Are food and fitness competing claims on adults' time?

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Abstract

Time spent exercising and preparing food is linked to lower risk of obesity, yet time is scarce in American households. It is unclear if food preparation and exercise complement one another, or if people trade off one to make time for the other. We used the 2003-2010 American Time Use Surveys (N=112,037) to fit zero-inflated negative binomial models predicting exercise time as a function of time spent preparing food and household structure. A 10-minute increase in food preparation time was associated with lower probability of exercising 10 more minutes among both men and women (IRR=0.97, 95% CI=0.96-0.99 for men; IRR=0.99, 95% CI=0.98-0.99 for women), and this association did not vary by household structure. We conclude that the few adults who make time to exercise on a given day do so at the expense of time spent preparing food. Public health recommendations should account for this tradeoff in Americans' time budget.

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The increased prevalence of obesity among U.S. adults is a major public health concern (Flegal et al., 2012). Obesity is defined using the body mass index (BMI), calculated as weight in kilograms divided by the square of height in meters. In 2009-2010, 33.3% of adults ages 20 years and older were overweight (BMI 25 – 29.9) and 35.9% were obese (BMI > 30) (Flegal et al., 2012). By contrast, in 1960-1962 only 31.5% of adults ages 20 to 74 years were overweight and 13.4% were obese (Ogden and Carroll, 2010). The upward trend in obesity has been linked to trends in Americans' time use: Americans are spending less and less time preparing food and being physically active (Cutler et al., 2003; Kolodinsky and Goldstein, 2011). Public health research has linked time spent preparing food and regular exercise to healthier diets and a lower risk of obesity, respectively (Jabs and Devine, 2006; Haskell et al., 2007; Zick et al., 2011). Ideally, adults would make time for both activities as part of a healthy lifestyle, but households' time scarcity may make food preparation and exercise competing claims on adults' time.

Time spent preparing food is at a historical low. Women's time spent preparing food declined from an average of 92 minutes per day in 1975 to 51 minutes per day in 2006, while men's time spent preparing food has hovered around 20 minutes per day throughout this period. (Zick and Stevens, 2009). Societal and demographic changes have driven this trend. Time spent eating meals has declined, while time spent snacking has increased (Zick and Stevens, 2009). With fewer traditional meals, less time is needed to prepare food. Also, meals away from home increasingly substitute for at-home cooking, making food preparation a choice rather than a necessity (Guthrie et al., 2002). Concurrently, rising women's employment and the shift away from two-parent households towards single-parent households have placed new constraints on the amount of time available for household tasks, including food preparation (Bianchi et al., 2000; Mancino and Newman, 2007).

As with time spent preparing food, time spent being physically active has also declined (Brownson et al., 2005). This is due to a more sedentary lifestyle, and not a decline in exercise participation. In 2004, 23.7% of adults reported no leisure-time physical activity, compared to 29.8% in 1994 (CDC, 2005). Despite this, many American adults remain too inactive, with only 49% meeting physical activity guidelines in 2005 (Haskell et al., 2007). Americans' commutes, jobs and non-exercise leisure activities have become increasingly sedentary. Increases in daily vehicle miles traveled per capita, the proportion of the labor force in white-collar jobs, and "screen time," time spent in front of a TV or computer, have profoundly reduced time spent being physically active on any given day (Brownson et al., 2005; Dunton et al., 2009). Parents, married adults, and full-time workers are particularly likely to engage in little to no leisure-time physical activity (Bellows-Riecken and Rhodes, 2008; Brown and Roberts, 2011).

Although spending time preparing food and exercising are both related to a lower risk of obesity, past studies have not examined whether the two activities are complements or substitutes. It is possible only the adults most committed to a healthy lifestyle spend significant amounts of time on both food preparation and exercise. On the other hand, the demands of family, work, and other leisure activities may leave little room for food preparation and exercise; in this case, choosing to spend time on one would necessarily require decreasing time spent on the other. In light of the public health recommendations that adults make time for both food preparation (Lichtenstein et al., 2006) and regular exercise (Haskell et al., 2007), we analyzed if adults' time expenditures on food preparation and exercise complement or substitute for one another.

