

Stages of Weight Change Among an Occupational Cohort

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Objective: To assess the readiness to change dietary intake and body weight among production workers. We also ascertained differences between self-perceived and measured body mass index. **Methods:** This cross-sectional study queried physical activity, psychosocial factors, fruit and vegetable intake, and readiness to change based on the transtheoretical model. **Results:** Sixty-three (28%) workers were overweight, and 114 (50%) were obese. Obese workers were in the following stages of weight change: precontemplation (4%), contemplation (45%), preparation (13%), action (21%), and (17%) maintenance. Ten percent of overweight workers erroneously reported their body mass index to be normal. **Conclusions:** About half of overweight/obese workers were in the precontemplation or contemplation stages for healthy dietary changes or weight loss. Recognizing the stages of change with regard to weight and the self-perception of weight status may help tailor workplace health promotion programs.

Obesity-related medical costs for US adults have been estimated by the Centers for Disease Control and Prevention at \$147 billion in 2008, with each obese adult having medical costs averaging \$1429 higher than for a normal weight adult.¹ Beyond medical costs, being overweight, defined as body mass index (BMI) 25 to 29.9 kg/m² has been found to predict sick leave episodes lasting longer than 7 days.^{2,3} An association between BMI and long-term absenteeism (more than 22 days over a 4-year period) has also been reported.⁴ In addition, obesity has been associated with an increased risk of occupational injuries and illnesses.⁵⁻¹²

Obesity is associated with health-related job limitations, especially for jobs with high physical demands or those requiring short times to complete tasks.¹³ Obese workers have difficulty moving to perform job functions because of body size and associated physical limitations.¹³ Obesity has also been widely associated with musculoskeletal or joint-related pain in the feet,¹⁴ knees,¹⁵⁻¹⁹ back,²⁰⁻²⁴ shoulders,^{12,25-29} and hands.^{30,31} In addition, obesity has been associated with an increased risk of occupational injuries.^{9,11} Reported injuries attributed to obesity include sprains, strains, injuries to the lower limb or torso, and injuries due to falls or overexertion.⁹

The US civilian workforce employed approximately 140 million people in 2009.³² Workers spend a quarter of their lifetime and up to half of their waking lives at work or commuting.³³ It is estimated

that 65% of the US adult population could potentially be reached by workplace health intervention programs if they were universally available.³³

Distorted perceptions of adults' weight status have been widely reported.³⁴⁻³⁸ For example, one quarter of overweight and obese adults in the National Health and Nutrition Examination Survey misperceived their weight status.³⁶ These individuals were also reportedly less likely to either have wanted to or attempted to lose weight.³⁶ Misperceptions among those overweight or obese may be a considerable barrier for weight loss interventions and behavior change.

To the best of our knowledge, there are no data available regarding perceptions of weight status and intentions for diet change among production workers. We, therefore, studied the readiness to change dietary intake and weight, assessed by questions based on the transtheoretical model (TTM) of behavior change. We also ascertained differences between self-perceived and measured BMI.

METHODS

This cross-sectional study was nested within two prospective cohorts (the WISTAH Distal Upper Extremity [DUE] cohort and the BackWorks Low Back Pain [LBP] cohort).^{39,40} Both studies were approved by the University of Utah's Institutional Review Board (#s 00010930 and 00011889). Baseline data for these cohorts were collected during worksite enrollments conducted between 2002 and 2007. Additional data for this study were collected during study completion visits in the spring of 2012 and analyzed in 2013. Mean participation time during the cohort phases for the workers reported in this study were LBP cohort 6.7 ± 1.5 years and DUE cohort 8.8 ± 0.5 years. The parent cohort studies have detailed methods papers published,^{39,40} thus a brief summary of the methods follows.

