Overweight Physicians During Residency: A Cross-Sectional and Longitudinal Study

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Abstract

Background Resident physicians are at risk for increasing weight status given their changes in environment, resources, and stress level.

Objective To describe body mass index (BMI), blood pressure, eating habits, and physical activity during postgraduate training and to compare the findings to data for nationally matched controls.

Methods This was a combined cross-sectional study and longitudinal cohort, with a comparison to matched controls in 2 academic hospital centers in the eastern and western United States. BMI and blood pressure were objectively measured, and an eating and exercise habits recall was obtained for 375 enrolled medical and surgical residents (93 longitudinally) at the onset of each postgraduate year (PGY) in 2006, 2007, and 2008.

Results Nearly half (43%) of overweight residents described themselves as normal weight. Residents were more likely to be overweight (BMI $\geq$25) at the beginning of PGY-3 than at the beginning of PGY-1 (49% versus 30%; odds ratio 2.26; 95% confidence interval 1.19–4.28). The average BMI of residents at PGY-1 was lower than that of their matched controls, but the magnitude of this difference decreased with increasing PGY ($P = .02$).

Conclusions Overweight status is underacknowledged by overweight residents and increases by PGY of training. These changes differ significantly from that of controls and may affect overweight physicians' long-term health.

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Introduction

Physicians are at risk for poor physical health because of their low percentage of primary care maintenance[1,2] and noncompliance with federal health recommendations for physical activity and healthy eating practices[3]; this is particularly true for those who work 65 or more hours each week.[4] Postgraduate training is associated with sleep deprivation, including decreased working memory, increased medical errors, and decreased rates of personal[5] and occupational satisfaction.[6–14] Recently, more attention is being paid even earlier to medical students with increased reports of the need to monitor and evaluate their well-being.[15] However, residents present a unique challenge given their inconsistent and demanding work hours.

Additionally, there is a suggestion that physical well-being may influence physician performance. Earlier research found trainees to be inconsistent in identifying overweight status in their patients and providing appropriate counseling.[16] Therefore, it is concerning that physicians who do not exercise regularly and have a high resting heart rate are less likely to counsel their patients about exercise.[17–19] Physicians who maintain a healthy lifestyle are more likely to identify which patients should receive counseling, and to provide accurate and consistent prevention counseling.[20,21] In turn, overweight patients are more likely to express confidence in the treatment provided by physicians who are not overweight and to attempt weight loss when physicians disclose their own diet practices and physical activity regimens.[22–24]

Previous studies reporting weight gain upon entering higher education suggest that residents may be at a unique risk for increasing weight status given their environment, resources, and stress level.[25] Although quality of life has been a primary focus of measurement in residents, particularly after the change in work hours,[12,26–28] there is inadequate literature addressing the changes in the physical

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health of trainees as a result of residency training. This study serves to fill the gap in the literature on the association of physical health with residency training. This study is the first to quantify the body mass index (BMI), blood pressure, and behaviors of resident physicians by year of training and compare these measures to those of matched controls from a national database.

What was known

Resident physicians are at risk for increasing weight status given their changes in environment, resources, stress level, and nonadherence to health-promoting practices.

What is new

The average body mass index of first-year residents was lower than that of their matched controls, but the magnitude of this difference decreased with increasing training year.

Limitations

Small sample with limited enrollment rate and very limited participation by severely overweight physicians may be indicative of selection bias.

Bottom line

Overweight status is underacknowledged by overweight residents and increases by training year, which may affect their long-term health.

Methods

Setting and Participants

Medical and surgical residents were approached during intern orientation, continuity clinics, and lecture series at the onset of each academic year in 2006, 2007, and 2008. We recruited residents from the departments of emergency medicine, internal medicine, obstetrics and gynecology, pediatrics, psychiatry, and surgery at site 1 and from the departments of family medicine, internal medicine, obstetrics and gynecology, pediatrics, and surgery at site 2.

