

Healthy Exercise Habits Are Associated With Lower Risk of Burnout and Higher Quality of Life Among U.S. Medical Students

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Abstract

Purpose

Although burnout and low quality of life (QOL) are common among medical students, little remains known about personal fitness habits of medical students that may promote well-being.

Method

In 2012 the authors conducted a cross-sectional study of U.S. medical students to explore relationships between burnout, QOL, and compliance with Centers for Disease Control and Prevention (CDC) exercise recommendations. Wilcoxon-Mann-Whitney tests, Fisher exact tests, and multivariate logistic regression were performed.

Results

Among approximately 12,500 medical students invited to participate, 4,402 (35.2%) completed surveys. Most (2,738/4,367; 62.7%) engaged in aerobic exercise in accordance with CDC recommendations, while fewer (1,685/4,376; 38.5%) adhered to muscle strengthening recommendations. Burnout prevalence was lower among students who exercised aerobically consistent with CDC recommendations compared with those who exercised less (53.1% vs. 60.8%, $P < .0001$). Similarly, rates of burnout were also lower among students who strength trained consistent with CDC recommendations (51.8% vs. 58.6%, $P < .0001$). Overall QOL scores were higher

for medical students adhering to CDC recommendations for aerobic exercise (7.2 vs. 6.6, $P < .0001$), strength training (7.2 vs. 6.8, $P < .0001$), or both aerobic and strength training (8.0 vs. 7.0, $P < .0001$). Compliance with CDC exercise guidelines remained independently associated with lower risk of burnout and higher QOL on multivariate analysis controlling for age, sex, relationship status, children, and year in school.

Conclusions

Students whose aerobic exercise and/or strength training habits are consistent with CDC guidelines appear less likely to experience burnout and to have higher QOL.

Studies have extensively documented the high prevalence of burnout among medical students, potential contributing factors, and the potential personal and professional consequences.¹⁻¹³ Little is known, however, about personal exercise habits that may reduce the risk of burnout or promote medical student well-being. A 2010 national study of U.S. surgeons found that 55% exercised in accordance with Centers for Disease Control and Prevention (CDC) aerobic guidelines, and 36.5% were compliant with CDC strength training guidelines.¹⁴ Surgeons compliant with CDC aerobic exercise guidelines

were more likely to have high well-being than those who were not compliant, after controlling for a variety of personal and professional characteristics. In a 2003 study of 2,316 medical students attending 16 U.S. medical schools, 61% adhered to CDC aerobic exercise guidelines (at least 150 minutes per week of moderate physical activity or 60 minutes per week of vigorous physical activity).¹⁵ In that study, students who reported less stress and fewer days of “bad mental health” were more likely to exercise in accordance with guidelines. A separate study evaluating the effectiveness of a 12-week team-based, incentivized exercise program found that residents participating in the intervention were more likely to meet the Department of Health and Human Services recommendations for exercise, had higher quality of life (QOL) scores, and had a lower risk of burnout compared with the control group.¹⁶ To our knowledge, no previous study has explored the relationship between adherence to CDC guidelines for physical activity (e.g., aerobic exercise, strength training) and QOL or risk of burnout among U.S. medical students. Understanding the relationship between adherence to national guidelines and student

well-being could help inform students about individual strategies to reduce the risk of burnout and improve QOL.

Method

Participants and procedures

As previously reported,¹⁰ in 2012 we sent an e-mail message inviting all 26,760 medical students listed in the Physician Masterfile (PMF) to participate in the study. The PMF includes nearly all medical students enrolled at accredited MD-degree-granting schools in the United States. Three reminders were sent to students over the ensuing two weeks. Approximately 12,500 medical students opened at least one e-mail invitation and were considered to have received an invitation to participate in the study. Participation was voluntary, all responses were anonymous, and no incentive for participation was offered. The Mayo Clinic institutional review board approved the study.

Study measures

The comprehensive survey included items evaluating demographic characteristics (age, sex, parental status, relationship status), burnout, QOL, and exercise habits.

