Cardiorespiratory Fitness in Internal Medicine Residents: Are Future Physicians Becoming Deconditioned?

Farshid Daneshvar, MD
Michael Weinreich, MD
Danial Daneshvar, MD
Michael Sperling, MD
Chadi Salmane, MD
Harout Yacoub, MD
James Gabriels, MD
Thomas McGinn, MD, MPH
Marianne C. Smith, MD, FACP

ABSTRACT

Background Previous studies have shown a falloff in physicians' physical activity from medical school to residency. Poor fitness may result in stress, increase resident burnout, and contribute to mortality from cardiovascular disease and other causes. Physicians with poor exercise habits are also less likely to counsel patients about exercise. Prior studies have reported resident physical activity but not cardiorespiratory fitness age.

Objective The study was conducted in 2 residency programs (3 hospitals) to assess internal medicine residents' exercise habits as well as their cardiorespiratory fitness age.

Methods Data regarding physical fitness levels and exercise habits were collected in an anonymous cross-sectional survey. Cardiopulmonary fitness age was determined using fitness calculator based on the Nord-Trøndelag Health Study (HUNT).

Results Of 199 eligible physicians, 125 (63%) responded to the survey. Of respondents, 11 (9%) reported never having exercised prior to residency and 45 (36%) reported not exercising during residency ($P < .001$). In addition, 42 (34%) reported exercising every day prior to residency, while only 5 (4%) reported exercising daily during residency ($P < .001$), with 99 (79%) participants indicating residency obligations as their main barrier to exercise. We found residents' calculated mean fitness age to be 5.6 years higher than their mean chronological age ($P < .001$).

Conclusions Internal medicine residents reported significant decreases in physical activity and fitness. Residents attributed time constraints due to training as a key barrier to physical activity.

Introduction

In addition to contributing to their own personal health, physicians dedicated to fitness are more likely to counsel their patients on the topic.[1] Cardiorespiratory fitness is an important component of personal health, as poor fitness is a risk factor for both all-cause and cardiovascular mortality.[2] A study that evaluated students from multiple US medical schools found a positive correlation between students' level of physical activity and their physical activity counseling practices. This study also found that the perceived importance of physical activity counseling declined over the 4 years of medical school.[1] These findings highlight the need to emphasize physical fitness for the duration of medical education and future training.

Cardiorespiratory fitness is best evaluated by determining the maximum oxygen consumption of an individual during strenuous physical activity ($\dot{V}O_2$max). The most widely accepted method of measuring $\dot{V}O_2$max is by monitoring a patient's vital signs, as well as venous and arterial blood gases during incremental exercise. This method of testing is costly, time consuming, and invasive.[3] Multiple studies have demonstrated that nonexercise models can accurately predict a person's $\dot{V}O_2$max.[2,4] In our study, a nonexercise regression model developed using data from the Norwegian Nord-Trøndelag Health Study (HUNT) cohort study was used to determine $\dot{V}O_2$max.[4]

The HUNT study, which included 4637 subjects, compared measured $\dot{V}O_2$max with $\dot{V}O_2$max calculated from a multivariate regression model and found that the most important predictors of $\dot{V}O_2$max were age, physical activity, and waist circumference. Using age, physical activity, waist circumference, and resting heart rate the HUNT model can approximate 90% of subjects within the nearest quartile of measured $\dot{V}O_2$max.[4]

The effect of internal medicine residency on a resident's fitness age has not been studied to date. This study investigates change in HUNT fitness age and

DOI: http://dx.doi.org/10.4300/JGME-D-15-00720.1

Editor's Note: The online version of this article contains the survey used in the study.

TABLE 1
Distribution of Demographic and Clinical Characteristics

Characteristic	No. (%)
Hospital	
North Shore–Long Island Jewish Hospital	69 (55)
Staten Island University Hospital	56 (45)
Sex	
Male	82 (66)
Female	43 (34)
Postgraduate year	
1	47 (38)
2	40 (32)
3	38 (30)
Ethnicity	
White	57 (46)
Black or African American	5 (4)
Hispanic/Latino	4 (3)
Asian/Pacific Islander	42 (34)
Other	17 (14)

physical activity for a cohort of internal medicine residents.

Methods

This cross-sectional study was conducted at 2 internal medicine residency programs: The North Shore–Long Island Jewish (NSLIJ) Health System Residency Program in Long Island, New York, and the Staten Island University Hospital (SIUH) in Staten Island, New York. Categorical internal medicine residents were eligible for participation. The only exclusion criteria was current pregnancy.

An introductory e-mail was sent to the categorical internal medicine residents at all sites with general details of the study. Participation in the study was voluntary. Each resident was asked to fill out an anonymous self-administered survey, which was based on the HUNT calculator online questioner (https://www.ntnu.edu/cerg/vo2max) at the end of noon conference (provided as online supplemental material) during the fall of the 2014–2015 academic year. The time of day was chosen deliberately as the residents would have been seated for at least 45 minutes and the measurements of their resting heart rates would be most accurate. Data regarding physical fitness levels and exercise habits, along with height, weight, waist circumference, and resting heart rate, were collected. While height and weight were self-reported, waist circumference and resting heart rate measurements were made under direct supervision of the investigators. These measurements were made using tape measures and portable pulse oximeters, respectively. Using the results of the survey, a fitness calculator based on the multivariate regression model developed in the HUNT study was used to calculate the participant's predicted $\dot{V}O_2$max and fitness age. There were no differences in subgroup analysis of the results between the 2 residency programs and between male and female residents.