Subjects

Subjects were at least 18 years of age at enrollment and employed at one of eight participating companies in Utah. Subjects were excluded if they could not give informed consent, did not speak either English or Spanish, and were planning to retire within 4 years of study enrollment. To improve generalizability of the results, subjects were recruited from eight varying employment settings, that is, airbag manufacturing, office workers, sewing facility, red meat processing, printing operations, cabinet manufacturing, medical technology production facility, and aluminum extrusion facility.^{39,40}

Baseline Measures

At baseline enrollments, workers completed a laptop-administered questionnaire under the supervision of a research assistant. Baseline data utilized included the following demographics: age, sex, education level, and race. Education levels were grouped into two categories for the analyses—(1) eight grade or less, some high school, high school graduate, or General Education Development; and (2) some college, college graduate (bachelor's degree or higher).

Height and weight were measured in stocking feet. If weight exceeded 200 kg, two scales were used simultaneously and the sum was recorded. A BMI less than 18.5 kg/m² was considered

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underweight, between 18.5 and 24.9 kg/m² was considered normal, 25 to 29.9 kg/m² was considered overweight and greater than 30 kg/m² obese.⁴¹ Height was assumed to have not changed appreciably during the study.

At study completion, subjects completed another laptop-administered questionnaire, and their weight was remeasured. Survey items quantified physical activity outside work, psychosocial factors (eg, depression, job satisfaction, and family problems), knowledge of BMI, knowledge of total cholesterol (TC) levels, fruit and vegetable intake, and questions based on the TTM,⁴²⁻⁴⁴ assessing readiness to change fruit and fat intake as well as readiness to change weight.

Leisure-time physical activity questions addressed 21 specific activities (eg, baseball and basketball); in addition, other nonspecified activities could be added.^{39,40} Each of those activities was further queried for the number of months per year, the average number of times per week, and the average number of minutes each activity was performed. A composite of all these activities was calculated, and the total reported leisure-time physical activity in minutes per week was assessed.

Dietary intake questions were included that have been previously developed and were slightly modified for this population.⁴⁵ Fruit and vegetable intake was assessed by asking “How many times do you typically eat a serving of fruit in 1 day?” and “How many times do you typically eat a serving of vegetables in 1 day?”

Questions also aimed at determining subject’s current stages of change based on the TTM. The TTM was developed in 1981 by Prochaska et al⁴²⁻⁴⁴ and has been widely utilized in the health promotion and education field.^{42,46-52} It incorporates concepts from previously developed models such as the Health Belief Model.⁵² Questions for each health indicator (diet and weight) were adapted from previous studies.⁴⁶⁻⁵² Readiness to change weight was adapted⁴⁸ and modified for this study by asking subjects to select one out of seven statements, each representing a stage of change to the following question: “Which statement best describes how you feel about your weight?” Possible responses included “My weight is about right and I am not planning on trying to change it.” (precontemplation); “I want to lose weight, but I don’t know where to start.” (contemplation), “I have decided to lose weight and I have a plan to start in the next 6 months.” (contemplation), “I am trying to gain weight.” (contemplation); “I plan on starting to make changes (diet, exercise, etc.) within the next month.” (preparation); “I have recently made changes to lose weight (within 6 months).” (action); and “I have been making changes to lose weight for longer than 6 months.” (maintenance). Similar questions were used to determine stages of change regarding fat and fruit intake.

Subjects were asked whether they could recall their current BMI (*yes/no*). Questions on how subjects perceive their weight and TC were also included. Subjects were asked “Do you think your total cholesterol is: good/ not good/unsure?” and “Do you believe you are: underweight/normal weight/overweight/obese/unsure?” Intake of cholesterol-lowering medication was also assessed.

Having received any education (eg, doctor, the Internet, and magazines) in weight management, diet/nutrition, or physical fitness throughout the study duration was also assessed. Weight was measured in stocking feet at study completion.

Data Analyses

All analyses were performed using SAS 9.3 (SAS Institute, Cary, NC). Outliers and missing study data were verified by pulling individual subject’s charts. Imputation using the study mean was used when missing data could not be verified—total cholesterol and weight were each imputed for two subjects.

