The Impact of Obesity on Unemployment Duration

Jeremy Groves, PhD

and

Virginia Wilcox, PhD\*

Department of Economics

Northern Illinois University

Dekalb, IL

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Obesity and its concomitant morbidity have a profound effect on the working careers of Americans. Prior studies document that the obese are less likely to be employed than their nonobese peers. Lower employment may be due to higher job turnover and/or longer duration of unemployment spells. To better understand the connection between obesity and unemployment, we estimate the impact of obesity on the duration of unemployment spells by estimating a hazard rate model of unemployment duration for individuals with BMI’s classified as overweight and obese drawn from the National Longitudinal Survey of Youth (1997). Our findings indicate that, on average, overweight and obese job seekers experience significantly longer spells of unemployment, other things equal. The average effects; however, differ dramatically by race and gender with women experiencing longer spells across BMI classifications and Black women seeing longer unemployment spells compared to White women of similar BMI. Conversely, men see no impact on unemployment spells by BMI; however, Black men experience longer spells than White men, all else equal

\* corresponding author

[vlw@niu.edu](mailto:vlw@niu.edu)

815-753-6957

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1. Introduction

Millions of American workers are obese. Because this condition affects workers in the prime years of their working lives, it may have a profound effect on their working careers. Recent studies report that obesity causes significantly higher levels of unemployment among American workers and appropriate policy design requires that we better understand the factors of such spells. To contribute to our understanding of the relationship between obesity and unemployment, we examine the impact of obesity on the duration of unemployment spells and further investigate the impact by sex and race.

To the standard job search model found in the labor economics literature we add a variable representing obesity and estimate its differential impact on unemployment duration using a Cox Proportional Hazard (CPH) model with individual frailty for data selected from the National Longitudinal Survey of Youth (1997). Our results indicate that overweight individual see a 5% increase in unemployment spells while obese individuals see a 11% increase. Furthermore, we show that not all races and genders experience equal effects from BMI as White women classified as overweight experience unemployment spells about 12% longer than White women of normal BMI (the baseline). Likewise, White women classified as obese experience spells that are about 19% longer than the baseline. For Black women, those with a normal BMI experience the largest impact on unemployment spells seeing spells that last about 29% longer than the baseline. The duration for Black women classified as overweight or obese are shorter compared to Black women with a normal BMI and are about the same as the impact experienced by White women of the same BMI classification. For men, however, BMI classification has no impact on unemployment spell duration for any race; however, Black men, in general, all experience unemployment spells about 16% longer than White men.

**2. Prior Studies**

Many studies have examined the relationship between weight and labor earnings in many countries.[[1]](#footnote-1) Although the econometric methods used to handle the potential endogeneity between weight and wages have varied across studies, most (not all) have reported that obese workers, especially women, earn lower wages, other things equal. Averett and Korenman (1996), Cawley (2004), Baum and Ford (2004), and Conley and Glauber (2005) all found a wage penalty for obesity in the range of 0.6–12%. More recently, Han, Norton, and Powell (2011) reported that for women, a one-unit increase in the body mass index (BMI) is directly associated with 1.83% lower hourly wages, while no BMI wage penalty is found for men.[[2]](#footnote-2) However, obesity (BMI>30) is associated with 3.5% lower hourly wages for both women and men. Because Han et al. (2011) included both direct and indirect (via educational attainment and choice of occupation) effects of an increase in BMI, the estimated effect is larger than that found in prior studies. (Gilleskie, Han, and Norton (2017) )

Fewer studies have examined the employment effects of obesity, but the evidence is drawn from several countries. These studies include field experiments, analyses of the effect of obesity on the probability of employment, and studies of the impact of obesity on the duration of unemployment spells. Rooth (2009) conducted a field experiment in Sweden to discern if employers are less likely to hire obese persons. He finds that job applications sent with the weight-manipulated photos had significantly lower invitations for interviews: Six percentage points lower for men and eight percentage points lower for women.

Caliendo and Lee (2013) found similar results in their study of the employment outcomes of newly unemployed job applicants in Germany. The authors reported that despite making more job applications and engaging more in job training programs, obese women "experienced worse (or at best similar) employment outcomes than normal weight women."

Other studies of the effect of obesity on the probability of unemployment report differing findings: Morris (2007) found that obesity has a significant negative impact on employment for both men and women in a survey of English workers from 1997 and 1998. He finds that failure to account for the endogeneity between obesity and employment led to underestimation of the effect for women. In contrast, Lindeboom, Lundberg, and van der Klaauw (2010), using a long panel sample for Great Britain, reported that obesity decreases employment when estimated in an ordinary least squares regression, but that this effect disappears in an instrumental variable regression model instrumenting obesity with parental obesity and using individual first differences. This suggests that it is unobserved characteristics of the individual rather than obesity that cause employment penalties. Looking beyond Great Britain, Greve (2008) found a negative effect of high BMI on the probability of employment for both men and women in a study using data from a Danish panel survey.

