4 Obesity and Health Outcomes in Older Irish Adults

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tilda
Staidéar Fadaimseartha na hÉireann um Dhul in Aois
The Irish Longitudinal Study on Ageing

4 Obesity and Health Outcomes in Older Irish Adults

Key findings

- 35% of older Irish adults are classified as obese according to their body mass index; a further 44% are overweight.
- According to World Health Organisation criteria, 53% of older Irish adults are at a substantially increased risk of metabolic and cardiovascular disease based on their waist circumference.
- Obesity at wave 1 is strongly associated with cardiovascular disease at wave 2. Both men and women who were obese at wave 1 have a significantly higher prevalence of diabetes at wave 2, while obese men have a significantly higher prevalence of heart attacks, and obese women have a significantly higher prevalence of angina.
- Increased waist circumference at wave 1 is associated with the development of disability, particularly among women.
- A significantly higher proportion of men who were obese at wave 1 had reduced their alcohol intake by wave 2 (in comparison with men who were of normal weight at wave 1).

4.1 Introduction

Obesity is considered a chronic disease and is defined by the World Health Organisation (WHO) as excess body fat to the extent that health may be impaired (1). Worldwide, the prevalence of obesity has increased dramatically in recent decades, leading many to classify it as an epidemic (1). While the prevalence of obesity has begun to stabilise in some countries, Ireland has demonstrated one of the highest increases in obesity prevalence in the last decade (2). According to the 2011 National Adult Nutrition Survey (NANS) (3), the most dramatic increase in obesity among Irish adults was observed in 51-64 year old men, rising from 11% to 42% over the past two decades.

These figures are based on Body Mass Index (BMI), which is an indicator of overall body fatness. In older adults waist circumference is considered to be a more useful measure of

obesity than BMI (4). In the NANS survey (3), over half of all 50+ year olds were reported to have a substantially increased waist circumference.

In older adults obesity is associated with depression, disability, frailty (5, 6) and cardiovascular disease (7-9); however, the effects of rising obesity rates on the health and wellbeing of older Irish adults have yet to be examined. Using objective measures of BMI and waist circumference collected at wave 1, this chapter will document the prevalence of overweight and obesity in our older population, and examine the association between excess body fat at wave 1 and the prevalence of cardiovascular disease, disability, mental and behavioural health at wave 2.

4.2 Prevalence of obesity

In wave 1 of TILDA, height, weight and waist circumference were measured during the health assessment which took place in either a health centre or the participant's home. These measures were then used to calculate BMI and waist circumference. Detailed protocols for these measurements can be accessed on the TILDA website (http://www.tcd.ie/tilda/about/project-description/data-collection). The following analyses are based on participants who completed a health assessment at wave 1 and the computer assisted personal interview (CAPI) at wave 2, giving a total sample size of 5,349.

BMI is the metric traditionally used to define overweight and obesity. However, in older adults, BMI does not reflect age-related loss of muscle mass (10). Additionally, the distribution of body fat may change, with a greater proportion of fat deposited centrally, around the abdomen (11). Therefore in older adults, waist circumference (WC) may be a more useful indicator of obesity than BMI, since fat deposited in this region is associated with greater risk of cardiac and metabolic disease (4).