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Burnout and QOL

We measured burnout using the Maslach Burnout Inventory.¹⁷ Because high scores on either the emotional exhaustion (≥ 27) or depersonalization (≥ 10) scales distinguish between clinically burned-out and non-burned-out individuals,¹⁷ we considered those who scored high on either the emotional exhaustion or depersonalization domain of burnout to have at least one manifestation of professional burnout. Overall QOL over the past week was measured using a standardized linear analog scale (0 = “As bad as it can be”; 10 = “As good as it can be”). This scale has documented validity in a variety of medical conditions and populations.^{18,19} Mean scores of 7 or higher are typical of healthy individuals in the general population.^{20,21} Consistent with a previous study,²² we considered respondents with QOL scores of 8 or higher to have high overall QOL.

Exercise habits

To evaluate exercise habits relative to CDC guidelines,²³ we asked students to indicate the number of minutes per week they spent in moderate-intensity exercise (e.g., brisk walking, riding bike on level ground, water aerobics), number of minutes per week spend in vigorous-intensity exercise (e.g., jogging or running, riding bike on hills, swimming laps, playing basketball), and number of times per week they strength trained each major muscle group (e.g., legs, hips, back, abdomen, chest, shoulders, arms). Medical students were considered adherent with CDC aerobic exercise guidelines if they engaged in at least 150 minutes per week of moderate-intensity exercise, at least 75 minutes per week of vigorous-intensity exercise, or an equivalent mix of moderate- and vigorous-intensity exercise (each minute of vigorous-intensity exercise equivalent to approximately 2 minutes of moderately intense exercise).²³ Medical students were considered adherent with CDC strength training guidelines if they strength trained each major muscle group at least twice per week.²³

Statistical analysis

We used descriptive statistics to characterize the sample. Associations between measures of well-being (e.g., burnout, QOL) and exercise habits were tested using Wilcoxon-Mann-Whitney tests and Fisher exact tests. We also conducted two separate multivariable logistic regression analyses to identify

factors independently associated with burnout and QOL. Factors included in these models included demographic variables (e.g., sex, relationship status, children, year in school), compliance with CDC aerobic exercise recommendations, and compliance with CDC muscle strength training recommendations. All analyses were done using SAS statistical software version 10 (SAS Institute Inc., Cary, North Carolina).

Results

Of the roughly 12,500 students who received an invitation to participate,

4,402 (35.2%) completed the survey. The demographic characteristics and well-being profile of study participants have been previously reported.¹⁰ The median age of responders was 25, and 1,972 (45.1%) were male. The demographic characteristics (i.e., sex, age, year in school) of participating medical students were generally similar to the 66,461 medical students listed in the PMF, although fewer participants were male (medical students 1,972/4,376 [45.1%] vs. 35,031/66,461 [52.7%]). With respect to burnout, 1,892 (44.6%) students had high emotional exhaustion, 1,562 (39.9%) had high depersonalization, and 2,378

Table 1

Exercise Habits of 4,402 U.S. Medical Students, From a National Study of the Relation of Exercise Habits to Burnout and Quality of Life, 2012

| Type of exercise | Description | No. (%) |
|---|---|--------------------|
| Aerobic exercise | Minutes of moderately intense aerobic exercise per week | |
| | Less than or equal to 30 minutes | 1,040 (23.8) |
| | 30–59 minutes | 1,206 (27.6) |
| | 60–119 minutes | 1,000 (22.9) |
| | 120–149 minutes | 415 (9.5) |
| | Greater than or equal to 150 minutes | 711 (16.3) |
| | Missing | 30 (0.68) |
| | Minutes of vigorous aerobic exercise per week | |
| | Less than or equal to 30 minutes | 1,453 (33.3) |
| | 30–44 minutes | 471 (10.8) |
| | 45–59 minutes | 358 (8.2) |
| 60–74 minutes | 532 (12.2) | |
| 75–89 minutes | 225 (5.15) | |
| Greater than or equal to 90 minutes | 1,331 (30.5) | |
| Missing | 32 (0.73) | |
| Medical students compliant with CDC aerobic exercise recommendations^a | | 2,738/4,367 (62.7) |
| Strength training | Episodes of muscle strength training per week | |
| | None | 1,721 (39.3) |
| | 1 | 970 (22.2) |
| | 2 | 797 (18.2) |
| | 3 | 579 (13.2) |
| | 4 or more | 309 (7.1) |
| | Missing | 26 (0.59) |
| | Medical students compliant with CDC strength training recommendations^b | |
| Overall physical activity | Medical students compliant with CDC aerobic exercise recommendations^a and CDC strength training recommendations^b | 1,488/4,379 (34.0) |

Abbreviation: CDC indicates Centers for Disease Control and Prevention.