Methods

We use data from the American Time Use Survey (ATUS), a nationally representative survey that assesses how individuals spend their time (U.S. Census Bureau, 2012). A three-stage, stratified sampling procedure is used to select households that have completed month eight of the Current Population Survey. Within the selected households, a person aged 15 years or older is randomly selected to complete a telephone interview detailing time use over the previous day. We analyzed the 24-hour activity recall data collected from 2003 through 2010, a pooled sample of 216,556 cases. We restricted the sample to the 205,490 respondents age 18 and older. After excluding cases with missing data, we obtained an analytic sample of 112,037 cases.

Our outcome was duration of leisure-time exercise on the diary day (Zick et al., 2011). We summed the duration of all activities on the diary day classified as exercise or sports and lasting at least 10 minutes (Haskell et al., 2007). We included activities coded as leisure-time sports and exercise, excluding work-, travel-, housekeeping-, or childcare-related activities (Ham et al., 2009; Zick et al., 2011). We also excluded activities falling below a MET threshold of 3.3 (Zick et al., 2011), using Tudor-Locke and colleagues' (2009) data linking ATUS activity codes to MET scores. Our main independent variable was total time spent preparing food on the diary day (Zick and Stevens, 2009). We summed the duration of all activities coded as food preparation, food presentation, or food cleanup. We anticipated that the relation of food preparation to exercise time would vary by household structure, as couples and parents may have more constraints on time use than single, childless adults (Nomaguchi and Bianchi, 2004; Bellows-Riecken and Rhodes, 2008). We defined household structure as a set of four mutually exclusive categories: single childless; single parent; childless couple; and couple with children. We measured couple status as a matter of household structure rather than marital status as the two are highly correlated ($r = 0.83$).

We included several potential confounders that may determine both time spent preparing food and time spent exercising. These were: diary day (weekend vs. weekday; holiday vs. non-holiday; summer vs. other seasons); age (top-coded at 80); gender; race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, or other); educational attainment (less than high school, high school or equivalency diploma (GED), some college or associate's degree (AA), or bachelor's degree (BA/BS) or higher); work status (not working, working part time (less than 40 hours per week), or working full time); and income tertile (Mancino and Newman, 2007; Nomaguchi and Bianchi, 2004; Bellows-Riecken and Rhodes, 2008; Zick and Stevens, 2009; Zick et al., 2011). Income was collapsed into tertiles because the original categorical measure had very uneven gaps between categories, and did not adjust for inflation over the 2003-2010 period. We created weighted rankings on this measure for each year of the ATUS, and divided households into tertiles by their income to obtain a measure of income more comparable across survey years.

We described the distributions of exercise time and time spent preparing food in our sample, noting differences by household structure, gender, and their interaction. We then predicted time spent exercising as a function of the independent variables described above, using zero-inflated negative binomial count models (ZINB) to correct for the excess number of respondents reporting zero time spent exercising (Lee et al., 2010). ZINB models are appropriate for count measures with a large number of zeroes, including exercise time (Buis et al., 2009; Slymen et al., 2006). The model estimates two equations: a logit predicting whether a respondent will not exercise at all and a count model of exercise time in 10-minute intervals (Long, 1997). We included all independent variables, as well as survey year, in both equations.

As prior work has shown time use to differ significantly by gender, we analyzed men and women separately (Bianchi et al., 2000; Nomaguchi and Bianchi, 2004). Together with the interaction terms, this means we estimated the association between food preparation time and time spent exercising for eight different subgroups: single childless men; single fathers; men in childless couples; coupled fathers; single childless women; single mothers; women in childless couples; and coupled mothers. We tested the significance of gender differences by fitting pooled models and interacting all independent variables with a binary measure of gender. All tests were two-tailed. All analyses were performed using Stata/MP 12.0 (StataCorp LP, College Station, TX), applying sample weights to produce unbiased point estimates and using the replicate variance technique to calculate the standard errors (U.S. Census Bureau, 2012).

Results

Table 1 presents descriptive statistics for men and women in the sample. Participation in leisure-time exercise on the diary day was low. Only 16% of men and 12% of women exercised on the diary day; average time spent exercising was 19 minutes for men and 9 minutes for women, including those who did not exercise on the diary day. Respondents also spent little time on the diary day preparing food. Average time spent preparing food was 44 minutes among women and less than 17 minutes among men. In other words, the average respondent, male or female, spent less than an hour on both exercise and food preparation on the diary day.

