was associated with an increase in MCS score of 2.59 (95%CI: (0.32, 4.87); $p = 0.04$) and a decrease in PCS score of 1.58 (95%CI: (0.09, 3.06); $p = 0.03$). In this modeling, when compared to DH students, OT students had a significant decrease in the PCS score ($p < 0.01$) and a significant increase in the MCS score ($p = 0.04$) across time.

Table 3. Median (lower quartile, upper quartile) of total hours of activities within each occupational category at baseline, 1-year, and 2-year for previous six months.

	Baseline (n = 136)	1-year (n = 136)	2-year (n = 136)	p-value[a]
Fitness	123.4 (37.9–238.2)	75.8 (13.0–173.2)	77.9 (0–181.9)	<0.01
Sports	0 (0–29.2)	0 (0–2.2)	0 (0–1.1)	<0.01
Creative arts	52.0 (0–136.4)	4.3 (0–65.0)	8.7 (0–99.6)	<0.01
Social	103.9 (43.3–181.9)	82.3 (19.4–155.9)	77.9 (0–188.4)	0.28
Leisure	376.7 (155.9–649.5)	389.7 (155.9–727.4)	363.7 (166.7–649.5)	0.97
Work	311.8 (19.5–772.9)	21.7 (0–130.0)	26.0 (0–337.7)	<0.01
Animal care	0 (0–26.0)	0 (0–4.3)	0 (0–45.5)	0.52
Caregiving	0 (0–0)	0 (0–0)	0 (0–0)	0.21

[a]Friedman-Kendall-Smith test was conducted to show the difference of total hours between baseline, 1-year, and 2-years.

Table 4. Average (SD) and frequency (%) across normative reference categories for the PCS and MCS scores at baseline, 1-year, and 2-year.

	Baseline (n = 136)	1-year (n = 136)	2-year (n = 136)	p-value[a]
PCS	57.6 (4.4)	57.9 (5.1)	58.2 (3.9)	0.47
Same or above average	130 (95.6%)	131 (96.3%)	131 (96.3%)	0.22
Below average	3 (2.2%)	0 (0.0%)	4 (2.9%)	
Well below average	3 (2.2%)	5 (3.7%)	1 (0.7%)	
MCS	50.4 (7.0)	47.4 (8.6)	48.2 (8.1)	<0.01
Same or above average	117 (86.0%)	104 (76.5%)	106 (77.9%)	<0.001
Below average	11 (8.1%)	15 (11.0%)	13 (9.6%)	
Well below average	8 (5.9%)	17 (12.5%)	17 (12.5%)	

Note. MCS = mental health composite score; PCS = physical health composite score.

[a]Repeated measures ANCOVA was conducted to compare continuous PCS and MCS scores between three measurement times. Friedman's test was conducted to compare ordinal categorical PCS and MCS scores.

Discussion

The purposes of this study were to characterize changes in the amount and type of extracurricular activity participation among college students and to explore the relationship between participation in different occupational categories and overall health. The results indicate that students spend less time participating in sports, fitness, creative arts, and work while enrolled in a professional-degree program. Overall, general physical and mental health were satisfactory, with the majority of the participants reporting health at or above the normative average. However, average mental health scores decreased significantly from baseline at the 1-year follow-up and 2-year follow-up, and more so in DH students than OT students. Paid or volunteer work was negatively associated with PCS and positively associated with an increase in MCS.

Participation and engagement in different types of occupations are essential for stress management and overall well-being,[10] and balanced life activities can promote health.[22–24] However, it is difficult to measure the

Table 5. Univariate mixed effects linear models investigating the association of extracurricular activity participation on PCS and MCS controlling for academic program and follow-up times.

Variable	PCS			MCS		
	Estimate[a]	95% CI	p-value	Estimate[a]	95% CI	p-value
Fitness, 10 hours/week[b]	−0.22	(−0.96, 0.53)	0.57	−0.21	(−1.43, 1.01)	0.73
Sports, 10 hours/week[b]	0.24	(−2.55, 3.03)	0.87	0.86	(−3.72, 5.44)	0.71
Arts, 10 hours/week[b]	0.27	(−0.53, 1.07)	0.51	−0.36	(−1.69, 0.97)	0.59
Social, 10 hours/week[b]	−0.60	(−1.51, 0.32)	0.20	0.66	(−0.84, 2.17)	0.39
Leisure, 10 hours/week[b]	−0.18	(−0.46, 0.10)	0.21	−0.27	(−0.74, 0.20)	0.26
Work, Yes[c]	−1.35	(−2.22, −0.48)	0.002	0.66	(−0.75, 2.08)	0.36
Animal, Yes[c]	−0.84	(−1.84, 0.17)	0.10	0.78	(−0.89, 2.46)	0.36
Caregiving, Yes[c]	0.27	(−1.00, 1.55)	0.67	0.03	(−2.05, 2.12)	0.97

Note: MCS, mental health composite score; PCS, physical health composite score.

[a]Estimates of β (95% CI) were provided using mixed effects linear models after controlling the follow-up time and academic group.