Studies using American data to estimate the impact of obesity on the probability of employment have also reported mixed findings: Norton and Han (2008) used information from specific genes linked to obesity as instrumental variables to estimate the effect of obesity on employment. They found that obesity has no effect on the employment of men or women. Cawley, Han, and Norton (2011) suggested, however, that because genes typically act in concert with other genes, it may be that the genes for neurotransmitters used as instruments may "affect too many things to be valid instruments in most contexts".

Cawley and Danziger (2006) investigated whether obesity is a barrier to employment for former welfare recipients. They found that obese white women are "less likely to work at any survey wave [and] spend a greater percentage of months between waves receiving cash welfare". They commented that "the magnitude of the difference in labor market outcomes between the morbidly obese and those who are less heavy is in some cases similar in magnitude to the differences in these labor market outcomes between high school dropouts and graduates." This suggests that obesity has a strong negative impact for at least some groups in the United States. Renna and Thakur (2010) examined the impact of obesity on employment for another group in the United States population, those nearing retirement. They found that obesity increases the probability of taking an early retirement by 1.5% for men and by 2.5% for women.

Finally, a few studies have considered the relationship between obesity and the duration of unemployment. Härkönen (2007) examined the obesity gap in female unemployment in Finland. After controlling for human capital and demographic characteristics and job search behavior, the author found that obese women have a lower probability of transitioning from unemployment to employment. He attributes this differential to employer discrimination. A similar study using French household data (Paraponaris, Saliba, and Ventelou, 2005) found that "having a BMI greater… than the median BMI decreases the ability to regain employment, and as the deviation increases, the likelihood of employment decreases." The authors also reported that this effect is stronger for women than men. Finally, Katsaiti and Shamsuddin (2016) find a significant impact of obesity on unemployment duration among women in Germany.

While not focused on obesity, Stewart (2001) used a short longitudinal panel to identify the impact of impaired health on the duration of unemployment spells for a sample of unemployed Canadians. She reported that individuals with impaired health experienced significantly longer unemployment spells than unemployed persons without impairments. The longer duration of unemployment among impaired persons led to a larger proportion of the unemployed having impaired health.

Our review of the literature yields mixed findings regarding both the impact of obesity on earnings and on the probability of employment, but many report negative effects. The few studies that examined the connection between poor health or obesity and the duration of unemployment spells consistently found that the negative relationship is driven by longer duration of unemployment between jobs. Unlike the reviewed studies, our research focuses on the impact of obesity on unemployment duration using data for the United States. Further, our use of panel data with repeated unemployment spells (NLSY97, 1992-2006) permits us to control for unobservable individual characteristics that are time-invariant.

**3. Job Search Model of Unemployment Spells**

The number of unemployed workers at any point in time is influenced by both the rate of job turnover and the duration of unemployment spells between jobs which is the factor we focus on. For this research we adopt standard methods used by labor economists studying job search and unemployment.[[3]](#footnote-3) Job search models explicitly formulate the process in which a person invests time, money, and effort in conducting a job search. If a job offer is received, the individual compares the discounted value of future income of accepting the job (**Ve**) to the expected value of future income of continued job search (**Vu**). The individual continues searching until an offer is received for which **Ve > Vu**. The process of searching is combined with the probability of the person receiving an acceptable job offer to generate a prediction of how long the individual will search before he or she will find and accept a job. This period is termed the duration of the unemployment spell. The duration of any given unemployment spell depends upon many factors, including the person’s search efforts, his or her attributes and skills, and the number and type of job openings in the labor market while he or she is searching.

In the classical job search model, the average duration of unemployment (***T***) is expressed as a function of the rate at which a job seeker receives offers (***ρ***) and the probability that he or she will accept an offer that is made (***A***):

(1) ***T = 1 / [ρA]***

The probability of accepting an offer (***A***) depends upon the searcher’s comparison of the expected value of accepting versus the expected value of continued search (**Ve** and **Vu**). The level of labor demand, characteristics of the individual, and the intensity of the individual’s job search determine the magnitude of ***ρ***:

(2) ***ρ = ρ(Ld, Ci, Si)***

Labor demand factors (***Ld***), such as the unemployment rate, determine the number of positions available, other things equal. The characteristics of the job seeker (***Ci***), such as the person’s age, education, and job experience, determine the likelihood of there being a job vacancy that matches the individual, other things equal. Finally, the intensity of the person’s job search (***Si***) influences the time until the job seeker is offered a position because it influences the likelihood of finding a match of his or her characteristics with current vacancies, other things equal.