4.2.1 Body mass index

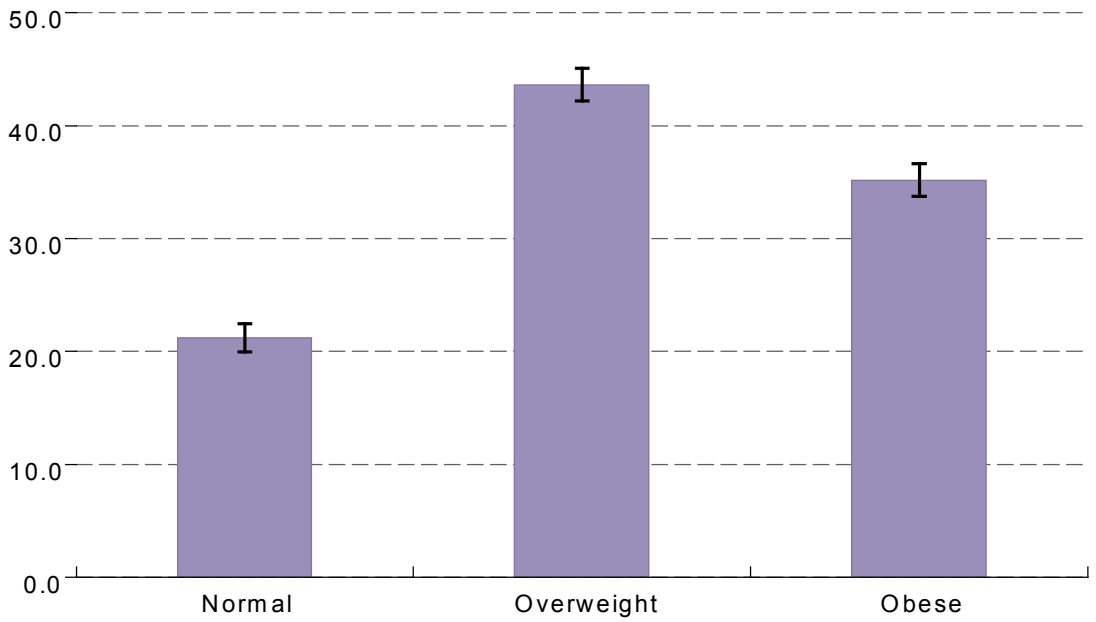
BMI is calculated as weight in kilograms divided by height in metres squared (kg/m2). WHO (1) cut-offs are used to define persons as 'underweight', 'normal', 'overweight' and 'obese' (see Table 4.1). In TILDA less than 1% of the population is classified as underweight so this group has been excluded from further analyses.

Table 4.1: World Health Organisation body mass index classifications

Classification	BMI (kg/m^2)
Underweight	<18.50
Normal	18.50-24.99
Overweight	25.00-29.99
Obese	≥30.00

Overall 35% of older Irish adults are obese, with a further 44% classed as overweight (see Figure 4.1).

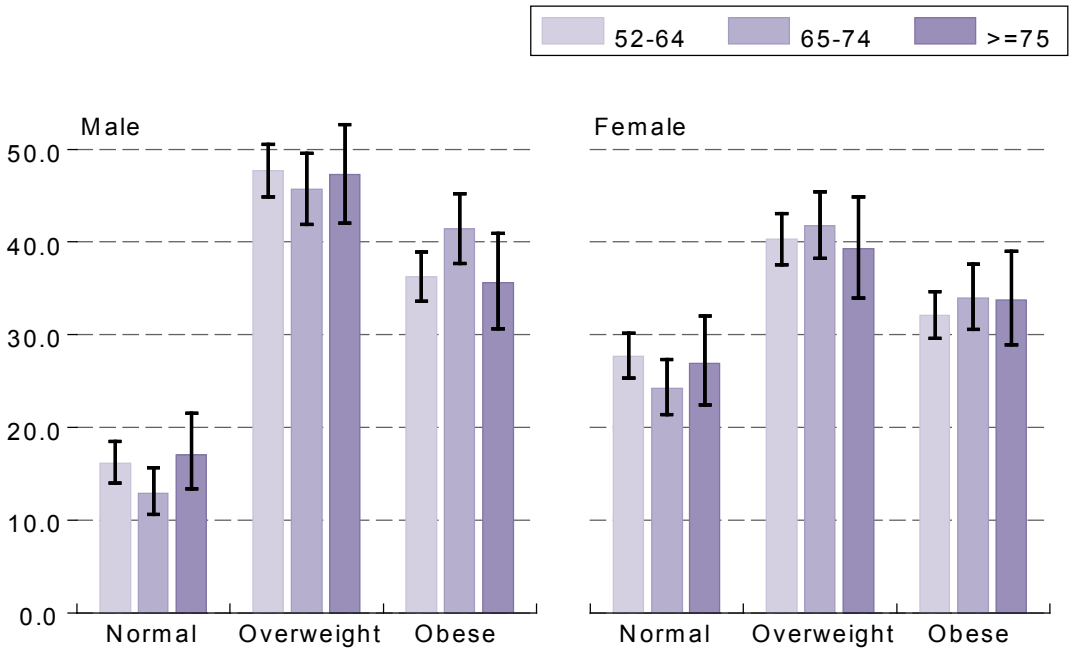
Figure 4.1: Distribution of body mass index at wave 1