Inclusion criterion for the cross-sectional study was enrollment as a postgraduate year (PGY)-1, PGY-2, or PGY-3. Exclusion criteria were no current or past pregnancy and no known medical conditions (eg, hypertension, hyperthyroidism, or hypothyroidism). Residents were told that the purpose of the study was to document physical health over the course of their training, and that their participation was voluntary and confidential. Written informed consent was obtained. No compensation was provided.

Of the 1071 eligible full-time residents (600 at site 1 and 471 at site 2 in 2006, 2007, and 2008), 111 of 360 eligible completed the enrollment in 2006, 110 of 363 eligible in 2007, and 154 of 348 eligible in 2008. A total of 375 residents were enrolled; 93 were measured sequentially in more than 1 year of the study (71 residents for 2 years and 22 residents for all 3 years).

Data Collection

Residents were asked to remove their white coat and shoes before being weighed, according to the modified National Health and Nutrition Examination Survey (NHANES) protocol. Weight was measured with a portable electronic scale (Taylor Scale Solutions, Whitehall, PA), and height was obtained with a measuring tape. BMI was calculated as body weight in kilograms divided by body surface area in square meters (kg $\div$ m^2), with overweight defined as BMI $\geq$25 to $<$30.[29] Two blood pressure measurements were obtained 5 minutes apart on the left arm of seated residents using a digital self-inflating device (HEM-712C Automatic Blood Pressure Monitor, Omron Electronics LLC, Schaumburg, IL), and the average of the 2 measurements was recorded. Hypertension was defined as systolic blood pressure $\geq$140 or as diastolic blood pressure $\geq$90. Weight and blood pressure were both measured at the initial and subsequent longitudinal measurements, when applicable.

To minimize the time of evaluation for each subject, brief instruments were used to assess health behaviors. Eating habits were assessed using the Rapid Eating and Activity Assessment for Participants short version, a 16-item questionnaire that was designed to indicate the frequency of unhealthy eating behaviors, with some validity evidence when used in medical students.[30] Physical activity was determined using a 2-question questionnaire previously found to have some validity evidence when used with patients. A frequency of 2 or more times per week of both mild and moderate exercise produced a score of sufficient physical activity.[31]

Residents provided their department affiliation, PGY, age, gender, and race. Department affiliation and PGY were verified with the official residency directory. Age was listed in years, and race was categorized as Caucasian American, African American, Latin American, Asian American, or other. Residents were also asked to self-describe as underweight, normal weight, overweight, or very overweight.

Statistical Analysis

All analyses were performed using SAS Version 9.1 (SAS Institute Inc, Cary, NC), with statistical significance set at $P < .05$ using 2-sided tests. The baseline characteristics for each variable were compared using an analysis of variance for continuous variables and a χ^2 test for trends in categoric variables. For the primary analysis with the cross-sectional cohort, multivariate linear regression for the continuous outcomes (BMI, systolic blood pressure, and diastolic blood pressure) and logistic regression for the dichotomous

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outcomes (overweight and hypertension) were used to compare differences in outcome variables across program years. The regression models included the main effects for program year, age at the first year, gender, race (Caucasian versus non-Caucasian), and site (1 versus 2). For the longitudinal analysis of residents who completed follow-up measurements, continuous outcomes were compared across program years adjusting for age at the first year, gender, race, and site using a mixed-model analysis of repeated measures.[32] Generalized estimating equations (GEE) were used to evaluate the dichotomous outcomes of overweight status and hypertension. Similar to the cross-sectional analysis, the models included the main effects of program year and covariates.

Matched controls from the NHANES database (2005–2006)[33] were selected for each resident physician (1:1 matching) based on age, gender, race, and years of education.[34,35] A mixed-model analysis for continuous outcomes and GEE for dichotomous outcomes were used to compare differences in the outcome variables.[32]

Institutional review boards at both participating institutions approved the study.

Results

The baseline characteristics of all enrolled residents by PGY are shown in TABLE 1. There were differences by PGY for age, gender, and site, as well as in our unadjusted outcome measures of BMI and blood pressure.