A tenet of job search theory is that search activities have costs and the higher the cost of search, the lower will be the intensity of the individual’s search activities. Less intense search implies that a longer time is needed to find an appropriate match and, therefore, the longer the duration of the person’s unemployment spell. A large body of empirical research has examined the many factors that influence the intensity of job search. For example, research indicates that more generous unemployment benefits reduce the opportunity cost of unemployment, implying that more generous benefits allow the recipient to be more selective about accepting a position, leading to longer duration of unemployment. In comparison, less generous benefits push searchers into accepting job offers more quickly, other things equal. Alternatively, if the economy is experiencing a recession, research indicates that the lower availability of jobs leads to a longer duration of unemployment, other things equal.[[4]](#footnote-4)

We estimate a reduced form model and are unable to test for specific causes explaining why obesity might lengthen the duration of an unemployment spell. However, there are multiple reasons why the duration of unemployment spells may be longer among obese persons. Some of these stem from the employers’ demand for labor such as employers expecting the average obese worker to incur higher health care costs and thus be reluctant to hire an obese person because of these costs. Alternatively, employers may believe that obese workers are less productive and, again, be reluctant to hire an obese person. Both reasons reduce the rate at which a job seeker receives offers and increase the duration of unemployment. Employers may also engage in taste discrimination where they prefer to hire non-obese workers for reasons not related to productivity or costs thus reducing the probability of the employer making an offer to an obese person. This, again, reduces the rate at which a job seeker receives offers and increasing the duration of unemployment.

To the extent that obesity affects physical mobility and self-esteem, it is also possible that it affects job seekers’ search activities by increasing the cost of job search if the job seeker finds it more difficult to prepare for and/or attend interviews. This will in turn decrease the intensity of search and thereby decrease the rate at which a job seeker interviews and receives offers. This will lengthen the duration of unemployment. The probability that a person will accept an offer of employment depends upon the person's 'reservation wage’, the minimum wage at which an offer would be accepted, and it may be that an obese person expects job tasks associated with a job to be more difficult, this will raise the reservation wage and reduce the probability that he or she will accept an offer, and lengthen the duration of unemployment.

The goal of this research is to establish the existence and magnitude of a net effect of obesity on the average duration of unemployment spells. Accordingly, we estimate the reduced form effect of obesity on the duration of unemployment and do not attempt to distinguish the source of the effect.

**4. Econometric Model**

To test whether obesity has a significant differential impact on unemployment duration while controlling for unobserved individual-specific effects, we estimate the hazard model, shown below, and calculate the probability that an unemployment spell for individual ***i*** will end given that it has lasted until time ***t***.

**(3)**

In this formulation, ***ho*** denotes an unknown baseline hazard function measuring the likelihood of experience the “event” or end of spell at time ***t*** thatis shared by all and is only a function of time (that is, how long the spell has lasted up to this point in time). This baseline hazard is multiplied by the term incorporating individual characteristics, measured by the vector and weighted by the vector . A challenge involved in estimating this model is the choice of the baseline hazard function which can be addressed by assuming that the baseline hazard functions for the treated and untreated observations are proportional to each other, as is done in the Cox Proportional Hazard (CPH) model, and thus cancel in the likelihood estimation, or by specifying, *ex ante*, a parametric functional form as in the Accelerated Failure Time model. Nonparametric estimates of the survival and hazard functions for the different BMI categories used to identify treatment in this model show that the curves are approximately proportional through most of the time in the sample and thus we estimate the model using the Cox Proportional Hazard framework.[[5]](#footnote-5)

The nature of our data includes repeated unemployment spells for several individuals which may introduction unobserved heterogeneity into the model. We control for this by assuming ‘frailty’ in model which allows the baseline hazard function to be ‘shifted’ based on the group or cluster that is the source of the heterogeneity. For example, an individual may have low self-esteem that is not reported in the survey but affects their search for new employment or, more importantly, may be correlated with obesity. By assuming frailty across individuals, we allow self-esteem, or any other unobserved individual characteristic, to ‘shift’ the baseline hazard function thus controlling for the unobserved individual impact on the overall hazard of a given unemployment spell ending. We allow this shift to vary by individual comparable to individual random effects regression models for panel data.[[6]](#footnote-6)

Specifically, we add the term , to the hazard function, shown in equation (4), where identifies the group or cluster to which the observation belongs (in this case the individual themselves) and denotes a matrix of individual specific parameters with distributed according to the Gaussian distribution with mean zero (Therneau and Grambsch, 2000).

**(4)**

The coefficients estimated in the CPH model can be expressed as hazard ratios via the formula assuming the baseline hazard is modified by a one unit increase in the given parameter of interest multiplied by its estimated coefficient. A hazard ratio less than one (generated by a negative coefficient estimate) indicates that an increase in the variable of interest causes the likelihood that the spell ends at time *t* (given it has lasted to time *t*) to be smaller than the baseline hazard, all else equal, implying that the unemployment spell has a higher likelihood of continuing (sometimes referred to as increased survivability). A hazard ratio larger than one (generated by a positive coefficient estimate) implies that the increase in the variable of interest causes the hazard to increase, meaning the likelihood of the unemployment spell ending in time t (given it has lasted to time *t*) has increased over the baseline hazard (sometimes referred to as decreased survivability), i.e., shorter duration of the unemployment spell.