[Table 1 about here]

Table 2 presents results from the logit equation estimated by the ZINB model, predicting zero exercise on the diary day. Among women, time spent preparing food is not significantly associated with zero exercise on the diary day, regardless of household structure. Among single childless men, each 10 minutes spent preparing food predict a 3% increase in the odds of not exercising (OR=1.03, 95% CI: 1.02-1.05). Yet among men in couples, the relationship between food preparation and any exercise changes direction, with food preparation time negatively associated with the odds of not exercising at all. Though these results suggests exercise behavior may be contingent on food preparation time use, particularly among men, the logistic model's main utility is in identifying those people who are expected to exercise on the diary day, and for whom a time trade-off between exercising and preparing food is salient.

[Table 2 about here]

Results from the count equation estimated by the ZINB model are presented in Table 3. Among single childless adults, spending 10 more minutes preparing food is associated with a lower probability of spending 10 more minutes exercising (IRR=0.97, 95% CI=0.96-0.99 for men; IRR=0.99, 95% CI=0.98-0.99 for women). There is no gender difference in the coefficients at the 95% confidence level (p=0.229). Further, the interactions of food preparation with household structure are not significant for either men or women. In other words, adults who spent more time preparing food spent less time exercising, regardless of gender or household structure. While food preparation may complement a minimal level of involvement in exercise among partnered men (as indicated in Table 2), even in this group, allocating time between these activities on the diary day is a zero-sum game, with one activity substituting for the other.

[Table 3 about here]

Discussion

Our study examined the association between food preparation and physical activity; specifically, whether adults who engage in one behavior are also more likely to make time for the other.

Analyzing time use data from a large, nationally representative sample, we found strong evidence of a substitution effect: adults who exercised on their diary day did so at the expense of food preparation: the more time they spent preparing food, the less time they exercised. This trade-off between time spent preparing food and time spent exercising was independent of gender and household structure. Devoting *any* time to exercise on the diary day, however, was positively associated with food preparation time among partnered men.

Our study adds to the increasing complex literature on the clustering of health behaviors within individuals. Berrigan et al. (2003) found that adherence to public health recommendations for physical activity, tobacco use, alcohol consumption, fruit and vegetable consumption, and dietary fat intake was clustered among U.S. adults. Yet studies of other health behaviors have found no such evidence of clustering. For example, time spent preparing meals did not correlate with the nutritional quality of the meal (Chu et al. 2012). Our results bolster the evidence against health behavior clustering. Considering the amount of time devoted to food preparation and exercise, we found evidence of health behavior substitution rather than clustering.

The concept of time scarcity is a useful framework for synthesizing our findings with prior work. Devoting more time to one activity inherently limits the amount of time available for other activities. Both of the health behaviors we studied are time-intensive, whereas many of the health behaviors considered elsewhere are not, especially non-activities such as not using tobacco. Other recommendations require little time expenditure on the margin, including fruit and vegetable intake, dietary fat intake, and alcohol consumption. By contrast, at-home food preparation and exercise are activities where the minimal time expenditures are non-trivial and further time expenditures are often necessary. With a fixed time budget, individuals may be more likely to substitute one health behavior for another, just as they substitute among paid work, unpaid work, personal care and fitness activities (Taniguchi and Shupe, 2012)

The limitations of our study illuminate promising avenues for further work on health behavior clustering. Although the ATUS time use data are detailed and comprehensive, the survey only covers a single day. It is unclear if some people make up for not exercising or preparing food on a given day by spending more time on either activity on another day. Further, the definition of exercise is restricted to leisure-time physical activity above a particular MET threshold. But, to some extent, people may choose to make other aspects of their life more physically demanding (e.g., choosing to bike to work rather than drive) to compensate for not exercising in another context. Further research should reveal how people rearrange their time use when they intend to spend more time being physically active. Finally, future studies should investigate which combinations of time spent exercising and preparing food are most beneficial to individuals' and households' health given a range of possible time budgets.