Note. N = 5349; Missing obs = 0; Error bars correspond to 95% confidence intervals

Figure 4.2 illustrates obesity prevalence by age and sex. Obesity is more prevalent among men (38%) than women (33%) (see Appendix Table 4.A1). This finding is contrary to what is found internationally where women tend to have higher rates of obesity compared to men (2). No age differences are observed in the prevalence of obesity among TILDA participants.

Figure 4.2: Distribution of body mass index at wave 1 by age and sex



Note. N = 5349; Missing obs = 0; Error bars correspond to 95% confidence intervals

4.2.2 Waist circumference

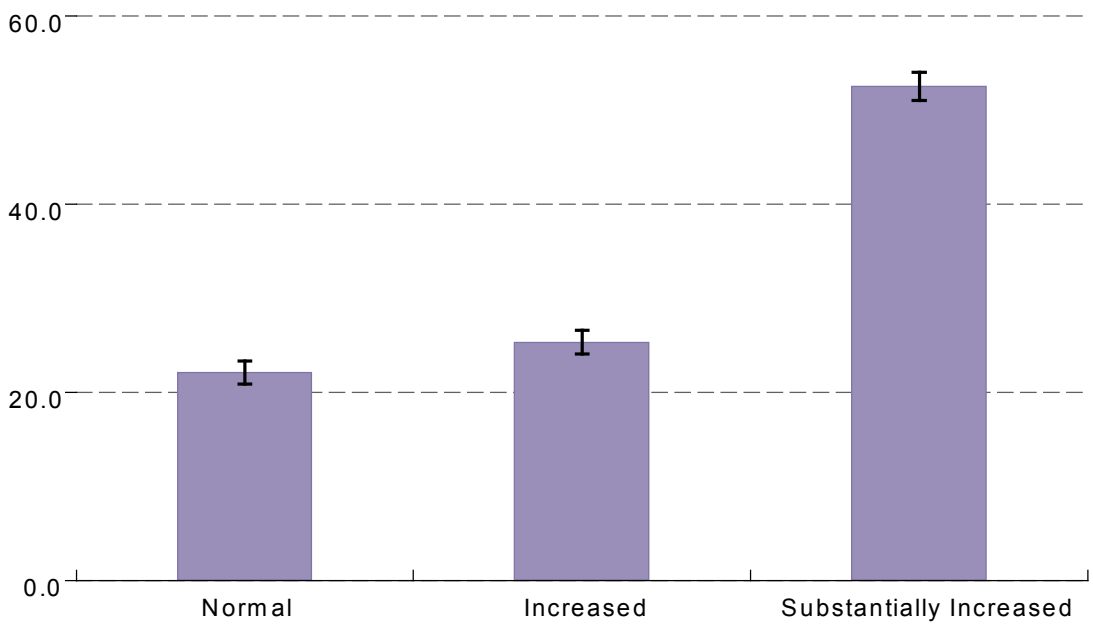
Using WHO cut-offs (11), TILDA participants were classified into three categories of WC indicating 'normal', 'increased' or 'substantially increased' risk of metabolic complications (see Table 4.2).