**5. Data**

The data for this research are drawn from the National Longitudinal Study of Youth – 1997 (NLSY97). We use data for 1997 to 2011[[7]](#footnote-7) due to changes in the frequency of the survey after 2011 which impact key variables in our model. Unemployment spells (SPELL) are calculated using the weekly employment variable generated by the NLSY97 indicating if the respondent is employed, unemployed, or out of the labor force during each week within sample period.[[8]](#footnote-8) The length of an unemployment spell is determined by counting the number of consecutive weeks the respondent is classified as unemployed and a spell ends by the respondent becoming employed or leaving the workforce. Characteristics of the previous employer, discussed below, are matched to individuals’ unemployment spells using a unique job identifier created by NLSY97.[[9]](#footnote-9)

Table 1 provides the names, definitions, and summary statistics of the variables used in the analysis. While height and weight are collected annually, the raw data contain several errors with numbers being transposed or simply missing requiring us to fill in the missing values and correct the errors by first removing any observation larger than 2.5 standard deviations of the mean for each individual.[[10]](#footnote-10) For the height, the average height among the remaining observations is assumed as the height for the respondent over the entire sample. Missing and removed weights are replaced by interpolation using a linear methodology built into the R package *tidyverse* (Wickham et al., 2019). The imperial measures for each respondent are converted to metric and used to calculate the respondent’s BMI for that year. According to the standard BMI scale, individuals with a BMI below 18.5 are classified as underweight, those with a BMI between 18.5 and 24.9 are classified as having a normal BMI, individuals with BMI values from 25 to 29.9 are classified as being overweight, and those with BMI values over 30 are classified as being obese.[[11]](#footnote-11)

Control variables included in the analyses are of two types: The first describes the *personal characteristics* of the individual who experiences the unemployment spell and the second describe the *job specific characteristics* for the job immediately preceding the spell. For the personal characteristics we link the annual reported values of the individual characteristics to the year in which the unemployment spell started, and these values are assumed constant for the duration of that spell. Besides obesity, we include age (Age), an indicator if the respondent is over twenty-one years of age at the start of the unemployment spell (Ovr21), gender (Male\*, Female), race (White\*, Black, and Hispanic), marital status (NeverMarried\*, Married, and Separated),[[12]](#footnote-12) education (LessHS\*, HS, SomeCol, CollegeGrad, and CollegePlus),[[13]](#footnote-13) the presence of a child six years of age or young within the household (Child6), the household size (HH\_Size), a measure of gross family income (GFinc),[[14]](#footnote-14) and ability (Score) as measured by the ASVAB Math and Verbal Score Percentile.[[15]](#footnote-15) This score percentile, calculated by the NLSY97, is similar to the Armed Forces Qualification Test (AFQT) often used in other surveys. The NLSY97 asks respondents what, if anything, they plan to do regarding their weight with the choices of gaining weight, losing weight, staying the same, or doing nothing. We include indicators measuring how the respondent answered this question using the option of doing nothing as the reference category. Also included are self-reported health status (Good\*, Average, and Poor), census region of residency (NorEst, NorCen, South, and West\*), and a measure of job search behavior of a respondent during each employment spell (SearchCT) which is a count of the number of search methods the respondent reports having used during the unemployment spell.[[16]](#footnote-16)

The job specific characteristics include the respondent’s tenure (Ten) in the job immediately prior to the unemployment spell, total labor market experience (Exp)[[17]](#footnote-17) measured as the sum of all previous employment tenures, the occupation (OCC) and industry (IND) of the job immediately prior to the unemployment spell,[[18]](#footnote-18) and whether that job had union representation (Union). We also include indicator variables denoting the reason the unemployment spell started (Quit, Forced, Ended, Illness, Unknown\*)[[19]](#footnote-19) and the unemployment rate (Urate) for the Census region in which the individual resides to capture overall labor market tends. The monthly unemployment rates, obtained from the Saint Louis Federal Reserve Bank’s FRED website, are matched with the month and year the unemployment spell begins.





**6. Results**

**6.1 Descriptive Analysis**

For the full sample of 15,228 unemployment spells, Table 1 reports that the average unemployment spell lasted 12.6 weeks. There are only 391 spells reported by 224 respondents with a BMI classification of underweight experiencing an average unemployment spell of 11.30 weeks, 7,051 spells reported by 2,746 unique respondents with a BMI classified in the normal range with an average unemployment spell of 11.42 weeks, 4,084 spells reported by 1,941 respondents who were classified as overweight at the start of the spell with an average duration of about 12.90 weeks, and the remaining 3,702 spells were experienced by 1,351 respondents who were classified as obese at the start of the spell with an average duration of 14.68 weeks. The increase in the spell duration across BMI classification is statistically significant at the highest level between each BMI class with the exception of the spell lengths for the underweight and normal weight categories.

Figure 1 shows the non-parametric Kaplan–Meier (K-M) survival curves for the full sample for each of the four BMI categories for the first 30 weeks.[[20]](#footnote-20) The survival probability is the likelihood that an unemployment spell continues given that it has lasted until that time and the median survival time, the point at which the survival probability is 50%, is shown with dashed lines. The mean survival occurs at five weeks for those in the normal and underweight BMI class, six weeks for those in the overweight class, and eight weeks for those in the obese class. Additionally we see that the survival curves appear parallel across most weeks as required by CPH estimation framework.