^aMedical students were considered compliant with CDC aerobic exercise guidelines if they engaged in at least 150 minutes per week of moderate-intensity exercise, at least 75 minutes per week of vigorous-intensity exercise, or an equivalent mix of moderate- and vigorous-intensity exercise (each minute of vigorous-intensity exercise equivalent to approximately 2 minutes of moderately intense exercise).²³

^bMedical students were considered in compliance with CDC strength training guidelines if they strength trained each major muscle group at least twice per week.²³

(55.9%) had burnout. The mean overall QOL score was 7.0 (standard deviation 1.9), as has been previously reported.¹⁰

Table 1 shows the exercise habits of participating medical students. Most (2,738/4,367 [62.7%]) engaged in aerobic exercise in accordance with CDC recommendations, while fewer (1,685/4,376 [38.5%]) did strengthening activities in accordance with recommendations. Approximately one-third of students (1,488/4,367 [34%]) engaged in physical activity consistent with both aerobic and strength training guidelines.

The mean emotional exhaustion and depersonalization scores as well as the prevalence of high emotional exhaustion, high depersonalization, and burnout were lower among students who engaged in aerobic exercise consistent with CDC recommendations (all $P < .01$; Table 2). Similarly, mean emotional exhaustion score as well as the prevalence of high emotional exhaustion and burnout were lower among students who strength trained consistent with CDC recommendations (all $P < .0001$). Mean emotional exhaustion scores as well as the prevalence of high emotional exhaustion (574/1,448 [39.6%] vs. 1,316/2,784 [47.3%], $P < .0001$) and burnout (742/1,454 [51.0%] vs. 1,632/2,789 [58.5%], $P < .0001$) were also lower for students adherent to *both* aerobic and strength training recommendations. No relationship was found between mean depersonalization score and compliance with strength training recommendations (see Table 2) or compliance with both aerobic and strength training guidelines (1,042/2,706 [38.5%] vs. 517/1,405 [36.8%], $P = .28$).

Overall QOL scores were higher for medical students following CDC recommendations for aerobic exercise (7.2 vs. 6.6, $P < .0001$), strength training (7.2 vs. 6.8, $P < .0001$), or both aerobic exercise and strength training (7.3 vs. 6.8, $P < .0001$). Similarly, the prevalence of a high QOL score was higher among those students following CDC recommendations for aerobic exercise (49.1% vs. 35.9%, $P < .0001$), strength training (49.1% vs. 41.1%, $P < .0001$), or both aerobic exercise and strength training (50.8% vs. 40.8%, $P < .0001$).

Compliance with CDC exercise guidelines remained independently associated with risk of burnout and QOL on multivariate

analysis after controlling for age, sex, relationship status, children, and year in school. Medical students compliant with CDC aerobic exercise guidelines (OR 0.79) or strength training guidelines (OR 0.86) had lower odds of burnout (Table 3). Similarly, medical students compliant with CDC aerobic exercise guidelines had higher odds of high QOL scores (OR 1.78; Table 4).