Table 4.2: WHO waist circumference classifications

Risk Classification	Waist circumference (cm)	
	Men	Women
Normal	<94	<80
Increased	94-101	80-87
Substantially Increased	≥102	≥88

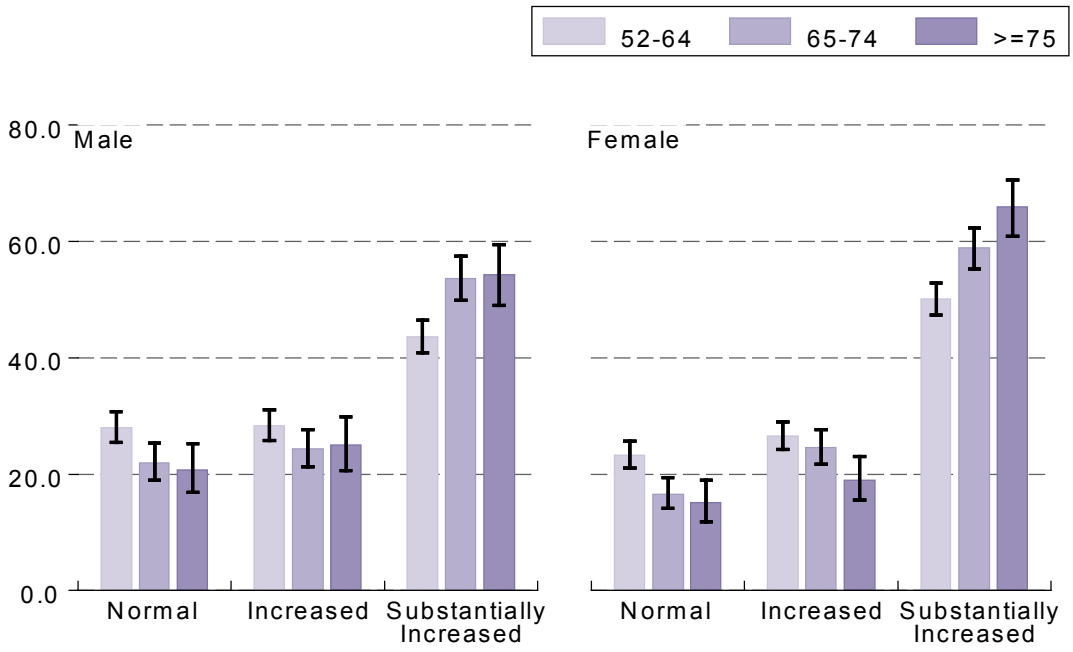
Based on the above criteria, 53% of Irish adults aged 50 and over are classified as centrally obese and at substantially increased risk of metabolic complications (see Figure 4.3 and Appendix Table 4.A2).

Figure 4.3: Distribution of waist circumference at wave 1



Note. N = 5349; Missing obs = 0; Error bars correspond to 95% confidence intervals

Figure 4.4: Distribution of waist circumference at wave 1 by age and sex



Note. N = 5349; Missing obs = 0; Error bars correspond to 95% confidence intervals

A greater proportion of women (56%) have a substantially increased WC compared to men (48%) (see Appendix Table 4.A2). Age differences are apparent in the prevalence of WC with men and women aged 65 and over having significantly larger waist circumstances compared to younger adults aged 52-64 years (Figure 4.4).

Our findings show that obesity (defined by BMI) and central obesity (defined by WC) are major health concerns for Irish adults aged 50 years and over. International findings indicate that life expectancy at age 50 is decreased for obese men and women (12) and obesity also increases the number of years people live with disability (13). International findings indicate that this will have substantial social and economic costs, by increasing the number of years people live with disability and increasing the care burden on the state (13). Early interventions aimed at preventing and reversing this epidemic are therefore necessary, to avoid an unsustainable drain on future health and social services.