Figures 2 and 3 show the K-M survival curves for the female and male subsamples, respectively. For female respondents the median survival time, or median unemployment spell length, is four weeks for those in the underweight class, five weeks for the normal class, six weeks for the overweight class, and eight weeks for the obese class. For male respondents, the median unemployment spell length is seven weeks for those underweight, six weeks for those of normal weight, seven weeks again for those classified as overweight and eight weeks for those in the obese class. From these nonparametric graphs we suspect that there is likely not much difference in spell lengths for women or men between the underweight, normal, and overweight classifications, but that there may be an impact for those in the obese classification with a slightly larger impact for women than men.

Chart

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While these figures appear to support the hypothesis that an unemployment spell is influenced by BMI classification, the values reported in Table 1 for other variables and previous research indicate that respondent characteristics also vary by BMI class. As one moves across BMI classes, respondents tend to be older, more likely to have a child under the age of six present in the household, have a smaller gross family income, have a lower ability score, are more likely to be married, and have longer job tenures. The percentage of respondents with less than high school, high school or equivalent, and some college across the BMI categories while the percentage that have more than four years of college decreases across the BMI categories. The percentage of respondents who are White declines as one moves to higher BMI classifications, while the share of Black and Hispanic respondents rises. Respondents in the obese category utilized more search methods than respondents in the other two categories, had longer average tenure in their previous job, and experience longer periods of overall employment as measure by experience.

**6.2 Regression Analysis**

Tables 2 through 4 report coefficient estimates of the hazard functions across several specifications. In general, a negative coefficient estimate indicates that the hazard rate (likelihood) of ending an unemployment spell is lower compared to the baseline hazard and a positive coefficient estimate indicates that the factor increases the hazard rate of ending the unemployment spell relative to the baseline.





Table 2 shows the model estimated with only the different BMI categories and column (1) shows the estimates of the Cox Proportional Hazard model indicating that a respondent classified as underweight at the beginning of the spell does not experience a significant impact on the duration of their unemployment spell whereas those classified as overweight can expect to experience a 10% longer unemployment spell, all else equal, compared to a respondent who is of normal weight. With the average spell being about 12.60 weeks, the overweight respondent can expect to experience unemployment for a total of 13.80 weeks. The respondent that is obese can expect to experience unemployment for about 20% longer or about 2.5 weeks longer than an individual of normal BMI.

Beyond the previously discussed endogeneity caused by repeated spells for a given individual, one may also be concerned that BMI, specifically weight, may itself be impacted by the length of an unemployment spell. To satisfy the assumptions of the CPH model, we use the BMI classification at the start of the unemployment spell, and this remains constant for the duration of the spell leading to a low likelihood of endogeneity bias; however, to further allay fears of endogeneity, we estimate the simple model using the BMI classification for the respondent in the year prior to the start of the unemployment spell. The stability of the estimates shown in column (2) indicate this potential source of endogeneity should not be a problem in this context. Column (3) tests the other source of possible endogeneity by estimating the model with frailty across individuals. As discussed previously, we allow for there to be a unique term which modifies the baseline hazard for all spells experience by that individual to account for unobserved variation that is specific to the individual respondent similar to random intercepts in linear models.

The magnitude of the BMI classification effect grows across all three BMI classification; however, remains statistically insignificant for those in the underweight classification. Overweight individuals now experience a 14% increase in duration and obese individuals experiences a 28% increase in the unemployment spell, all else equal.[[21]](#footnote-21) Among the diagnostic statistics shown in the table, the standard deviation for the individual specific constant term gives a sense of the variation among individuals in the dataset. This statistic can be interpreted as indicating that an individual located one standard deviation from the average respondent experiences a baseline hazard about 40% different from the average individual’s baseline hazard. As the “average individual” is not clearly defined, we simply show this statistic to show the dispersion of the individual shift factors in the mixed effects estimation.

Finally, we use the lagged BMI classification combined with the individual frailty in column (4) and we do see some shifts in magnitude and significance among these results. Specifically, those who are shown to be underweight in the year leading up to the start of the unemployment spell see a reduction in their spell of about 12% compared to those in the normal BMI classification and this result is slightly significant. Additionally, there is an increase of about four-percentage points among those classified as overweight and a two-percentage point increase among those classified as obese.

Table 3 reports coefficient estimates after adding individual, market, and job specific controls to the base model. Columns (1) and (2) show the estimates from adding individual specific characteristics without and with frailty across individuals. Since we again reject the null hypothesis of no frailty effects, columns (3) and (4) maintain the assumption of frailty across individuals with column (3) adding market related measures and column (4) including job specific effects, mostly via fixed industry and occupational effects.