Discussion

This large national study of U.S. medical students found that 62.7% had aerobic exercise habits consistent with CDC guidelines, 38.5% engaged in strength training consistent with CDC guidelines, and 34.0% participated in regular physical activity meeting both guidelines. Nationally, 28% of Americans age 25 to 44 have aerobic exercise habits consistent

Table 2

Burnout, Quality of Life, and Exercise Habits of 4,402 U.S. Medical Students, From a National Study of the Relation of Exercise Habits to Burnout and Quality of Life, 2012

| Category | No | Yes | <i>P</i> value |
|--|--------------|--------------|----------------|
| CDC aerobic compliant, no. of respondents^a | 1,629 | 2,738 | |
| Emotional exhaustion score, mean (SD) | 26.4 (9.9) | 24.4 (10.1) | < .0001 |
| High emotional exhaustion score (≥ 27), no. (%) | | | |
| Yes | 779 (49.7) | 1,107 (41.7) | < .0001 |
| No | 788 (50.3) | 1,548 (58.3) | |
| Missing | 62 (3.8) | 83 (3.0) | |
| Depersonalization score, mean (SD) | 8.6 (5.7) | 8.1 (5.8) | < .01 |
| High depersonalization score (≥ 10), no. (%) | | | |
| Yes | 619 (40.7) | 934 (36.2) | < .01 |
| No | 903 (59.3) | 1,645 (63.8) | |
| Missing | 107 (6.6) | 159 (5.8) | |
| Burnout, no. (%) ^b | | | |
| Yes | 954 (60.8) | 1,413 (53.1) | < .0001 |
| No | 616 (39.2) | 1,250 (46.9) | |
| Missing | 59 (3.6) | 75 (2.7) | |
| Overall QOL | | | |
| Mean (SD) | 6.6 (1.9) | 7.2 (1.8) | < .0001 |
| High QOL score (≥ 8), no. (%) | 583 (35.9) | 1,345 (49.1) | < .0001 |
| CDC strength training recommendations, no. of respondents^c | 2,691 | 1,685 | |
| Emotional exhaustion score, mean (SD) | 25.9 (9.8) | 24.0 (10.2) | < .0001 |
| High emotional exhaustion score (≥ 27), no. (%) | | | < .0001 |
| Yes | 1,233 (47.6) | 657 (40.1) | |
| No | 1,360 (52.4) | 980 (59.9) | |
| Missing | 98 (6.0) | 48 (1.8) | |
| Depersonalization score, mean (SD) | 8.5 (5.7) | 8.3 (5.9) | .68 |
| High depersonalization score (≥ 10), no. (%) | | | .68 |
| Yes | 962 (38.2) | 597 (37.5) | |
| No | 1,557 (61.8) | 993 (62.5) | |
| Missing | 172 (10.6) | 95 (3.5) | |
| Burnout, no. (%) ^b | | | |
| Yes | 1,523 (58.6) | 851 (51.8) | < .0001 |
| No | 1,075 (41.4) | 792 (48.2) | |
| Missing | 93 (5.7) | 42 (1.5) | |
| Overall QOL | | | < .0001 |
| Mean (SD) | 6.8 (1.9) | 7.2 (1.8) | |
| High QOL score (≥ 8), no. (%) | 1,105 (41.1) | 826 (49.1) | < .0001 |

(Table continues)

Table 2
(Continued)

| Category | No | Yes | P value |
|--|--------------|-------------|---------|
| CDC aerobic and strength training recommendations, no. of respondents | 2,891 | 1,488 | |
| Emotional exhaustion score, mean (SD) | 25.8 (9.8) | 23.9 (10.3) | < .0001 |
| High emotional exhaustion score (≥ 27), no. (%) | | | < .0001 |
| Yes | 1,316 (47.3) | 574 (39.6) | |
| No | 1,468 (52.7) | 874 (60.4) | |
| Missing | 107 (6.6) | 40 (1.5) | |
| Depersonalization score, mean (SD) | 8.3 (5.7) | 8.2 (5.9) | .35 |
| High depersonalization score (≥ 10), no. (%) | | | .28 |
| Yes | 1,042 (38.5) | 517 (36.8) | |
| No | 1,664 (61.5) | 888 (63.2) | |
| Missing | 185 (11.4) | 83 (3.0) | |
| Burnout, no. (%) ^b | | | < .0001 |
| Yes | 1,632 (58.5) | 742 (51.0) | |
| No | 1,157 (41.5) | 712 (49.0) | |
| Missing | 102 (6.3) | 34 (1.2) | |
| Overall QOL | | | < .0001 |
| Mean (SD) | 6.8 (1.9) | 7.3 (1.8) | |
| High QOL score (≥ 8), no. (%) | 1,178 (40.8) | 755 (50.8) | < .0001 |

Abbreviations: CDC indicates Centers for Disease Control and Prevention; QOL, quality of life.

