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BRIEF REPORT

Differential changes in body mass index after retirement by occupation: hierarchical models

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Abstract

Objectives This paper examines whether retirement differentially affects body mass index (BMI) patterns by occupation; occupation embodies differences in on-the-job physical demands as well as socioeconomic characteristics that could lead to variation in post-retirement BMI.

Methods We use 12 years of national data from the US and hierarchical linear models to compare BMI trajectories among four broad occupational classes.

Results We find that those in service and other blue-collar occupations have significant increases in the slopes of their BMI trajectories after retirement, whereas participants in white-collar occupations exhibit no change. This may be due to differences in the physical requirements across blue and white collar jobs or differences in health habits post-retirement.

Conclusions Retirement may provide an opportunity to help prevent obesity in older individuals, especially blue collar workers.

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Introduction

Approximately 60% of US elders are obese or overweight, and nearly one in five individuals is obese (Flegal et al. 1998; Lakdawalla et al. 2005; Li et al. 2005; Ogden et al. 2006). This is despite the fact that obesity is a documented risk factor for numerous chronic diseases, including osteoarthritis, coronary heart disease, hypertension, type 2 diabetes, and some cancers (Patterson et al. 2004). The medical costs of obesity and overweight are extremely burdensome, particularly for older individuals who have more extensive comorbidity than younger people. The costs borne by government-sponsored insurance for obese individuals over 70 have been estimated to be over 20% greater than those for any other weight group (Lakdawalla et al. 2005).

Retirement has been recognized as an essential point for weight change and may thus present an opportunity for intervention. Nevertheless, rather limited research has been directed to assess its link to weight change. The results of the few studies have been quite consistent. Research has suggested increases in weight and waist circumference among Norwegian men retiring from active jobs (Nooyens et al. 2005), and increases in body fat and decrease in muscle mass among UK factory workers (Patrick et al. 1982). In the US, one study found that women were 58% more likely to have a 5% increase in body mass index (BMI) following retirement from blue-collar jobs (Forman-Hoffman et al. 2008), while another suggested that retirement led to significant increases in BMI among individuals with lower wealth and physically demanding jobs (Chung et al. 2009).

The objective of the present study is to determine whether retirement influences BMI patterns according to occupational affiliation, as occupation embodies differences in physical demands, education and other socioeconomic characteristics that could lead to variation in post-retirement BMI. Using 12 years of national data from the US, we use hierarchical linear models to compare BMI trajectories among four broad occupational classes.

Methods

Data and sample

We used data from the US Health and Retirement Survey (HRS) in this study. The primary goal of the HRS is to gather information on older workers' health and financial well-being as they advance toward and enter retirement. The initial HRS panel ($N = 12{,}652$), a stratified cluster sample, was first interviewed in 1992, with biennial interviews taken since then. Panel 1's birth years span 1931–1941. A second panel ($N = 4{,}849$) was added in 1998. Panel 2 includes two birth cohorts: children of the depression whose birth years span 1924–1930 and war babies whose birth years span 1942–1947. Spouses of primary respondents for all birth cohorts, regardless of age, are also surveyed. Our study used data from both the original HRS surveys (first 6 waves, 1992–2002) and Version H of the data prepared by RAND, a longitudinal data set that contains the most commonly used HRS variables. We restrict our sample to HRS participants who reported a transition from work to retirement during the 6-wave study frame ($N = 2{,}096$).

Variables

Our dependent variable is BMI. BMI is a continuous variable, taken from the RAND HRS, which was calculated as weight, in kilograms, divided by the square of height, in meters. The primary explanatory variable is current occupation. Current occupation is represented by four categories of job-related affiliation. These 4 mutually exclusive and exhaustive categories were created by collapsing data from 17 original categories in the HRS. They are: (1) professional, managerial and technical support (referent category), (2) sales, clerical and administrative support, (3) service (includes: private household services, protective services, food preparation, health service, and personal service), (4) other blue-collar occupations, including mechanical, construction, and precision production, operators, fabricators, and laborers, and farming, forestry, and fishing. Our time metric is centered on the event of retirement, which is defined as the mid-point of the survey waves between which the transition occurs. As such, we created 18 pseudo-periods: one each for the starting and ending points of all HRS waves and one for the mid-point of the periods.