Correlation statistics were conducted for characteristics, which were hypothesized to be associated. Population demographics at study completion were analyzed using frequencies, means, and

TABLE 1. Population Demographics and Survey Response Frequencies at Study Completion (N = 227)

	N (%)
Age, yrs	
≤30	34 (15)
>30 to ≤50	104 (46)
>50	89 (39)
Sex*	
Female	127 (56)
Male	100 (44)
Race*	
White	126 (55)
African American or Black	2 (1)
Asian	25 (11)
Pacific Islander or Native Hawaiian	25 (11)
Hispanic or Latino	49 (22)
Education level*	
8th grade or less	1 (1)
Some high school	18 (8)
High school graduated or GED	103 (45)
Some college	82 (36)
College graduate (Bachelor’s degree or higher)	23 (10)
BMI category (kg/m ²)	
Underweight (BMI < 18.5)	4 (2)
Normal (BMI 18.5–24.9)	46 (20)
Overweight (BMI 25–29.9)	63 (28)
Obese (BMI ≥ 30)	114 (50)
Mean total physical activity minutes per week summed	
0 to 240	182 (80)
240 to 480	33 (15)
More than 480	12 (5)
Do you know what your body mass index is?	
Yes	21 (9)
No	206 (91)
Do you believe you are:	
Underweight	14 (6)
Normal weight	59 (26)
Overweight	123 (54)
Obese	24 (11)
Unsure	7 (3)
Do you know what your current total blood cholesterol is?	
Yes	23 (10)
No	204 (90)
Do you think your total cholesterol is:	
Good	106 (47)
Not good	37 (16)
Unsure	84 (37)
Fruit and vegetables combined (servings/day)	
<5	84 (37)
≥5	143 (63)
	Mean ± SD
Age, yrs	50.2 ± 10.3
BMI (kg/m ²)	30.8 ± 7.4
Total physical activity (minutes per week)	130.3 ± 168.9
Total cholesterol (mg/dL)	182.7 ± 37.7

*These data were collected at baseline enrolments. BMI, body mass index; GED, General Education Development.

standard deviations. Stages of change were calculated as frequencies for the entire population, for those who are overweight or obese (BMI 25 kg/m² or more) and for those who believe that they are overweight or obese.

Differences in distributions across categorical variables were assessed with a chi-square test. The Fisher exact test was used for variables that had a frequency of five or less in a cell.

We assessed the data for attrition bias because a large proportion of our population did not finish the study. We aimed at determining whether those workers who exited the study have different characteristics than those who completed the study and would have therefore introduced attrition bias. Differences were assessed for demographics (age, sex, race, education, and marital status) by using the chi-square test analyses. Statistical significance was assessed by using α level of .05.

RESULTS

A total of 227 subjects participated in study completion visits. There were 91 (40%) participants enrolled from the DUE cohort and 136 (60%) from the LBP cohort. All subjects remaining in the cohort at termination and attended study termination visits were included in this study. The majority of subjects were between 30 and 50 years old (46%), female (56%), white (55%), or were high school graduates or had their General Education Development (45%) (see Table 1 for demographic data). Subjects had a mean BMI of 30.8 ±

7.4 kg/m² with 50% being obese and 28% overweight. The vast majority indicated not knowing their BMI (91%) or TC levels (90%). Most (80%) reported being physically active for less than 240 minutes per week. Most (63%) reported consuming at least five servings of fruits and vegetables combined.

We assessed the association of the following characteristics: (1) baseline weight and stages of weight change at study completion, (2) baseline BMI and stages of weight change at study completion, and (3) weight change from baseline to study completion and stages of weight change at study completion. Nevertheless, no correlation between any of these characteristics was found.

Attrition bias analyses indicated that only age significantly differed between those who exited the study and those who completed it ($P < 0.0001$). Workers who exited the study ($n = 386$) were younger. This is an expected finding because the study was longitudinal. Otherwise, there was no statistically significant difference between those who exited early or completed with regard to sex ($P = 0.3$), race ($P = 0.2$), marital status ($P = 0.2$), education ($P = 0.3$), weight ($P = 0.1$), and TC levels ($P = 0.6$).