This study was approved by the NSLIJ Institutional Review Board for recruitment from both locations.

Summary statistics are reported as mean ± standard deviation for continuous variables or frequency and as percentages for categorical variables. Differences between groups for continuous variables were evaluated with an independent sample *t* test. For evaluation of association between categorical data, chi-square test or Fisher's exact test was used. Comparability of exercise habits before and during residency was evaluated using the Bowker test for table symmetry. A paired *t* test was used to compare the differences in mean chronological age and fitness age. All statistical tests were 2-sided and conducted at the .05 level of

What was known and gap
Poor fitness may increase stress and burnout in residents, and make them less likely to counsel patients about exercise.

What is new
A study that collected data regarding physical fitness levels and exercise habits of internal medicine residents and assessed their cardiopulmonary fitness age.

Limitations
Cross-sectional design, self-reporting, and potential response bias reduce the ability to generalize or rule out other causes for the decline in exercise.

Bottom line
Residents' fitness age was higher than their chronological age. Residents reported decreases in physical activity, and implicated residency time constraints.

TABLE 2
Analysis of Exercise Habits Prior to and During Residency

Exercise Habit	Prior to Residency, n (%)	During Residency, n (%)	*P* Value
Almost never or less than once a week	11 (9)	45 (36)	< .001
Once a week	18 (15)	29 (24)	
2 or 3 times a week	50 (41)	42 (35)	
Almost every day	42 (34)	5 (4)	

TABLE 3
Fitness Parameters

Characteristic	Men (n = 82)	Women (n = 43)	Overall (N = 125)
Waist circumference (inches)			
Mean	34.93	29.29	32.99
SD	4.04	3.7	4.75
Median	34	30	33
Body mass index (calculated as kg/m^2)			
Mean	25.16	21.83	24.01
SD	3.67	3.44	3.91
Median	24.58	21.1	23.7
Resting heart rate (beats per minute)			
Mean	73.35	75.76	74.18
SD	10.11	11.76	10.72
Median	73	77	74
$\dot{V}O_2$max (mL/kg/min)			
Mean	50.17	41.13	47.06
SD	6.14	3.47	6.87
Median	50	41	47
$\dot{V}O_2$max optimal (mL/kg/min)			
Mean	52.35	42.28	48.89
SD	1.54	0.67	4.98
Median	53	42	52
Age (y)			
Mean	28.37	28.21	28.31
SD	2.68	2.19	2.52
Median	28	28	28
Fitness age (y)			
Mean	35.17	31.6	33.94
SD	12.92	8.28	11.63
Median	34	31	33

significance. Data analyses were conducted using SAS version 9.3 (SAS Institute Inc, Cary, NC).

Results

A total of 199 residents (109 from NSLIJ and 90 from SIUH) were eligible for participation in the study. Of these, 125 (63%) responded to the survey. Of the respondents, 82 (66%) were male, 47 (38%) were postgraduate year (PGY) 1, 40 (32%) were PGY-2, and 38 (30%) were PGY-3. Other demographic data are found in TABLE 1. Forty-five respondents (36%) indicated that they never exercised during residency versus 11 (9%) indicating that they never exercised prior to residency ($P < .001$). Five respondents (4%) reported exercising every day during residency, compared with 42 (34%) who reported that they had exercised every day prior to residency ($P < .001$; TABLE 2).

The majority of participants (79%, 99 of 125) reported that residency obligations were a main barrier to exercising. In addition, 89% (111 of 125) of respondents indicated that they need to change their exercise habits, and 55% (69 of 125) reported that they would be more likely to counsel their patients about exercising if they themselves exercised more often. The mean $\dot{V}O_2$max determined by the HUNT calculator[4] in participants was 47.1 with an SD of 6.87, and the mean $\dot{V}O_2$max optimal was 48.9 with an SD of 4.98.

The mean age of residents was 28.3 years (SD = 2.52 years), with an age range from 21 to 39 years old. The mean fitness age was calculated to be 33.9 years (SD = 11.63 years), with a calculated fitness age range from 20 to 75 years old (TABLE 3). The residents' mean fitness age was 5.6 years higher than their mean chronological age ($P < .001$; TABLE 4).

In subgroup analysis there were no statistically significant differences between male and female

TABLE 4
Differences Between Mean Fitness Age and Mean Chronological Age

Characteristic	No.	Mean Difference	SD	*P* Value
All Residents	125	5.6	11.12	< .001
Sex				
Male	82	6.8	12.24	.07
Female	43	3.4	8.24	

residents and between NSLIJ and SIUH residents in their mean fitness and chronological ages.