The residents' responses to the self-reported questionnaires on their physical activity, eating habits, and weight status did not vary significantly by their demographics or PGY. However, there was a significant reporting of unhealthy eating habits (TABLE 1). More than a fifth (22%) of residents consumed sweetened beverages on a daily basis, and only about half (56%) of all residents reported sufficient physical activity. Furthermore, only 25% of residents self-identified as overweight, whereas 34% of all residents were measured to be overweight (BMI $\geq$25 to $<$30). There were no obese residents (BMI $\geq$30) at any PGY. Of note, we found no significant differences in the baseline demographic characteristics among residents who were enrolled only once versus those enrolled longitudinally.

In the cross-sectional regression analysis, the average BMI was higher at PGY-3 than at PGY-2 or PGY-1 ($P <$ .05) when adjusted for age, gender, race, and site. Furthermore, PGY-3 residents were more likely to be overweight than PGY-1 residents (odds ratio [OR] 2.26; 95% confidence interval [CI] 1.19–4.28), shown in TABLE 2.

Diastolic blood pressure was higher at PGY-3 than PGY-1 (79.7 versus 76.8, P = .04). There was no difference in mean systolic blood pressure or proportion of hypertension in successive training years (TABLE 2).

In the cohort of residents who were measured longitudinally, the mean BMI was not different across each of the 3 years of training (P = .23). However, the percent of residents who were categorized as overweight increased significantly over the course of training, from 12% at PGY-1 to 24% at PGY-3 (OR 2.32, 95% CI 1.17–4.62), shown in TABLE 3.

There was no increase in systolic blood pressure, diastolic blood pressure, or hypertension by PGY in the longitudinal analysis (TABLE 2).

Physical activity, eating habits, and self-descriptions did not vary significantly by program year, nor were they associated with linear BMI or among those who gained weight (n = 43) in either of our analyses. However, overweight residents were more likely than normal weight residents to often or sometimes eat at a restaurant (67% versus 51%, P = .002) and to often or sometimes consume sweetened beverages (29% versus 19%, P = .02). Although overweight residents were more likely than normal weight residents to describe themselves as "overweight or obese" (57% versus 9%, $P <$ .001), nearly half (43%) still inaccurately described themselves as "normal weight," as opposed to 91% of normal weight physicians who described themselves as "normal weight."

Finally, we analyzed our subjects in comparison to controls matched for age, gender, and education to determine whether our data were merely consistent with national data by age and year of collection, or whether residency itself could be identified as an independent contributor. Average BMI was lower for the resident physician group than for the control group for PGY-1 (24.2 versus 27.9, $P <$ .001) and PGY-2 (23.4 versus 27.4, $P <$ .001), respectively (TABLE 3). However, by PGY-3, this difference in BMI was no longer statistically different (25.1 versus 26.1; P = .26; OR 0.67; 95% CI 0.33–1.34), despite having been significantly different at PGY-1 (OR 0.28, 95% CI 0.19–0.41) and at PGY-2 (OR 0.27, 95% CI 0.15–0.48), shown in TABLE 3.

There was a statistically significant difference in systolic and diastolic blood pressure between the residents and controls for each PGY. In addition, residents were found to have an increased magnitude of difference of diastolic blood pressure over the 3 years of training (6.7 versus 10.4 mm Hg, P = .01). Differing rates of hypertension were not found to be statistically significant (TABLE 3).