Statistical method

We fit a series of hierarchical linear models (Bryk and Raudenbush 1987; Casella 1985; Goldstein 1987; Laird and Ware 1982; Ware 1985) to estimate occupation differences in BMI and its rate of change over time before and after retirement. The dependent variable is treated as continuous, and the average BMI is related to the primary explanatory variable (occupation) and covariates. Hierarchical linear models (also known as multi-level linear models) have several advantages over traditional methods of repeated-measures analysis: they use all available data on each subject; they are unaffected by randomly missing data; they can flexibly model time effects; and they allow for estimation of both cross-sectional and longitudinal effects.

The models are described mathematically below. The notation is as follows: y_{ij} refers to BMI of subject i at wave j, β_{i0} is a subject-specific random intercept, β_{i1} is a subject-specific random slope before retirement and β_{i2} is a subject-specific random slope after retirement. The first-level equation refers to *within-subject* effects of time on BMI before and after retirement. The second-level equation refers to *between-subject* effects and assesses how individuals' intercepts (i.e., BMI at retirement) and slopes (i.e., rate of change in BMI over time before retirement and after retirement) depend on current occupation and baseline covariates. The coefficients of primary interest in this model are the α regression parameters, which, in the first level 2 equation describe the effect of occupation and covariates on the intercept (or BMI at retirement), and in the second level 2 equation describe the effect of occupation and covariates on the slopes (or linear rate of change in BMI) before and after retirement.

Level 1 model

Before retirement

$$E(y_{ij}) = \beta_{i0} + \beta_{i1}\text{Year\_before\_retirement}$$

After retirement

$$E(y_{ij}) = \beta_{i0} + \beta_{i2}\text{Year\_after\_retirement}$$

Level 2 model

$$\beta_{i0} = \alpha_{00} + \sum_{d=1}^{3} \alpha_{0d}\text{occupation\_at\_retirement}_d + \sum \alpha_{0h}\text{covariate\_at\_retirement}_h + \varepsilon_{i0}$$

$$\beta_{i1} = \alpha_{10} + \sum_{d=1}^{3} \alpha_{1d}\text{occupation\_at\_baseline}_d + \sum \alpha_{1h}\text{covariate\_at\_baseline}_h + \varepsilon_{i1}$$

$$\beta_{i2} = \alpha_{20} + \sum_{d=1}^{3} \alpha_{2d}\text{occupation\_at\_retirement}_d + \sum \alpha_{2d}\text{covariate\_at\_retirement}_h + \varepsilon_{i2}$$

The slope before retirement is modeled as a linear function of occupation and covariates *at baseline*, while the intercept and slope after retirement are modeled as linear functions of occupation and covariates measured *at the last HRS wave before retirement*. Death and dropout are considered as covariates for slope after retirement, but not for intercept and slope before retirement, as there are no dropouts prior to retirement by design. Finally, for the post-retirement slope, we also control whether subjects report returning to work after retirement. The models were estimated with Version 4.21 of the MPlus software.

The hierarchical linear model is estimated with two separate specifications. The basic model allows the coefficient on occupation to capture both the direct and indirect effects of occupation, whereas the expanded model seeks to control for some of the indirect effects, thus allowing occupation to capture the direct effect and any unmeasured indirect impact. The basic model specification includes occupation and controls for year before (i.e., time until) retirement, demographic variables (gender, race, education, marital status) and dropout status (death or dropout). Our expanded model is obtained after backward elimination of non-significant variables (excluding the set of variables from the basic model, which are "forced" into the model) from a specification that began with an extensive set of covariates. The starting model specification added to the basic model control variables for health behaviors (problem drinking and tobacco use), economic status (categorized total non-housing wealth and income), employment (part-time employment, hours worked per week at primary job, health insurance coverage), and other job characteristics (physical effort, self-rated stress, opportunity for ascendance, work satisfaction, social relationships). Non-significant predictors of all three random effects were dropped from the model one at a time, such that the sample-adjusted Schwartz–Bayesian Information Criterion (BIC) decreases at each step. After backward, iterative elimination of non-significant variables, the expanded model specification contains the following additional variables: smoking status, non-housing wealth, health insurance, and hours worked. Descriptive statistics for the study variables are found in Table 1 (Column 1).