Stages of change for weight and fat and fruit intake are summarized in Table 2, stratified by baseline actual BMI or self-perceived weight status. A plurality ($n = 51$, 45%) of obese workers either wanted to lose weight but did not know where to start or had decided to lose weight and planned to start in the next 6 months. In addition, 24% ($n = 15$) of overweight workers thought that their weight was

TABLE 2. Stages of Change* N (%) Among Production Workers (N = 227) for Weight Reduction, Fat Intake, and Fruit Intake at Study Completion, in Relation to BMI or Self-Perceived† Weight Status

	Precontemplation	Contemplation	Preparation	Action	Maintenance	Total (N)
Weight reduction						
Measured BMI <25	26 (52)	14 (28)	6 (12)	1 (2)	3 (6)	50
Measured BMI 25–29.9	15 (24)	16 (25)	10 (16)	10 (16)	12 (19)	63
Measured BMI ≥30	4 (4)	51 (45)	15 (13)	24 (21)	20 (17)	114
Self-perceived underweight	8 (57)	6 (43)	0 (0)	0 (0)	0 (0)	14
Self-perceived normal weight	32 (54)	11 (19)	8 (13)	1 (2)	7 (12)	59
Self-perceived overweight	3 (2)	50 (41)	19 (16)	31 (25)	20 (16)	123
Self-perceived obese	0 (0)	10 (42)	4 (17)	2 (8)	8 (33)	24
Self-perceived unsure	2 (29)	4 (57)	0 (0)	1 (14)	0 (0)	7
Decreasing fat intake						
Measured BMI <25	24 (48)	9 (18)	5 (10)	5 (10)	7 (14)	50
Measured BMI 25–29.9	13 (21)	13 (21)	9 (14)	13 (20)	15 (24)	63
Measured BMI ≥30	36 (32)	27 (24)	15 (13)	21 (18)	15 (13)	114
Self-perceived underweight	8 (57)	3 (22)	2 (14)	1 (7)	0 (0)	14
Self-perceived normal weight	24 (41)	10 (17)	6 (10)	10 (17)	9 (15)	59
Self-perceived overweight	31 (25)	28 (23)	17 (14)	23 (19)	24 (19)	123
Self-perceived obese	7 (29)	6 (25)	3 (12)	4 (17)	4 (17)	24
Self-perceived unsure	3 (43)	2 (29)	1 (14)	1 (14)	0 (0)	7
Increasing fruit intake						
Measured BMI <25	20 (40)	13 (26)	5 (10)	5 (10)	7 (14)	50
Measured BMI 25–29.9	19 (30)	8 (13)	8 (13)	23 (36)	5 (8)	63
Measured BMI ≥30	32 (28)	22 (19)	16 (14)	24 (21)	20 (18)	114
Self-perceived underweight	5 (36)	3 (21)	2 (14)	0 (0)	4 (29)	14
Self-perceived normal weight	22 (37)	13 (22)	9 (15)	10 (17)	5 (9)	59
Self-perceived overweight	30 (24)	23 (19)	16 (13)	34 (28)	20 (16)	123
Self-perceived obese	10 (42)	4 (17)	1 (4)	6 (25)	3 (12)	24
Self-perceived unsure	4 (57)	0 (0)	1 (14)	2 (29)	0 (0)	7

*Stages of change are based on the transtheoretical model (TTM) of behavior change.

†Assessed by asking: Do you believe you are: underweight, normal weight, overweight, obese, or unsure.
BMI, body mass index.

about right (healthy) and they did not want to change it. Similarly, most workers who believed to be overweight ($n = 50, 41\%$) or obese ($n = 10, 42\%$) were contemplating weight loss. Only 33% ($n = 8$) of workers who believed that they were obese were in the maintenance stage of weight reduction.