Discussion

The major finding in this study is that residents are more likely to be overweight at the beginning of PGY-3 than they

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TABLE 1 **Residents' Baseline Characteristics by PGY**

	All (N = 375)		PGY-1 (N = 209)		PGY-2 (N = 105)		PGY-3 (N = 61)	
	Mean, N	SD, %	Mean, N	SD, %	Mean, N	SD, %	Mean, N	SD, %
Demographics								
Age, y	28.6	3.0	28.6	3.0	28.9	2.9	29.4	2.7
Gender								
Female	204	54.4	102	48.8	62	59.1	40	65.6
Race								
Caucasian	259	69.1	144	68.9	73	69.5	42	68.9
Other	116	30.9	65	31.1	32	30.5	19	31.2
Site								
One	258	68.8	153	73.2	62	59.1	43	70.5
Two	117	31.2	56	26.8	43	40.9	18	29.5
Clinical outcomes								
BMI	24.1	3.9	24.2	3.9	23.4	3.6	25.1	4.2
Overweight (≥25 to <30)	125	33.5	71	33.9	27	25.7	27	44.3
Blood pressure								
SBP	125.8	15	125.7	15.7	126	15.1	125.8	12.3
DBP	76.9	9.7	76.1	9.6	77.6	10.4	78.7	8.2
Hypertension	76	20.5	43	20.9	23	21.9	10	17
Behaviors								
Physical activity								
Yes	206	54.9	117	57.1	50	48.5	39	65
Eating habits								
Eat at restaurants	209	56.3	113	54.6	63	60.1	33	55
Eat high-fat snacks	186	49.6	93	44.5	61	58.1	32	52.5
Eat high-sugar snacks	229	61.1	130	62.2	62	59.1	37	60.7
Drink sweetened beverages	83	22.1	47	22.5	22	21.0	14	22.9
Self-description								
Normal weight	266	74.9	151	76.3	75	76.5	40	67.8
Overweight	89	25.1	47	23.7	23	23.5	19	32.2

Abbreviations: PGY, postgraduate year; SD, standard deviation; BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); SBP, systolic blood pressure; DBP, diastolic blood pressure.

are at the beginning of PGY-1. This is despite a nonsignificant change in the mean BMI, suggesting that it may be a result of a small effect size that shifts the categorization of the overall population. One noticeable effect of this shift is described in a comparison to matched controls drawn from a national database. At the beginning of PGY-3, residents are no less likely to be overweight, while at the beginning of PGY-1 residents are less likely to be overweight, compared with matched controls. Although we did not find changes in hypertension status over the course of training, diastolic pressure was significantly higher in PGY-3 than in PGY-1. Similarly, there were no differences in hypertension status between the residents and matched controls, although absolute systolic and diastolic

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TABLE 2 **BMI and Blood Pressure, by Year and by Comparison**

	PGY-1		PGY-2		PGY-3		PGY-3 vs PGY-1	
	Mean, %	SE, 95% CI	Mean, %	SE, 95% CI	Mean, %	SE, 95% CI	Difference of Least Squares Mean, Odds Ratio	95% CI
Cross-sectional cohort								
Weight status								
BMI, mean, SE	24.1	0.29	23.8	0.37	25.6	0.48	1.47[a]	0.45–2.48
Overweight, % (95% CI)	30	22–39	25	17–35	49	34–64	2.26[a]	1.19–4.28
Blood pressure, SE								
SBP, mean	126.1	1.1	127.3	1.4	128.2	1.84	2.04	-1.87–5.95
DBP, mean	76.8	0.79	78.5	1	79.7	1.32	2.88[a]	0.08–5.68
Hypertension, % (95% CI)	22	15–30	25	16–37	21	12–35	0.92	0.41–2.06
Longitudinal cohort								
Weight status								
BMI, mean, SE	23.4	0.59	23.7	0.56	23.9	0.58	0.42	-0.23–1.07
Overweight, % (95% CI)	12	6–24	19	10–32	24	12–43	2.32[a]	1.17–4.62
Blood pressure, SE								
SBP, mean	126.3	2.2	124.4	1.97	123.9	2.12	-2.46	-6.11–1.18
DBP, mean	78.1	1.88	79.2	1.65	78.7	1.8	0.62	-2.70–3.95
Hypertension, % (95% CI)	11	4–19	10	5–21	19	9–35	1.95	0.80–4.77

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); PGY, postgraduate year; SE, standard error; CI, confidence interval; SBP, systolic blood pressure; DBP, diastolic blood pressure.