Results

Basic model

The results from the basic model are shown in two different forms: Fig. 1 displays results graphically while regression coefficients and standard errors are displayed in Table 1. Intercept results (Fig. 1, Panel A; Table 1, Column 2) indicate that participants in service and other blue-collar occupations have slightly higher BMI than those in the two white-collar occupation classes, although these differences are not statistically significant. Regarding the trajectories (Fig. 1, Panel A; Table 1, Column 3), we observe a modest upward trend in BMI for all occupations but service in the pre-retirement period, with no statistically significant difference in BMI slope between professional and managerial occupation (referent category) and any of the other three other occupation categories. [The BMI slope before retirement for the referent occupation group was statistically different from zero, while after retirement there was only a trend ($p = .08$)]. However, after retirement (Fig. 1, Panel A; Table 1, Column 4) differences emerge. First, the positive BMI slopes of other blue-collar occupations and service occupations become steeper, which indicates acceleration in the increase in BMI for these two occupation categories. Of the two groups, other blue-collar occupation has a larger pre/post-retirement slope change relative to the referent group. This is reflected in the statistically significant ($p < .01$) difference in post-retirement BMI slope between other blue-collar occupations and professional and managerial occupations (Table 1). Furthermore, the difference between service occupations and the referent category was significant at alpha = 0.10 but not at alpha = 0.05 ($p = .07$, Table 1). And second, the positive slopes of sales, clerical occupations and professional and managerial occupations become negative or flatter, respectively, after retirement, which indicates deceleration in the increase in BMI for these groups. Nonetheless, the post-retirement change in slope is similar for the two groups, so that no statistically significant difference is indicated between the two.

Expanded model

The results from the expanded model (Fig. 1, Panel B; Table 1, Column 5–7), which includes a more extensive set of covariates, are qualitatively similar to those generated by the basic model, in that retirement appears to induce a consequential increase in slopes for BMI for other blue-collar occupations and service occupations ($p < .01$ for other blue-collar occupations; $p = .05$ for service) relative

Table 1 Effect of retirement on body mass index (BMI)