The plurality of obese workers was in the precontemplation phase regarding their fat intake ($n = 36, 32\%$). Most overweight workers were in the contemplation or precontemplation ($n = 26, 42\%$) stage for decreasing fat intake. In addition, most believing themselves to be obese were in the precontemplation stage regarding increasing their fruit intake ($n = 10, 42\%$). Those workers had no plans of eating more fruit. Only 21% ($n = 24$) of obese workers reported having tried to eat more fruit recently.

Stratified results of stages of weight change for workers with a BMI 25 kg/m² or more are presented in Table 3. Regarding obese workers, 45% ($n = 51$) indicated being in the contemplation phase

for weight change. Only 21% ($n = 24$) of obese workers indicated having recently made changes to lose weight. Among overweight workers, 49% ($n = 31$) either thought their weight was about right and did not want to change it or wanted to lose weight but did not know where to start. Similarly, 41% ($n = 47$) of those who self-reported to be overweight were contemplating weight change.

The majority of workers with a BMI 25 kg/m² or more performed less than 240 minutes of leisure-time physical activity per week ($n = 140, 79\%$). Moreover, most of them were contemplating weight loss ($n = 61, 44\%$). Only 6% ($n = 10$) of workers with a BMI 25 kg/m² or more reported participating in more than 480 minutes per week of leisure physical activity.

Figure 1 shows the distribution of measured BMI and self-perceived BMI status. Workers who indicated being “unsure” about their BMI ($n = 7$) were excluded from this graph. Ten percent of the workers ($n = 22, 10\%$) who were overweight believed that their BMI

TABLE 3. Stages of Change for Weight Reduction Among Production Workers With a BMI 25 kg/m² or More at Study Completion ($n = 177$). *N* (%)

	Precontemplation	Contemplation	Preparation	Action	Maintenance	Total	<i>P</i>	
Age, yrs								
≤30	3 (13)	9 (37)	1 (4)	7 (29)	4 (17)	24	<0.0001	
>30 to ≤50	10 (11)	39 (45)	10 (11)	14 (16)	15 (17)	88		
>50	6 (9)	19 (29)	14 (22)	13 (20)	13 (20)	65		
Sex*								
Female	8 (8)	37 (38)	18 (18)	15 (15)	21 (21)	99	0.1	
Male	11 (14)	30 (39)	7 (9)	19 (24)	11 (14)	78		
Race*								
White	11 (11)	35 (33)	11 (10)	25 (24)	23 (22)	105	0.04	
African American or black	0 (0)	1 (50)	0 (0)	0 (0)	1 (50)	2		
Asian	3 (43)	2 (29)	0 (0)	1 (14)	1 (14)	7		
Pacific Islander or Native Hawaiian	2 (8)	8 (33)	9 (38)	2 (8)	3 (13)	24		
Hispanic or Latino	3 (8)	21 (54)	5 (13)	6 (15)	4 (10)	39		
Education level*†								
High school graduated or GED	15 (24)	16 (25)	10 (16)	10 (16)	12 (19)	63		0.0007
Any college	4 (4)	51 (45)	15 (13)	24 (21)	20 (17)	114		
Mean total physical activity minutes per week summed								
0 to 240	17 (12)	61 (44)	18 (13)	24 (17)	20 (14)	140	<0.0001	
240 to 480	2 (7)	4 (15)	3 (11)	10 (37)	8 (30)	27		
More than 480	0 (0)	2 (20)	4 (40)	0 (0)	4 (40)	10		
BMI category								
Overweight (BMI 25–29.9)	15 (24)	16 (25)	10 (16)	10 (16)	12 (19)	63	<0.0001	
Obese (BMI ≥30)	4 (3)	51 (45)	15 (13)	24 (21)	20 (18)	114		
Do you know what your body mass index (BMI) is?								
Yes	0 (0)	4 (36)	2 (18)	2 (18)	3 (28)	11	0.007	
No	19 (11)	63 (38)	23 (14)	32 (19)	29 (18)	166		
Do you believe you are:								
Underweight	0 (0)	1 (100)	0 (0)	0 (0)	0 (0)	1	<0.0001	
Normal weight	15 (50)	6 (20)	3 (10)	1 (3)	5 (17)	30		
Overweight	2 (2)	47 (41)	18 (15)	30 (26)	19 (16)	116		
Obese	0 (0)	10 (42)	4 (17)	2 (8)	8 (33)	24		
Unsure	2 (33)	3 (50)	0 (0)	1 (17)	0 (0)	6		

*These data were collected at baseline enrollments.