[Insert Table 3]

The inclusion of individual specific controls in columns (1) and (2) reduces the impact of BMI classification on unemployment spells across all three BMI classifications. For those in the underweight class, the impact becomes negative indicating a spell about 5% longer than those in the normal class, but the estimate is not statistically significant. Likewise, for those in the overweight class, individuals may experience a spell more than 2% longer than those in the normal BMI classification; however, this result is also not statistically significant. Obese individuals, on the other hand, experience a statistically significant increase of about 7%. While not shown, we estimate the model shown in column one using the lagged BMI classification and the estimated coefficients are equivalent those shown in column one.[[22]](#footnote-22)

Adding market (column 3) and job specific (column 4) controls does not change the magnitude of the BMI classification effects significantly, but for obese individuals, the statistical significance decreases to between five and ten percent. The estimated effects of the other covariates are relatively stable in both magnitude and statistical significance across the specifications in Table 3, with the largest change being observed when frailty is added to model estimate (columns (1) and (2)). We observe that women have a shorter duration compared to men, on average, of about 10% while age increases the duration of unemployment spells by between four and eight percent. Once job specific controls are added, those over twenty-one see an increase in unemployment spells that is only slightly statistically significant whereas Black individuals see unemployment spells significantly longer than those for Whites (around 20% longer), while Hispanic and White respondent spell lengths are not statically different. Increases in family income or ability tend to slightly shorten unemployment spells while those with an education including a high school degree or higher see significantly larger decreases in spell duration of between 10 to 20% compared to those with no high school degree.

Respondents in the North Central, Northeastern, and South Census regions see longer durations than those in the West region with the longest being seen in the Northeast and, as one would expect, higher regional unemployment rates lead to longer unemployment spell durations. The remaining coefficients show little to no statistical significance including measure of what the respondent plans to do about their weight, how many search tools they utilized during the spell, the reason for the start of the spell (after industry and occupation effects are added) or leaving a job with union representation.

**6.3 Analysis of Subgroup Effects**

It is well known that men and women have different labor market experiences and that the race of the respondent may also contribute to different experiences. Table 4 shows the estimates for model estimated on sub-samples of women and men separately with interactions between the BMI classification and race. In all cases the models are estimated assuming frailty across individuals and include the full set of controls including occupation and industry fixed effects.[[23]](#footnote-23) Furthermore, the use of the subsamples and variable interactions do not significantly alter the distribution of the individual specific shift factors as indicated by the variable coefficient standard deviation.

[Insert Table 4]

The first column show that, all else equal, women classified as underweight or overweight see no statistical difference in their unemployment spell duration compared to women classified as normal weight; however, the sign on the impact for women that are underweight is positive, indicating a shorter duration, while the sign is negative for those overweight. Women classified as obese see a 13% increase in their unemployment spell duration compared to women of other classifications. Black women experience a significant increase in their unemployment spell of around 22% while Hispanic women see no statistical difference in the duration of their unemployment spell, all else equal.

The second column interacts the racial identifier with the BMI class and sheds some additional light on how different women are impacted by their BMI classification and race. The duration of underweight White women remains insignificant; however, the magnitude increases. Overweight White women experience a slightly significant increase in duration of about 10% compared to White women in the normal category. White women classified as obese see their spell duration increase to about 16%. A Black woman with a BMI classification of normal sees a 27% increase in their unemployment spell, or almost 3.5 weeks longer, than their White counterpart, also with a BMI classification of normal. Surprisingly, however, Black women classified as overweight see a shorter unemployment spell compared to Black women with a normal BMI classification indicating that compared to a White women of normal BMI class, a Black women classified as overweight experience an unemployment spell about 12% longer. The impact on Black women classified as obese is positive, which would make their spells slightly shorter than Black women with a normal BMI, but this result is not statistically significant. Black women classified as underweight may observe a duration almost twice as long as their normal weight counterparts; however, because the estimate is not statically significant, we cannot be confident in this result. As before, being Hispanic has no impact on unemployment spell regardless of BMI classification.

For men, the last two columns of Table 4 show a very different set of effects. As with women, the first column does not include interaction effects and the second column does. Interestingly, men classified as underweight experience a longer unemployment spell compared to normal weight males; however, this result is just barely significant and loses its significance when interaction effects are added. The interaction effects show that for White men, there is no statistically significant impact on unemployment spell by BMI; however, if the magnitudes were to be believed, underweight men would experience longer spells while obese men would experience slightly shorter spells. Black men with a normal BMI experience unemployment spells about 16%, or just under two weeks, longer than White men with a normal BMI and being a Black man in any of the other classifications does not change this result based on the statistical significance. Looking only at magnitudes, however, indicates a slight shortening of the spell compared to normal weight Black men for underweight men and even more so for overweight Black men while obese Black men by experience much longer unemployment spells. Again, Hispanic men seem to experience no statistically significant impact; however, underweight Hispanic men may experience unemployment duration of about 22% longer than White men of normal weight and obese Hispanic men may also see longer spells.

There are also some interesting comparisons between men and women among the other control variables as well. Separated women experience longer unemployment spell than men who are separated; however, higher gross family incomes shorten women’s spell length faster than men’s. Education also has different impacts across gender with males enjoying a much larger impact from any level of education on the shortening of their unemployment spell. While the relative difference is smaller for those with some college or a college degree, it is also interesting that women with more than a college degree see no statistical or economic benefit on their unemployment spell whereas men see a reduction of around 20%. Women see spells increase with tenure in the job immediately preceding the unemployment spell while the impact on men is smaller and not statistically significant. Conversely, men gain a slightly positive impact (shortening) of their unemployment spell duration s overall experience rises whereas women see no such effect. Finally, men in all three regions see longer durations compared to men in the West region. Only women in the Northeast region see any special regional impact on their unemployment spell.