Variable	Basic model				Expanded model		
	N (%)/mean (SD) (1)	Intercept (2)	Pre-retirement slope (3)	Post-retirement slope (4)	Intercept (5)	Pre-retirement slope (6)	Post-retirement slope (7)
Overall test of referent occupation							
Professional and managerial		26.53 (0.25)***	0.10 (0.02)***	0.05 (0.03)	26.89 (0.48)***	−0.01 (0.06)	0.04 (0.06)
Occupation							
Professional and managerial	757 (36.12)	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Sales, clerical and admin.	498 (23.76)	−0.27 (0.27)	0.01 (0.02)	−0.01 (0.03)	−0.22 (0.27)	0.01 (0.02)	0.01 (0.03)
Service	211 (10.07)	0.02 (0.38)	−0.01 (0.04)	0.08 (0.04)	0.13 (0.37)	−0.004 (0.04)	0.08 (0.04)*
Other blue-collar	630 (30.06)	0.19 (0.28)	0.01 (0.03)	0.09 (0.03)**	0.21 (0.29)	0.01 (0.03)	0.09 (0.03)**
Age	56.66 (3.33)	0.05 (0.03)	−0.001 (0.003)	−0.01 (0.002)***	0.05 (0.03)	0.000 (0.003)	−0.008 (0.003)**
Gender							
Female	898 (42.84)	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Male	1,198 (57.16)	0.54 (0.22)*	−0.05 (0.02)**	−0.06 (0.02)**	0.52 (0.23)*	−0.05 (0.02)**	−0.06 (0.02)**
Marital status							
Married/partnered	1,689 (80.58)	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Not married	407 (19.42)	0.62 (0.27)*	0.02 (0.02)	−0.003 (0.03)	0.47 (0.27)	0.03 (0.02)	0.003 (0.03)**
Race/ethnicity							
White	1,635 (78)	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Hispanic	119 (5.68)	1.09 (0.45)*	−0.01 (0.04)	−0.03 (0.06)	0.81 (0.45)	0.01 (0.04)	−0.03 (0.06)
Black	312 (14.89)	1.48 (0.30)***	−0.005 (0.03)	−0.04 (0.03)	1.19 (0.31)***	0.01 (0.03)	−0.03 (0.03)
Other race	30 (1.43)	−0.38 (0.94)	−0.05 (0.08)	−0.07 (0.08)	−0.17 (0.89)	−0.05 (0.08)	−0.07 (0.08)
Years of education	12.78 (2.91)	−0.04 (0.04)	.0001 (0.004)	0.01 (0.01)	−0.04 (0.04)	−0.001 (0.004)	0.01 (0.01)
Smoking status							
Non-smoker	1,659 (79.15)	–	–	–	Ref.	Ref.	Ref.
Smoker	437 (20.85)	–	–	–	−1.74 (0.26)***	0.01 (0.02)	0.01 (0.03)
Non-housing wealth (in $)							
Wealth ≤ $7,500	298 (14.22)	–	–	–	0.89 (0.38)*	−0.07 (0.03)*	0.004 (0.04)
Wealth > $7,500 and ≤$25,000	366 (17.46)	–	–	–	0.93 (0.32)**	−0.02 (0.03)	−0.07 (0.04)
Wealth > $25,000 and ≤$60,000	411 (19.61)	–	–	–	0.73 (0.28)*	0.01 (0.03)	−0.002 (0.03)
Wealth > $60,000 and ≤$150,000	488 (23.28)	–	–	–	0.54 (0.23)*	0.01 (0.02)	−0.01 (0.03)
Wealth over $150,000	533 (25.42)	–	–	–	Ref.	Ref.	Ref.
Health insurance							
Employer-sponsored	1,893 (90.31)	–	–	–	Ref.	Ref.	Ref.
No Employer-sponsored	203 (9.69)	–	–	–	−0.69 (0.22)**	−0.03 (0.03)	0.01 (0.03)
Government-sponsored	91 (4.34)	–	–	–	Ref.	Ref.	Ref.
No Government-sponsored	2,005 (95.66)	–	–	–	0.28 (0.30)	0.13 (0.04)**	0.000 (0.04)

Table 1 continued

Variable	Basic model				Expanded model		
	N (%)/mean (SD) (1)	Intercept (2)	Pre-retirement slope (3)	Post-retirement slope (4)	Intercept (5)	Pre-retirement slope (6)	Post-retirement slope (7)
Other private	272 (12.98)	–	–	–	Ref.	Ref.	Ref.
No Other private	1,824 (87.02)	–	–	–	−0.60 (0.31)	−0.01 (0.03)	0.02 (0.03)
Weekly hours pre-retirement	40.99 (10.15)	–	–	–	−0.003 (0.008)	0.000 (0.001)	0.001 (0.001)
Dropout status							
Completer	1,765 (84.21)			Ref.	–	–	Ref.
Deceased during study	142 (6.77)	–	–	*−0.27 (0.06)****	–	–	*−0.26 (0.06)****
Dropped out during study	189 (9.02)	–	–	*−0.05 (0.04)*	–	–	*−0.05 (0.04)*

Columns 2–7: regression coefficients (standard errors); * $p < .05$, ** $p < .01$, *** $p < .001$

Note that these are original calculations conducted in New Haven, CT, 2010

to the professional and managerial occupation category. Nonetheless, one departure from the basic model is that, with the additional covariates in the expanded model, the BMI slope of the professional and managerial occupation is not statistically different from zero either before or after retirement.