^aMedical students were considered compliant with CDC aerobic exercise guidelines if they engaged in at least 150 minutes per week of moderate-intensity exercise, at least 75 minutes per week of vigorous-intensity exercise, or an equivalent mix of moderate- and vigorous-intensity exercise (each minute of vigorous-intensity exercise equivalent to 2 approximately minutes of moderately intense exercise).²³

^bBurnout was defined as having high emotional exhaustion and/or high depersonalization.

^cMedical students were considered in compliance with CDC strength training guidelines if they strength trained each major muscle group at least twice per week.²³

Table 3
Factors Independently Associated With Burnout Among 4,402 U.S. Medical Students, From a National Study of the Relation of Exercise Habits to Burnout and Quality of Life, 2012^{a,b}

| Independent factors | Odds ratio ^c (95% CI) | P value |
|---|----------------------------------|---------|
| Compliant with CDC aerobic exercise guidelines (vs. not) | 0.79 (0.69, 0.92) | .002 |
| Compliant with CDC strength training guidelines (vs. not) | 0.81 (0.75, 0.99) | .04 |
| Third-year student (vs. fourth-year) | 1.68 (1.38, 2.05) | < .0001 |
| First-year student (vs. fourth-year) | 0.67 (0.56, 0.80) | < .0001 |
| Other-year student (vs. fourth-year) | 1.26 (0.85, 1.87) | .25 |
| Second-year student (vs. fourth-year) | 1.19 (1.00, 1.42) | .0503 |
| Age (for each year older) | 0.98 (0.96, 1.001) | .07 |
| Have children (vs. not) | 0.96 (0.72, 1.28) | .78 |
| Female (vs. male) | 0.89 (0.78, 1.01) | .08 |
| Married (vs. single) | 0.96 (0.81, 1.13) | .62 |
| Partnered (vs. single) | 1.09 (0.92, 1.29) | .31 |

Abbreviation: CDC indicates Centers for Disease Control and Prevention.

^aBurnout was defined as having high emotional exhaustion and/or high depersonalization.

^bFactors in the model: age, sex, year in school, relationship status, parental status, compliant with CDC aerobic exercise recommendations, compliant with CDC muscle strength training recommendations.²³

^cOdds ratio more than 1 indicates a higher risk of burnout; odds ratio less than 1 indicates a lower risk of burnout.

with guidelines, 10.2% engage in muscle-strengthening activities consistent with guidelines, and 21.5% participate in regular physical activity meeting both guidelines.²⁴ These findings suggest that U.S. medical students are more physically active than age-similar individuals in the general population. Medical students in our cohort whose aerobic exercise and/or strength training habits were consistent with CDC guidelines were less likely to have burnout and had clinically significant higher QOL scores.

These findings suggest that medical students who follow CDC guidelines for aerobic exercise and strength training are more mentally healthy. Other studies support relationships between physical activity and mental health and health-related QOL,^{14,15,25-27} with prospective cohort studies suggesting a protective effect of exercise on future mental illness or at least a bidirectional relationship between exercise and mental health.^{28,29} Notably, approximately a third of participating medical students did not follow the CDC aerobic exercise guidelines, while nearly two-thirds did not follow strength training guidelines. Because aerobic activity and strength training were both independently associated with a lower risk of burnout, these findings suggest that a majority of medical students may be neglecting a potentially simple and tangible activity that could enhance their physical and emotional well-being. Beyond the potential personal physical and mental health benefits of exercise, medical students' exercise habits also relate to their perceptions about their role in counseling patients regarding healthy diet and exercise,¹⁵ suggesting that being personally compliant with CDC exercise guidelines could have a larger public health impact.