[a] Statistically significant difference of least squares means or odds ratio.

blood pressures were significantly higher for residents. The clinical significance of this finding is unclear, but it should be considered in future evaluations of resident health during training.

Another important finding was within the survey results, which yielded significant percentages of unhealthy practices and inaccurate perceptions, suggesting that many residents maintain unhealthy diet and physical activity practices and may lack the ability to recognize overweight status in themselves and their patients, both of which may influence their counseling choices.

This study has several limitations. We were not able to approach all residents given the constraints of their schedules and intern orientation. Our overall enrollment rate was approximately 35%. Although our results demonstrated a difference in overweight rates in PGY-1 versus PGY-3, the small size of our longitudinal cohort prevented us from adequately evaluating resident weight gain over time. Our results could be explained by a difference in the sampling, not in an actual difference in BMI. The lack of any obese residents in our recruitment may also suggest selection bias. Future studies could consider an additional self-reported weight and height by a survey as adjunct information. Finally, using a relatively small 1:1 matched cohort from the NHANES database as a control group may have limited our ability to compare to the national trend of increasing BMI.

Overall, our results are consistent with previous studies demonstrating that residents are at risk of having unhealthy habits and negative outcomes. Although previous studies have primarily examined mental health, this study begins to address physical changes that may occur in association with postgraduate training. Mechanisms that could contribute to increased BMI and blood pressure include increased levels of stress, decreased quality and quantity of sleep, and limited time to engage in physical activity. Additionally, there is a suggestion that prevailing behaviors in social networks are strong influences on likelihood of obesity, putting the close groups of residents at increased risk.[36]

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TABLE 3 **Residents versus NHANES Subjects**

	Resident Mean, %	SE, 95% CI	NHANES[a] Mean, %	SE, 95% CI	Difference of Least Squares Mean, Odds ratio	95% CI
PGY-1						
Weight status						
BMI	24.2	0.27	27.9	27.9	-3.75[b]	-4.70– -2.78
Overweight	34	28–41	65	65	0.28[b]	0.19–0.41
Blood pressure						
SBP	125.74	1.05	116.21	116.21	9.53[b]	7.18–11.9
DBP	76.08	0.67	69.43	69.43	6.65[b]	4.58–8.72
Hypertension	21	16–27	8	8	2.82[b]	1.58–5.06
PGY-2						
Weight status						
BMI	23.4	0.38	27.4	0.61	-4[b]	-5.36– -2.65
Overweight	26	19–35	57	47–66	0.27	0.15–0.48
Blood pressure						
SBP	125.98	1.47	112.47	1.25	13.5	10.2–16.8
DBP	77.59	0.94	65.84	1.19	11.75	8.85–14.7
Hypertension	22	15–31	2	1–7	13.76	3.09–61.2
PGY-3[c]						
Weight status						
BMI	25.1	0.5	26.1	0.81	-1.03[c]	-2.82–0.76
Overweight	45	33–58	55	43–67	0.67	0.33–1.34
Blood pressure						
SBP	125.91	1.95	114.62	1.68	11.19[b]	6.77–15.6
DBP	78.69	1.25	68.31	1.59	10.38[b]	6.49–14.4
Hypertension	17	9–29	9	4–20	2.08	0.74–5.84

Abbreviations: NHANES, National Health and Nutrition Examination Survey; SE, standard error; CI, confidence interval; PGY, postgraduate year; BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure.

[a] Data from the National Health and Nutrition Examination Survey (NHANES) 2005–2006, matched by age, gender, race, and years of education.
[b] Statistically significant difference of least squares means or odds ratio.
[c] The magnitude of the difference at the beginning of PGY-3 was less than those at either PGY-1 or PGY-2.

Conclusion

Given these findings and that practicing physicians' weight status and exercise habits have been shown to influence their professional practice, we suggest that graduate medical education should prioritize monitoring and intervening in the health maintenance of residents. Potential programs include health risk assessments, weight-gain prevention intervention, and further research to identify those at highest risk for changes in BMI and blood pressure.

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