[b]Variables of fitness, sports, arts, social, and leisure were modeled as continuous variables. The estimated regression coefficient for these variables is interpreted as the mean difference in PCS/MCS per 10 hours of weekly activity participation.

[c]Variables of work, animal, and caregiving were modeled as binary variables according to whether or not students participated in the activity.

Table 6. Multivariable mixed effects linear models investigating the association of extracurricular activity participation on PCS and MCS controlling for academic program and follow-up times.

Variable	PCS		MCS	
	Estimate[a]	p-value	Estimate	p-value
Intercept	58.7 (56.8, 60.5)	<0.001	51.1 (49.6, 52.7)	<0.001
Follow-up				
Baseline	Reference	–	Reference	–
12-month	−0.003 (−0.88, 0.87)	0.99	−2.93 (−4.27, −1.60)	<0.001
24-month	0.24 (−0.64, 1.12)	0.59	−2.10 (−3.44, −0.77)	<0.01
Group				
DH	Reference	–	Reference	–
OT	0.02 (−1.12, 1.17)	0.97	−2.07 (−4.28, 0.13)	0.07
Activity[b]				
Work, No	Reference	–	–	–
Work, Yes	−1.35 (−2.22. −0.48)	<0.01	–	–

Note. PCS = physical health composite score; MCS = mental health composite score.

[a]Estimates of β (95%CI) were provided using mixed effects linear models.

[b]This multivariable model was built following a process where insignificant variables were omitted, and only significant extracurricular activity variables were left in the model.

Table 7. Multivariable mixed effects linear models investigating the effect of change of extracurricular activity participation on ΔPCS and ΔMCS.

Variable	ΔPCS		ΔMCS	
	Estimate[a]	p-value	Estimate	p-value
Intercept	4.21 (1.97, 6.45)	<0.001	−4.43 (−6.13, −2.72)	<0.001
Follow-up				
12-month-Baseline	Reference	–	Reference	–
24-month-Baseline	0.35 (−0.49,1.18)	0.42	0.87 (−0.33, 2.06)	0.16
Group				
DH	Reference	–	Reference	–
OT	−2.45 (−3.96, −0.95)	<0.01	2.66 (0.13, 5.20)	0.04
Activity[b]				
ΔAnimal Care, No	Reference	–	–	–
ΔAnimal Care, Yes	−1.62 (−3.12, −0.12)	0.03	–	–
ΔWork, No	Reference	–	Reference	–
ΔWork, Yes	−1.58 (−3.06, −0.09)	0.04	2.59 (0.32, 4.87)	0.03

Note. ΔPCS = change of physical health composite score from baseline; ΔMCS = change of mental health composite score from baseline; ΔAnimal Care = Yes: change from no animal care activity participation to some animal care activity participation; ΔWork = Yes: change from no work/volunteer activity to some work/volunteer activity.

[a]Estimates of β (95%CI) were provided using mixed effect linear models.

[b]This multivariable model was built following a process where insignificant variables were omitted, and only significant extracurricular activity variables were left in the model.

balance of lifestyle, or the balance of daily activity, since the concept of occupational balance (defined as the balance of engagement in all kinds of occupations) involves both objective and subjective aspects. In this study, the total hours of participation of several occupational categories of activities decreased at 1-year and 2-year follow-up compared to the baseline, reflecting that the level of diversity of activities for college students declined after enrolling in their academic programs. Further research is needed to examine occupational balance in the college student population, potentially using emerging measurement scales to understand better how balance across occupations impacts student health.[25]

With decreases noted in mental health across our sample, examination of occupational balance that includes social engagement may be of high importance. Previous studies have indicated that social interactions and forming meaningful relationships with others contributed to college students' psychological well-being.[7,26] Mediators of this positive relationship between social activities and well-being may be impacted by a student's level of social skills and perceived social support.[27] Simultaneously, participation in extracurricular activities generally supports the development of social skills, such as communication, decision-making, and teamwork.[28] Moreover, social activity participation provides a sense of belonging and is related to a lower risk of having suicidal thoughts.[29] Despite decreases in mental health scores, we did not find any significant relationship between the amount of participation in social activity and MCS/PCS. Although not significant, total hours of social activity participation were noted to decline over the 2-year period in our sample. Future studies should go beyond quantity of social activities to examine the type and quality of social participation as it relates to health.

In addition to social engagement, volunteering or engaging in work that contributes to others has been related to better mental and physical health, less depression, and fewer health problems.[30] In first-year college students, working off-campus fewer hours was found to be negatively associated with psychological well-being, whereas working off-campus more than 20 hours per week was found positively associated with psychological well-being.[7] Other studies have shown that being involved in volunteer work was important in coping with stress that related to life transition in a widowed population,[31] which could play a similar role in the life transition of college students.[8] One possible theory for this improvement is that volunteering and working provide social connectedness and a sense of belonging;[32] however, other scholars have argued that spending a substantial amount of time working or volunteering could be harmful to students' psychological well-being because it reduces the time available for studying or forming social relationships.[7]

In this study, we found that whether someone was working or not was not related to mental health; however, a change in work status from not working prior to enrollment in the educational program to working during school was, in fact, associated with an increase in mental health. Alternately, both working and starting work were associated with decreased physical health in our sample; however, this decrease in PCS did not surpass the threshold for a clinical meaningful difference. It is possible that the SF-36 measurement is not sensitive enough to measure significant changes in physical function in a young, healthy student population. However, the fact that working led to a decrease in physical health may indicate that certain components of the PCS measure were different for students who are working compared to those who are not working. Therefore, it may be necessary to further explore the association of occupations with specific physical health components (e.g., pain), particularly in young and healthy college students. Also, as with social activities, future studies may need to consider the type of work and the quality of their working experience relative to individual students to understand better the nuances of the positive and negative impacts of work on health.