The association between exercise and better well-being found in this study, along with previous longitudinal studies^{28,29} demonstrating the potential beneficial effects of exercise on mental health, suggests that medical schools should consider encouraging physical fitness among students as part of their approach to reducing burnout and promoting wellness, as required by the Liaison Committee on Medical Education.³⁰ Studies suggest that students who perceive that their school (and their classmates) has positive attitudes toward exercise are more likely to adhere

Table 4

Factors Independently Associated With High Quality of Life Score Among 4,402 U.S. Medical Students, From a National Study of the Relation of Exercise Habits to Burnout and Quality of Life, 2012^{a,b}

| Independent factors | Odds ratio ^c (95% CI) | P value |
|---|----------------------------------|---------|
| Compliant with CDC aerobic guidelines (vs. not) | 1.78 (1.56, 2.02) | < .0001 |
| Married (vs. single) | 1.42 (1.21, 1.67) | < .0001 |
| Age (for each additional year) | 0.95 (0.94, 0.97) | < .0001 |
| First-year student (vs. fourth-year) | 0.64 (0.59, 0.77) | < .0001 |
| Second-year student (vs. fourth-year) | 0.45 (0.37, 0.53) | < .0001 |
| Third-year student (vs. fourth-year) | 0.41 (0.34, 0.51) | < .0001 |
| Other-year student (vs. fourth-year) | 0.64 (0.43, 0.94) | .02 |
| Partnered (vs. single) | 1.03 (0.84, 1.22) | .68 |
| Compliant with CDC strength training guidelines (vs. not) | 1.11 (0.97, 1.28) | .13 |
| Female (vs. male) | 1.09 (0.96, 1.24) | .16 |
| Have children (vs. not) | 1.03 (0.77, 1.37) | .85 |

Abbreviation: CDC indicates Centers for Disease Control and Prevention.

^aHigh quality of life was defined as having a quality of life score of 8 or higher (see Method section).

^bFactors in the model: age, sex, year in school, relationship status, parental status, compliant with CDC aerobic exercise recommendations, compliant with CDC muscle strength training recommendations.²³

^cOdds ratio less than 1 indicates a lower likelihood of high quality of life.

to exercise guidelines, as are those students who exercise with classmates.¹⁵ Other studies suggest that competitive, incentivized exercise programming¹⁶ and Olympic-style events with learning communities competing against one another³¹ may increase the proportion of students who participate in physical activity. Reducing membership costs or providing free access to fitness facilities may also be useful strategies to encourage physical activity among students.

How do these results compare to previous findings? Although, to our knowledge, no previous studies of medical students have evaluated the relationship between medical student physical activity and rates of burnout and QOL, a 2003 study of 1,658 medical students matriculated at 16 different medical schools found nearly identical rates of compliance with aerobic physical activity guidelines among medical students (61%). Similar to our study, this survey also found that physical activity levels among medical students were higher than age-similar individuals (50%).¹⁵ Our study expands our understanding of medical student health habits a decade later, includes more students, and evaluates compliance with muscle strengthening guidelines as well as aerobic guidelines.

Our study has several limitations. First, exercise habits were assessed by

self-report. Although this approach is consistent with numerous prior studies,^{14,15,32} it is unknown how accurately individuals self-report their actual fitness behaviors. Second, our study was cross-sectional, and we are unable to determine causality or direction of effect. Third, there are likely to be many personal and school-related factors in addition to the ones we explored that could influence exercise habits and wellness. Fourth, although our response rate of 35% is typical of national survey studies of physicians and medical students,^{33–36} it does increase the possibility of response bias. Although the demographic characteristics of our responders are generally similar to the overall U.S. medical student population, it is unknown whether students with distress are more likely to complete surveys on this topic because it is relevant to them or less likely to complete surveys because of apathy. The prevalence of burnout and reported QOL scores among our responders were also similar to what has been previously found in studies with higher participation rates.^{7,34} These findings lend support to the likelihood that responders in this study were representative.³⁷

Our study also has several important strengths. To our knowledge, this is the first national study of U.S. medical students exploring the relationship

between burnout, QOL, and compliance with CDC exercise guidelines. Second, the instruments used in our survey to measure burnout and QOL were validated, allowing comparison with other samples of medical students.