Discussion

Our findings confirmed prior work showing that internal medicine residents markedly decreased physical activity during residency and demonstrated increased cardiorespiratory fitness age versus actual resident age. Most residents perceived that residency responsibilities were a major barrier to exercise. The patients they care for also may be negatively affected, because physicians who have poor exercise habits are less likely to counsel their patients about proper physical fitness.[1]

This is not the first study describing a decline in physician fitness during residency. A study[5] evaluating the rate of burnout among residents and its relation to physical activity found that 79% of residents had a decline in physical activity after starting residency, and reported a lack of time and energy to be the major obstacles to regular physical activity. Interestingly, the same study found that residents who reported less physical activity were more likely to report burnout.[5] Another study[6] followed military physicians throughout their residency training, and found a decline in all training activities, including push-ups, sit-ups, and 2-mile run times as residency progressed. The overall findings have demonstrated that a decrease in physical activity among residents has led to decrease in $\dot{V}O_2$max (and thus increased fitness age as an indicator of declining cardiorespiratory fitness), which can predict long-term mortality.[2]

This study has several limitations, including the cross-sectional design that required obtaining data at a single time point. Subjects were not followed over the course of their residency, and we cannot demonstrate that individual subjects had a decline in physical fitness during residency. Many other factors (new cities, beginning a family) affect individuals at the beginning of residency, and we cannot be sure that the decline in physical fitness is due to residency training alone. Given the 63% response rate, and the 125 respondents who were assessed, there also may have been unintentional selection bias, as well as age and sex differences, among the 199 eligible residents. Finally, it is possible that residents may perform activities during their normal day-to-day activities that would meet the American College of Sports Medicine and American Heart Association definitions of moderate intensity activity, which includes a brisk walk that increases the heart rate and can be accomplished in 10-minute intervals.[7]

Next research steps may involve more objective measurements of residents' exercise habits in longitudinal studies to determine how physical activity changes during residency. This information may allow study of interventions to encourage the continuation of exercise for those residents already exercising, as well as promote the initiation of physical activity for others.

Conclusion

Internal medicine residents reported significant decreases in physical activity and fitness. Residents attributed time constraints due to training as a key barrier to physical activity.

New technologies such as step counters and heart rate monitors may assist in residents' self-assessment and increase their level of physical activity. The physical fitness of the nation's future physicians and their patients is dependent on further exploration of this topic.

References

1. Frank E, Tong E, Lobelo F, et al. Physical activity levels and counseling practices of US medical students. *Med Sci Sports Exerc*. 2008;40(3):413–421.
2. Nes BM, Vatten LJ, Nauman J, et al. A simple nonexercise model of cardiorespiratory fitness predicts long-term mortality. *Med Sci Sports Exerc*. 2014;46(6):1159–1165.
3. Vanhees L, Lefevre J, Philippaerts R, et al. How to assess physical activity? How to assess physical fitness? *Eur J Cardiovasc Prev Rehabil*. 2005;12(2):102–114.
4. Nes BM, Janszky I, Vatten LJ, et al. Estimating VO_2 peak from a nonexercise prediction model: the HUNT Study, Norway. *Med Sci Sports Exerc*. 2011;43(11):2024–2030.
5. Olson SM, Odo NU, Duran AM, et al. Burnout and physical activity in Minnesota internal medicine resident physicians. *J Grad Med Educ*. 2014;6(4):669–674.
6. Arora R, Lettieri C, Claybaugh JR. The effects of residency on physical fitness among military physicians. *Mil Med*. 2004;169(7):522–525.
7. Haskell WL, Lee IM, Pate RR, et al. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the

American Heart Association. *Circulation*. 2007;116(9):1081–1093.

Farshid Daneshvar, MD, is a Medical Resident, the Department of Medicine, North Shore–Long Island Jewish Health System (NSLIJ); **Michael Weinreich, MD,** is a Medical Resident, NSLIJ; **Danial Daneshvar, MD,** is a Research Fellow, NSLIJ, and Staten Island University Hospital (SIUH); **Michael Sperling, MD,** is a Medical Resident, NSLIJ and SIUH; **Chadi Salmane, MD,** is a Medical Resident, NSLIJ and SIUH; **Harout Yacoub, MD,** is a Medical Resident, NSLIJ and SIUH; **James Gabriels, MD,** is a Medical Resident, NSLIJ; **Thomas McGinn, MD, MPH,** is Chairman, NSLIJ; and **Marianne C. Smith, MD, FACP,** is Principal Investigator, Associate Director of Ambulatory Care, Associate Director of Research, and Director of Medical Student Education, NSLIJ and SIUH.

Funding: The authors declare no external funding source for this study.

Conflict of interest: The authors declare they have no competing interests.

Corresponding author: Farshid Daneshvar, MD, Staten Island University Hospital, Department of Medicine, 475 Seaview Avenue, Suite 104, Staten Island, NY 10305, 917.912.7167, dfdaneshvar@yahoo.com

Received November 17, 2015; revisions received June 27, 2016, and August 24, 2016; accepted October 18, 2016.