Leisure activity participation is the final area that has been previously associated with a decrease in stress and better subjective well-being.[26,33–35] However, in our study, no significant association between leisure activity participation and health scores was found. One possible explanation is the difference in how leisure activity was defined. We differentiated specific activities into separate categories (e.g., watching TV, reading) in contrast to studies that define leisure as time not occupied by work or personal chores and obligations.[35,36] For example, in Yarnel et al,[35] including items that have otherwise been studied as being social activities, such as making new friends, talking with other people, as part of the leisure and play category make it difficult to differentiate the effects of social activities from leisure. Leisure activities in our study do not include social activities such as dining; we specifically split social activities out as a category. Another possible explanation for the unexpected outcome in our results is that the effect of leisure activity participation in our college student population is different from other populations.[34] Specifically, while leisure activity or play is beneficial for children's development and older adults,[37] increased leisure activity in college students may occur in response to increased stress or be a sign of procrastination, each typically related to decreased health and well-being. Hence, the positive effect and the negative effect may cancel each other out in this population. Future research could explore the differences in health between college students who spend a high versus low amount of their time doing leisure activities.

Surprisingly, initiating animal care activities during the academic program was found to have a negative effect on physical health in this study, which contradicts the findings in previous studies where pet ownership is associated with better physical health.[38–41] For example, Matchock found that owning dogs may have a positive effect on the physical activity level of their owners and can have a favorable impact on their physical health and mental health.[39] Like this example, most research has focused on dog ownership, and more study is needed to understand the health-related effects of owning other types of pets. Moreover, whether participating in animal care activities, especially for animals other than dogs, has a positive effect on college students' health has yet to be closely examined.

This study has several limitations. We measured extracurricular activity participation by self-reported questionnaires, which increases the risk of recall bias. Asking the participants to recall the past six months' participation in all kinds of extracurricular activities may have resulted in responses that do not accurately reflect their actual participation levels. Moreover, multiplying the weekly hours of participation by the total months participated could have significantly over- or underestimated actual participation time due to hourly and weekly fluctuations across the months. Furthermore, the investigation of the relationship between extracurricular activity participation and health in this study relies on the assumption that the activity engagement in any of the past six months has an equal effect on health over the past month. That is, one might expect that activity engagement closer to the last month may have a greater effect on self-reported health compared to activity engagement six months ago. The method of collection of activity data did not allow us to evaluate such temporality of activity associations with mental and physical health. Also, as discussed, we did not measure the quality of the experience of the extracurricular activity. Recent studies indicate that the quality of activity experience mediates the impact of activity involvement on health and well-being.[1,37,42,43] Future studies could consider data collection techniques that would more precisely measure activity participation using more short-term recall, real-time assessment, or in combination with experiential measures. One such measure to consider is time as a quality indicator of the experience or engagement during the activity, such as if a flow state was induced.[44]

While the sample size was adequate for the analyses in this study, the generalization of the findings is limited by the inclusion of students from the same regional area and only two academic programs. There is likely wide variability in student experiences across different programs and in different universities. Moreover, participation in occupations and activities varies widely across geographical regions due to climate and other contextual factors, as well as across different cultures due to social norms and values. The eight categories of extracurricular activities were grouped in this study based on western philosophies and were likely influenced by a year-round temperate climate. In general, categorizations of activities are often critiqued as being "simplistic, privileged, value-laden, and culturally specific."[45] For example, leisure is often multi-dimensional, and activities are often experienced differently by individuals, such as some would consider gardening as pure leisure, whereas some consider it as work.[42] Future work could minimize limitations of geography, culture, and individual perspectives using categorization based on subjectively reported characteristics of the experience.[46]

This study examined the relationship between extracurricular occupation and college students' overall health. Educators should consider the potential impact of extracurricular occupations on the health of college students when designing academic courses. In addition, this study shows that students engage in fewer activities and shorter durations over the course of their programs. Further research is needed to understand this phenomenon and promote engagement in activities. Furthermore, future research should explore why mental health has deteriorated to most effectively support students' mental health.

Conflict of interest disclosure

The authors have no conflicts of interest to report. The authors confirm that the research presented in this article met the ethical guidelines, including adherence to the legal requirements, of the United States of America and received approval from the Institutional Review Boards of the University of Southern California and Loma Linda University.

Funding

This work was supported by grant number R01 OH010665 from the Centers for Disease Control and Prevention (CDC), National Institute for Occupational Safety and Health. The content is solely the responsibility of the authors and does not necessarily represent the official views of the CDC.

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