In conclusion, this large national study of U.S. medical students suggests that aerobic exercise and weight training activity consistent with the CDC recommendations are associated with lower rates of burnout and higher QOL. Although their adherence to guidelines is higher than the national age-matched population, only one-third of U.S. medical students engage in physical activity consistent with both aerobic exercise and strength training guidelines. Self-care strategies, such as adequate exercise, should be encouraged as part of a medical school's organizational response to high levels of student distress. Doing so should help better equip medical students with the skills they need to thrive, learn, and work within our complex health care environment. Innovative approaches to encouraging physical activity may increase the proportion of students adhering to CDC guidelines.

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References

- 1 Dyrbye L, Shanafelt T. A narrative review on burnout experienced by medical students and residents. *Med Educ*. 2016;50:132–149.
- 2 Dyrbye LN, Massie FS Jr, Eacker A, et al. Relationship between burnout and professional conduct and attitudes among US medical students. *JAMA*. 2010;304:1173–1180.
- 3 Dyrbye LN, Thomas MR, Eacker A, et al. Race, ethnicity, and medical student well-being in the United States. *Arch Intern Med*. 2007;167:2103–2109.
- 4 Jackson ER, Shanafelt TD, Hasan O, Satele DV, Dyrbye LN. Burnout and alcohol abuse/dependence among U.S. medical students. *Acad Med*. 2016;91:1251–1256.
- 5 Dyrbye LN, Thomas MR, Harper W, et al. The learning environment and medical