Despite its limitations, our study has significant implications for public health recommendations related to preparing food at home and physical activity. Recommendations are crafted in isolation, with the optimal level for each behavior considered independently of other behavior recommendations. We found that even single, childless adults, having the fewest time constraints, substitute between exercise and food preparation time. This suggests that for time-intensive behaviors, public health officials may needs to triage their recommendations by how much time they think people have to spend on these activities when taken together. If adults have a set time budget to devote to healthy behaviors, then recommendations should be tailored to make efficient use of that time budget.

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Table 1. Descriptive statistics for 2003-2010 ATUS.

	Men	Women
	Mean (SE) or %	Mean (SE) or %
Diary day time use		
Minutes of exercise	18.8 (0.4)	9.4 (0.2)
Any exercise?	15.9%	12.3%
Minutes preparing food	16.6 (0.2)	44.4 (0.3)
Household structure		
Single childless	35.9%	32.3%
Single parent	3.9%	11.7%
Couple childless	27.6%	25.7%
Couple parents	32.6%	30.3%
Diary day		
Summer	24.7%	25.5%
Holiday	1.8%	1.7%
Weekend	28.5%	28.5%
Age	42.9 (0.02)	44.6 (0.01)
Race/ethnicity		
White	70.2%	70.1%
Black	10.7%	12.2%
Hispanic	14.2%	12.6%
Other	4.9%	5.1%
Income tertile		
Bottom	26.5%	30.6%
Middle	48.8%	47.7%
Top	24.7%	21.7%
Education		
< HS	19.8%	18.2%
HS only	30.2%	30.0%
Some college/AA	23.6%	26.1%
BA or more	26.4%	25.7%
Work		
None	31.7%	43.9%
Part time	11.0%	20.7%
Full time	57.3%	35.4%
N	48662	63375

Survey weights applied.

Table 2. Odds ratios (OR) from zero-inflated negative binomial models.

	Binary outcome: No exercise on diary day				
	Men		Women		
	OR	(95% CI)	OR	(95% CI)	$p(b^{men}=b^{women})$
Food preparation time					
in 10-min. increments	1.03	(1.02-1.05)	1.00	(0.98-1.01)	0.002
Household structure					
Single childless	---		---		
Single parent	1.26	(1.03-1.54)	1.78	(1.56-2.03)	0.005
Couple childless	1.02	(0.92-1.13)	1.15	(1.06-1.26)	0.063
Couple parents	1.13	(1.03-1.24)	1.40	(1.28-1.52)	0.002
x food prep. time					
Single childless	---		---		
Single parent	0.95	(0.89-1.01)	1.01	(0.99-1.03)	0.057
Couple childless	0.96	(0.93-0.98)	0.98	(0.97-1.00)	0.068
Couple parent	0.95	(0.93-0.97)	1.00	(0.98-1.02)	0.002
N	48662		63375		

Survey weights applied. Models adjusted for diary day, age, race/ethnicity, income tertile, educational attainment, work status and survey year (ORs not shown).

Table 3. Incidence risk ratios (IRR) from zero-inflated negative binomial models.

	Count outcome: Exercise duration in 10-min. increments				
	Men		Women		
	IRR	(95% CI)	IRR	(95% CI)	$p(b^{men}=b^{women})$
Food preparation time					
in 10-min. increments	0.97	(0.96-0.99)	0.99	(0.98-0.99)	0.229
Household structure					
Single childless	---		---		
Single parent	1.09	(0.93-1.28)	1.00	(0.87-1.15)	0.425
Couple childless	1.19	(1.10-1.29)	1.04	(0.96-1.12)	0.014
Couple parents	1.07	(0.98-1.16)	1.02	(0.94-1.11)	0.463
x food prep. time					
Single childless	---		---		
Single parent	0.99	(0.96-1.28)	1.00	(0.96-1.12)	0.753
Couple childless	1.02	(0.99-1.05)	1.00	(0.99-1.01)	0.110
Couple parent	1.02	(0.99-1.03)	1.00	(0.98-1.01)	0.087
N	48662		63375		

Survey weights applied. Models adjusted for diary day, age, race/ethnicity, income tertile, educational attainment, work status and survey year (IRRs not shown).