**6.4 Robustness**

To test the robustness of these results we perform two additional estimations. In the first, we replicate the full model estimate with frailty across individual for subsamples of each race and each race-gender pairing in place of interactions. Secondly, since duration data is essentially condensed limited dependent variable data, we estimate the model using a Logit specification with a set of temporal dummy variables to control for duration dependence in the model (Beck, et. al., 1998).

The left side of Table 5 shows the coefficient estimates, sample sizes, and the standard deviation of the mixed effects for the full duration model with frailty for each of the race and race-gender subsamples. As previously shown, Whites seem to experience no statistically significant impact of BMI classification on unemployment spell duration as a whole, however, White women see similar impacts of BMI classified as shown in Table 4 with underweight White women possibly experiencing a shorter unemployment duration of about 13%, albeit not statistically significant, while overweight and obese women experiencing longer durations with slightly smaller point estimates and lower statistical significance than in Table 4.

[Insert Table 5]

For Blacks as a whole, obese Black individuals are shown to experience a longer unemployment spell compared to Blacks with a normal BMI classification; however, we cannot compare this to other races given the subsample approach. Compared to Black women of a normal BMI, there is no statistically significant difference in unemployment spell duration by Black women within the underweight or overweight classifications which differs from Table 4. Looking only at magnitude, however, the relative durations are similar with underweight Black women experiencing longer durations and overweight Black women seeing shorter durations compared to normal BMI Black women. The other difference is that in Table 4 Black women with an obese BMI class saw no difference in unemployment spell (or maybe a slightly shorter spell) compared to normal BMI Black women; however, in Table 5 we see that obese women see a 15% increase in the length of unemployment spells compared to normal BMI Black women. The results for Black men, on the other hand, closely align with those shown in Table 4, except for the underweight classification which has very few observations (only 35 such spells).

The biggest differences between Tables 4 and 5 are seen in the Hispanic population. Among the statistically significant results, obese BMI Hispanics see a 17% increase in unemployment spells compared to normal BMI Hispanics with most of this being driven by Hispanic women. The only other statistically significant results are among underweight Hispanic men who see an almost 50% increase in unemployment duration (about 7 weeks) compared to their normal BMI counterparts. While these impacts were hinted at in Table 4, but not statistically significant, using the Hispanic only subsamples allow for the more precise measures. For Hispanic women, there may be a slight decrease in duration, albeit not statistically significant, for those underweight and no discernable impact for those overweight. Additionally, for Hispanic men that are overweight see no discernable impact while those classified as obese may see a 14% increase in spell length, however, this result is, again, not statistically significant.

The results from the subsamples, therefore, mostly follow the overall trends seen in the within race full sample interactions with some minor variation among Black women that are overweight or obese and more of a change among Hispanics compared to the other models. Overall, however, nothing in Table 5 indicates that the basic results and implications from the previous estimates are invalid which leaves testing the robustness of the estimation methodology.

As outlined in Beck, et. al. (1998), duration data can also be thought of as grouped time-series data with a binary dependent variable and thus can be estimated with a limited dependent variable technic. The only modification is the need to determine if the data is duration dependent, meaning that the probability of a spell ending (or the dependent variable of employed switching from zero to one as would happen at the end of an unemployment spell) is dependent on the length of time since the last period the dependent variable was unity. In terms of the duration model, duration dependence would indicate that there is a baseline hazard that varies with time, as we show in the figures above. Therefore, taking duration dependence as given, we estimate the models again after transforming the data into a binary dependent variable time-series with the dependent variable measuring the probability of being employed a time *t* for individual *i*. We estimate this model with random mixed effects across individuals to better match with the frailty assumption in Table 4. The results for the race and race-gender subsamples are shown in the last three columns of Table 5 and the results are nearly identical between the estimation methodologies.[[24]](#footnote-24)

**7. Discussion**

Prior studies find that obesity causes significantly higher unemployment among American workers while others have suggested that it is unobserved characteristics of the individual rather than obesity cause these employment penalties (e.g., Lindeboom et al., 2010). Using data from the National Longitudinal Study of Youth (1997), we estimate the duration of unemployment spells assuming individual frailty (thus controlling for individual unobserved effects) and find that individuals classified obese spend about 7% more time unemployed, all else equal. In terms of weeks, this equates to about one additional week for those that are obese.

By splitting the sample into male and female subsamples and interacting the BMI classification with race we show that White women with an obese BMI classification experience unemployment spell about 12% longer than White women with a normal BMI and obese. Furthermore, a Black woman with a normal BMI sees the largest BMI effect on unemployment spell by experiencing spells that are about 27% longer, or about 3 weeks longer, than White women with normal BMI. Additionally, for Black women, being overweight reduces the unemployment spells compared to Black women with a normal BMI to about 12% or only 1.5 weeks longer than the baseline (White women with a normal BMI).