- student burnout: A multicentre study. *Med Educ.* 2009;43:274–282.
- 6 Dyrbye LN, Thomas MR, Huntington JL, et al. Personal life events and medical student burnout: A multicenter study. *Acad Med.* 2006;81:374–384.
 - 7 Dyrbye LN, Thomas MR, Massie FS, et al. Burnout and suicidal ideation among U.S. medical students. *Ann Intern Med.* 2008;149:334–341.
 - 8 Dyrbye LN, Thomas MR, Power DV, et al. Burnout and serious thoughts of dropping out of medical school: A multi-institutional study. *Acad Med.* 2010;85:94–102.
 - 9 Dyrbye LN, West CP, Satele D, Boone S, Sloan J, Shanafelt TD. A national study of medical students' attitudes toward self-prescribing and responsibility to report impaired colleagues. *Acad Med.* 2015;90:485–493.
 - 10 Dyrbye LN, West CP, Satele D, et al. Burnout among U.S. medical students, residents, and early career physicians relative to the general U.S. population. *Acad Med.* 2014;89:443–451.
 - 11 Enoch L, Chibnall JT, Schindler DL, Slavin SJ. Association of medical student burnout with residency specialty choice. *Med Educ.* 2013;47:173–181.
 - 12 Cook AF, Arora VM, Rasinski KA, Curlin FA, Yoon JD. The prevalence of medical student mistreatment and its association with burnout. *Acad Med.* 2014;89:749–754.
 - 13 Pagnin D, de Queiroz V, Carvalho YT, Dutra AS, Amaral MB, Queiroz TT. The relation between burnout and sleep disorders in medical students. *Acad Psychiatry.* 2014;38:438–444.
 - 14 Shanafelt TD, Oreskovich MR, Dyrbye LN, et al. Avoiding burnout: The personal health habits and wellness practices of US surgeons. *Ann Surg.* 2012;255:625–633.
 - 15 Frank E, Tong E, Lobelo F, Carrera J, Duperly J. Physical activity levels and counseling practices of U.S. medical students. *Med Sci Sports Exerc.* 2008;40:413–421.
 - 16 Weight CJ, Sellon JL, Lessard-Anderson CR, Shanafelt TD, Olsen KD, Laskowski ER. Physical activity, quality of life, and burnout among physician trainees: The effect of a team-based, incentivized exercise program. *Mayo Clin Proc.* 2013;88:1435–1442.
 - 17 Maslach C, Jackson SE, Leiter MP. *Maslach Burnout Inventory Manual.* 3rd ed. Palo Alto, CA: Consulting Psychologists Press; 1996.
 - 18 Gudex C, Dolan P, Kind P, Williams A. Health state valuations from the general public using the visual analogue scale. *Qual Life Res.* 1996;5:521–531.
 - 19 Rummans TA, Clark MM, Sloan JA, et al. Impacting quality of life for patients with advanced cancer with a structured multidisciplinary intervention: A randomized controlled trial. *J Clin Oncol.* 2006;24:635–642.
 - 20 Ware JE, Kosinski M, Keller SD, eds. *The SF-36 Physical and Mental Health Summary Scales: A Manual for Users of Version 1.* 2nd ed. Lincoln, RI: QualityMetric Incorporated; 2001.
 - 21 Cella D, Zagari MJ, Vondros C, Gagnon DD, Hurtz HJ, Nortier JW. Epoetin alfa treatment results in clinically significant improvements in quality of life in anemic cancer patients when referenced to the general population. *J Clin Oncol.* 2003;21:366–373.
 - 22 Shanafelt TD. Finding meaning, balance, and personal satisfaction in the practice of oncology. *J Support Oncol.* 2005;3:157–162, 164.
 - 23 Centers for Disease Control and Prevention. Physical activity for everyone. www.cdc.gov/physicalactivity/everyone/guidelines/adults.html#. Accessed October 31, 2016.
 - 24 Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System. <http://www.cdc.gov/brfss/>. Accessed October 31, 2016.
 - 25 Brown DW, Balluz LS, Heath GW, et al. Associations between recommended levels of physical activity and health-related quality of life. Findings from the 2001 Behavioral Risk Factor Surveillance System (BRFSS) survey. *Prev Med.* 2003;37:520–528.
 - 26 Stephens T. Physical activity and mental health in the United States and Canada: Evidence from four population surveys. *Prev Med.* 1988;17:35–47.
 - 27 Weight CJ, Sellon JL, Lessard-Anderson CR, Shanafelt TD, Olsen KD, Laskowski ER. Physical activity, quality of life, and burnout among physician trainees: The effect of a team-based, incentivized exercise program. *Mayo Clin Proc.* 2013;88:1435–1442.
 - 28 Griffiths A, Kouvonen A, Pentti J, et al. Association of physical activity with future mental health in older, mid-life and younger women. *Eur J Public Health.* 2014;24:813–818.
 - 29 Steinmo S, Hagger-Johnson G, Shahab L. Bidirectional association between mental health and physical activity in older adults: Whitehall II prospective cohort study. *Prev Med.* 2014;66:74–79.
 - 30 Liaison Committee on Medical Education. Accreditation standards. <http://lcme.org/publications/>. Accessed October 31, 2016.
 - 31 Drolet BC, Rodgers S. A comprehensive medical student wellness program—Design and implementation at Vanderbilt School of Medicine. *Acad Med.* 2010;85:103–110.
 - 32 Schwartz JS, Lewis CE, Clancy C, Kinoshian MS, Radany MH, Koplan JP. Internists' practices in health promotion and disease prevention. A survey. *Ann Intern Med.* 1991;114:46–53.
 - 33 Allegra CJ, Hall R, Yothers G. Prevalence of burnout in the U.S. oncology community: Results of a 2003 survey. *J Oncol Pract.* 2005;1:140–147.
 - 34 Dyrbye LN, Massie FS Jr, Eacker A, et al. Relationship between burnout and professional conduct and attitudes among US medical students. *JAMA.* 2010;304:1173–1180.
 - 35 Kuerer HM, Eberlein TJ, Pollock RE, et al. Career satisfaction, practice patterns and burnout among surgical oncologists: Report on the quality of life of members of the Society of Surgical Oncology. *Ann Surg Oncol.* 2007;14:3043–3053.
 - 36 West CP, Tan AD, Habermann TM, Sloan JA, Shanafelt TD. Association of resident fatigue and distress with perceived medical errors. *JAMA.* 2009;302:1294–1300.
 - 37 Johnson TP, Wislar JS. Response rates and nonresponse errors in surveys. *JAMA.* 2012;307:1805–1806.