†Education levels were grouped into two categories for the analyses: 1 = 8th grade or less, some high school, high school graduate, or GED; 2 = some college, college graduate (bachelor’s degree or higher).

BMI, body mass index; GED, General Education Development.

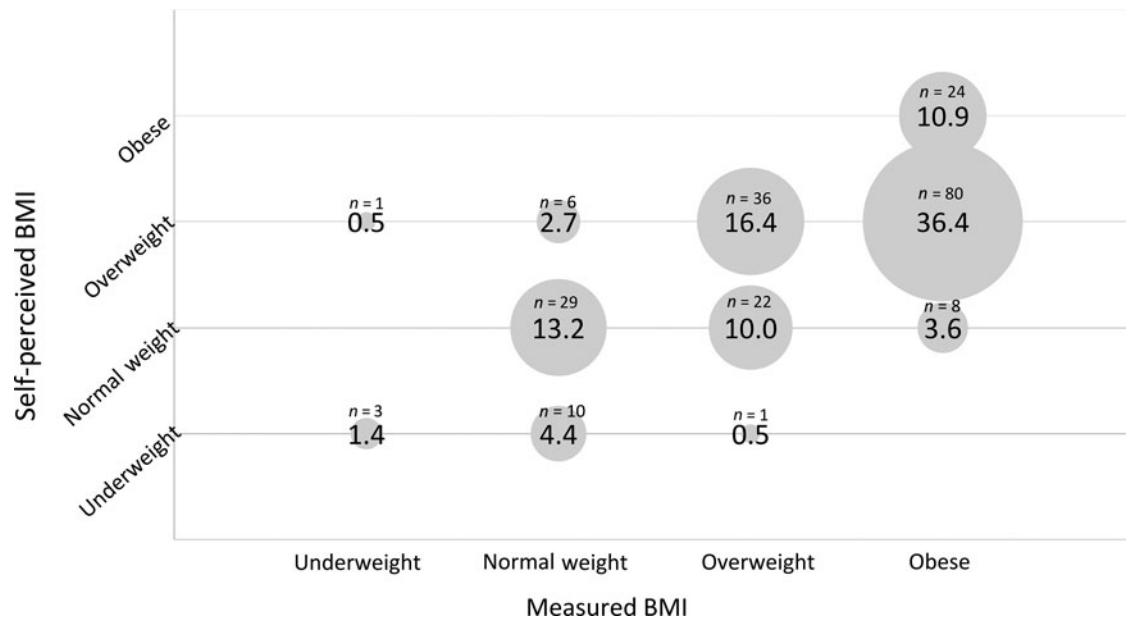


FIGURE 1. Agreement/disagreement (%) of measured BMI status and self-perceived BMI status among production workers ($N = 220$). BMI, body mass index.

was normal. A plurality of workers ($n = 80$, 36%) who were obese thought that they were merely overweight and rejected the option of “obese” in the questionnaire. Some of those who were obese ($n = 8$, 4%) thought that they were of normal weight and rejected “overweight” and “obese” categories for their weight. Of those with a normal BMI, 3% ($n = 6$) believed that they were overweight, whereas 4% ($n = 10$) even classified themselves as being underweight.

DISCUSSION

The combined prevalence of overweight and obesity of 78% in this working population is astonishing. The prevalence of obesity (50%) is greater than for the US adult population (36%)⁵³ and is twice as high as a recently reported prevalence for US workers (28%).¹⁰ Considering an even lower prevalence of 23% for obesity in the state of Utah,⁵⁴ these production workers represent an important target population for weight loss interventions.