White men do not seem to be impacted by BMI classification as no estimates are statically significant for White men whereas Black men, on the other hand, all suffer increased unemployment spells of about 16%, or about 1.75 weeks longer, than White males and, unlike with Black women, this impact on Black men is constant across BMI classification. This seems to indicate that with men, race and region are the dominate factors impacting unemployment duration while BMI classification has no statistical impact at all. With both men and women, Hispanic respondents see no impact by either their race or BMI classification. These results are mostly robust to both the estimation technique and the formation of the sample used to estimate the models.

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1. Averett and Korenman (1996), Baum & Ford (2004), Behrman and Rosenzweig (2001), Bhattacharya and Bundorf (2005), Cawley (2000, 2004), Cawley, Grabka, and Lillard (2005), Cawley and Danziger (2006), Conley and Glauber (2006), Garcia and Quintana-Domeque (2006), Gregory and Ruhm (2006), Han, Norton, and Stearns (2009), Han, Norton, and Powell (2011), Morris (2007), Norton and Han (2008), Pagan and Davila (1997), and Sabia and Rees (2012). [↑](#footnote-ref-1)
2. Body mass index is defined as the individual's body mass divided by the square of his or her height. [↑](#footnote-ref-2)
3. See Eckstein and van den Berg (2007) for a brief review of the theoretical job search model. [↑](#footnote-ref-3)
4. See Devine and Kiefer (1991) for a survey of the early literature and Eckstein and van den Berg (2007) for a more recent survey of the empirical literature. [↑](#footnote-ref-4)
5. Using CPH also simplifies the inclusion of frailty in the likelihood estimation process. [↑](#footnote-ref-5)
6. See Gutierrez (2002) for details about parametric frailty survival models. We model the individual frailty or clustering using the Mixed Effect method included in the R package *coxme*. [↑](#footnote-ref-6)
7. We do not include data post 2011 because the frequency of the survey changed from annually to every two years. Including these years would mean a higher rate of missing unemployment data due to lack of recall or dates and require more assumptions about how to match biennial data with the weekly employment records. [↑](#footnote-ref-7)
8. An alternative method to identify unemployment spells is to use the responses to the questions indicating the start and stop dates of employment. However, if the respondent is still employed at the time of the interview, the interviewer is instructed to insert the interview date creating complications in identifying spells that exist across calendar years. Additionally, there is no indicator if the respondent leaves the labor force or ends a spell with a new job. [↑](#footnote-ref-8)
9. In the weekly data, unemployment spells that are ended by employment are indicated using a unique job id. [↑](#footnote-ref-9)
10. While the weight and height questions are asked in each survey, they are sometimes either missing or contain recording errors. Prior to this modification, the average weight was 165.7 pounds and average height of 67.27 inches. Changing observations outside the 2.5 standard deviation range removed 1,525 weight observations and 3,991 height observations of the 134,760 respondent-year observations in the sample. After removal and replacement, the average weight was 165.5 pounds, and the average height was 67.33 inches. [↑](#footnote-ref-10)
11. Centers for Disease Control and Prevention (2017). [↑](#footnote-ref-11)
12. The reference category is indicated with an asterisk. For the race category, individuals classified as “mixed” are removed and there is no Asian race category in the original data. [↑](#footnote-ref-12)
13. Students that either dropped out of college prior to graduation or are still enrolled but have not yet graduated are classified as SomeCol. Students who have graduated from a 2-year or 4-year degree program and are not currently enrolled are classified as CollegeGrad and students who attended college for more than four years are classified as CollegePlus whether graduated, dropped out, or still enrolled. [↑](#footnote-ref-13)
14. Gross family income is adjusted using the inverse hyperbolic sine transformation, which is comparable to using the natural log transformation but allows values equal to zero. [↑](#footnote-ref-14)
15. Reported in the initial interview. [↑](#footnote-ref-15)
16. Many unemployment spells list no job search activities which we suspect is an error in the data collection or lack of recall by the respondent rather than a lack of job search activity. [↑](#footnote-ref-16)
17. We remove about 200 spells where the tenure measure is greater than the experience measure. [↑](#footnote-ref-17)
18. The occupation is based on the first two-digits of 1990 Census Occupation Codes resulting in 22 different occupation classifications. The industry is based on the first two digits of the 2002 three-digit Census Industry Code resulting in 18 different industry classifications. [↑](#footnote-ref-18)
19. Most of the respondents either do not report the reason for the start of the spell or there is missing data so the category UNKNOWN is used to capture these events. [↑](#footnote-ref-19)
20. After about 30 weeks the differences between the survival probability curves is hard to see in black and white and accounts for 90% of the unemployment spells in the sample. [↑](#footnote-ref-20)
21. While not shown, we utilize a loglikelihood test using the integrated log likelihood value to test the statistical significance of the individual specific effects and the null hypothesis of no frailty across individuals is rejected at the highest level. [↑](#footnote-ref-21)
22. The same holds true for the estimates in columns three and four. Results using the lagged BMI classification are available upon request. [↑](#footnote-ref-22)
23. The AIC indicate that the model without the industry and occupational fixed effects may fit the data slightly better, however, we maintain the fixed effects given the lack of significant impact on the estimate of the variables of interest. [↑](#footnote-ref-23)
24. The same holds true for the other models estimated in this paper and those results are available from the authors. [↑](#footnote-ref-24)