Discussion

This study investigated whether retirement serves as a precipitating factor for changes in BMI patterns among four broad occupational categories. The results of our analyses indicate that study participants who are in service and other blue-collar occupations have significant increases in the slopes of their BMI trajectories after retirement, whereas participants in white-collar occupations exhibit no change in their BMI patterns after retirement. Although observational data do not permit unambiguous assessment of mediation, differences in the nature of blue- and white-collar work may be the cause. Blue-collar occupations often involve physically demanding tasks, while white-collar occupations characteristically have very limited physical requirements. Thus, it may be plausibly argued that retirement's cessation of critical physical activity leads to sustained BMI gains for blue-collar workers, but that the non-significant changes among white-collar workers reflect the absence of work-place physical demands. This argument is made more persuasive by our models' controls for education and other socioeconomic status factors, which both vary across occupation categories and are important predictors of post-retirement lifestyle choices (Henkens et al. 2008), such as healthy eating and physical activity, which affect BMI.

However, the increase in BMI may be due to unmeasured sources of differences in lifestyle choices post-retirement. Post-retirement differences in BMI may also be due to systematic differences by occupation in eating and exercising post retirement. For example, the greater time availability in retirement may result in more exercise combined with healthier eating for white-collar workers. In contrast, the extra time may result in more sedentary activities combined with consuming more calories for those who were in other occupations.

Our study, whose findings are generally consistent with those reported in the earlier research (Chung et al. 2009; Forman-Hoffman et al. 2008; Nooyens et al. 2005; Patrick et al. 1982), has three advantages over previous studies on this topic. First, the design allows for reasonably long assessment of both pre- and post-retirement BMI trends, with a sufficient number of data points to construct legitimate trajectories. Second, our technique adjusts for intercept differences between occupation classes in a

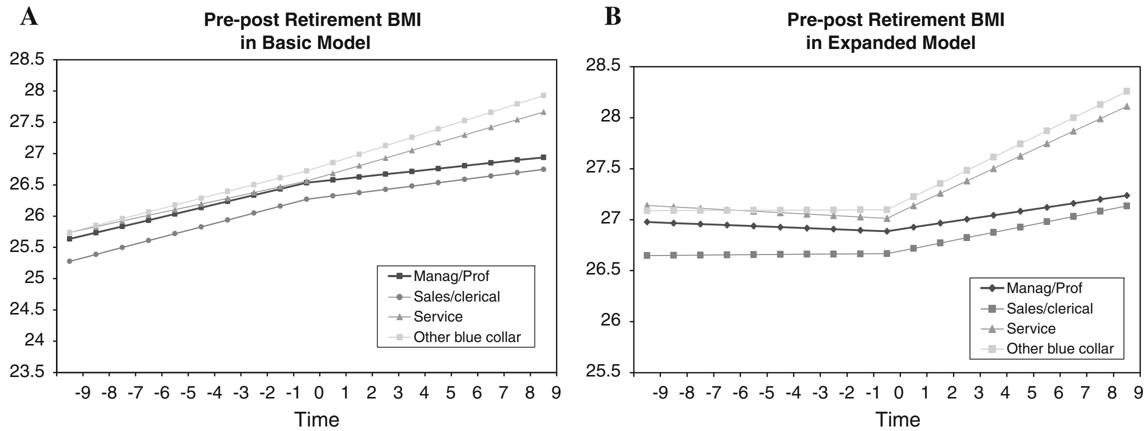

Fig. 1 Body mass index (BMI) trajectories by occupation class: basic and expanded models (BMI is on the *Y* axis; retirement is designated by time equal to zero; time is measured prior to or post the event of retirement). Note that these are original calculations conducted in New Haven, CT, 2010

manner that traditional statistical analysis cannot, an advance that strengthens our inferential capabilities. Third, we examine both a basic and expanded set of explanatory variables. And fourth, we control for attrition/dropout; failure to do so could result in biased findings.

Employment-based medical professionals and family physicians should be aware that retirement represents a critical event that alters the path of BMI for workers in blue-collar occupations. Information regarding the health risks of weight gain may then be conveyed to such individuals, and interventions to help blue-collar retirees maintain or lose weight may be made available. The result of intervening prior to retirement may be to delay or reduce the onset of obesity-related chronic diseases, which are costly and burdensome to public health programs for retired persons.

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