There seems to be a disconnect between worker’s measured and self-perceived BMIs, especially among the obese. Ten percent of overweight workers ($n = 22$, 10%) believed that their BMI to be normal, whereas a plurality of obese workers ($n = 80$, 36%) thought that they were overweight. Disconnects between actual and perceived body weights have been previously shown.^{36,55} The National Health and Nutrition Examination Survey reported that 23% of their large population misperceived their weight,³⁶ compared with 58% of this study’s workers who misperceived weight. Self-perceptions of being overweight are reportedly more common in women⁵⁵ and also vary by sex, race, and socioeconomic status.⁵⁵ Correction of these misconceptions may be an important consideration for the design of effective weight loss interventions.³⁶ Although this might represent nominal semantics, further investigation is warranted to determine the meaning and influence of these disconnects on health. It may not be as clinically meaningful if our workers can distinguish between being overweight or obese as opposed to simply being able to being aware of not being at a normal weight.

A plurality of overweight ($n = 31$, 49%) and obese ($n = 55$, 49%) production workers was in the precontemplation and contemplation stage of weight change. Workplace promotion programs in our participating facilities, which aim to help workers move along advanced stages of change, may not be useful for workers in the

precontemplation or contemplation stages of change. The majority of this working population may need support taking the first step for changing their weight. Future research may analyze workplace promotion programs to determine which stages of change are being targeted.

Pluralities of obese workers also fell into the precontemplation phase regarding their fat ($n = 36$, 32%) and fruit ($n = 32$, 28%) intake. Those workers did not have any plans of eating more or less fruit (fat) or did not know what the fat content of their diet is. Only 21% ($n = 24$) of obese workers had taken action and indicated having tried to eat more fruit recently. Similarly, only 18% ($n = 21$) of them had taken action to decrease their fat intake recently.

A study conducted to assess the stage of readiness to control weight and adopt weight control behaviors in primary care found that 72% of those overweight or obese were at advanced stages (preparation, action, or maintenance) for weight loss.⁵⁶ In contrast, the majority of obese and overweight workers in this study were contemplating weight loss but had not taken any action. Therefore, it may be appropriate to aim workplace promotion programs to provide specific strategies to move workers into higher stages of behavior change. Workers who are ambivalent or contemplating behavior change may not benefit from workplace promotion programs aimed at advanced stages of change (eg, action stage).

Strengths of this study include the use of anthropometric measures of body weight and body height as opposed to self-reported measures, which would likely have introduced biases toward lower BMIs. In addition, the recruitment from various employment settings helped improve generalizability of the results. Finally, the use of computerized questionnaires assured much higher rates of data completion through requiring answers and included quality control ranges to alert the participant of potential data entry errors that are questionable but could be over-ridden if they were accurate.

Several factors limit these findings including the cross-sectional design for the stages of change data. Heterogeneity in the study sample may be present because of the inclusion of participants from two different cohort studies. Recall bias inherently limits self-reported studies. Stages of change may have been over-estimated. Self-report also likely affected reporting of physical activity. The majority of subjects who reported more than 480 minutes

of physical activity were overweight or obese ($n = 10$, 83%). Evidence supports the belief that overweight individuals tend to overestimate or overreport the amount of activity they perform.^{57,58}

Given the well-documented effect of obesity on occupational illnesses, injuries, and overall increasing productivity costs, this research identified a target population for interventions to improve weight and weight-related comorbidities. The Bureau of Labor Statistics estimates US civilian employment of approximately 140 million people in 2009.⁵⁹ It is estimated that 65% of the adult population of the United States can be reached through worksites.³³ The workplace, therefore, may be an optimal location for workplace prevention programs in production facilities, targeted at weight loss interventions.

CONCLUSIONS

This population was 50% obese and 28% overweight. Despite these problems, a plurality of overweight or obese production workers was merely in the precontemplation or contemplation stages for weight loss. Of those who were obese, 36% thought of themselves as merely overweight. Potential effects include that worksite health promotion programs in these occupational settings may be more effective by particularly identifying and targeting those in the precontemplation and contemplation stages.

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