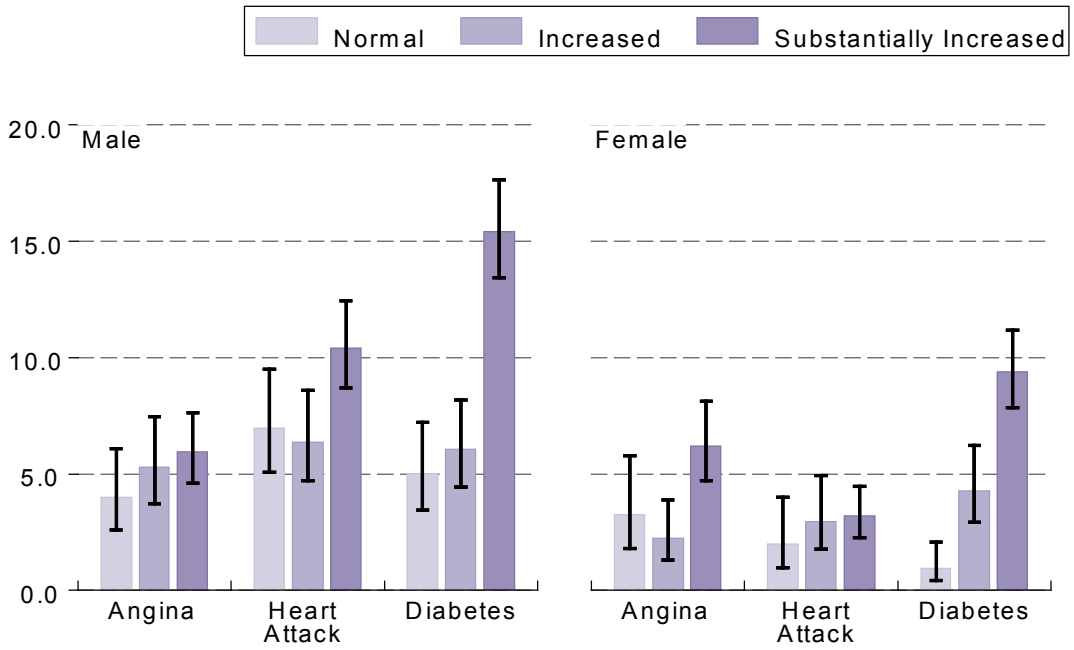
4.3 Obesity and cardiovascular disease

Cardiovascular disease (CVD) remains the leading cause of mortality in Ireland, accounting for 32% of deaths in 2012 (14). Obesity is an independent risk factor for CVD; for every 5kg/m2 increase in BMI above 25kg/m2, CVD mortality increases by 40% (15). Similarly a 1cm increase in WC is associated with a 2% increased risk of incident CVD (16). Though the mechanisms behind these associations have not been fully elucidated, it is known that excess body fat directly impacts on insulin resistance, thus increasing the risk of type-2 diabetes (15). Excess fat in the abdominal area may directly affect how fats are broken down and transported in the body, leading to high cholesterol (17). These risk factors in turn increase the likelihood of developing further CVD.

4.3.1 Obesity and prevalence of cardiovascular disease

Figure 4.5 shows prevalence of cardiovascular disease at wave 2 by wave 1 WC classification and sex. A strong association is observed between WC and diabetes. Just over 15% of men with a substantially increased WC have been diagnosed with diabetes compared to 5% of men with a normal WC. Corresponding figures for women are 9.4% for substantially increased WC and 1% for normal WC. Differences between men and women are observed for other conditions whereby men with a substantially increased WC have a significantly higher prevalence of heart attacks (10% versus 7% for normal WC) and women with substantially increased WC have a higher prevalence of angina (6.2% versus 3.2% for normal WC). Similar associations are evident for BMI and can be seen in Appendix Table 4.A3.

Figure 4.5: Prevalence of cardiovascular disease at wave 2 by wave 1 waist circumference classification and sex



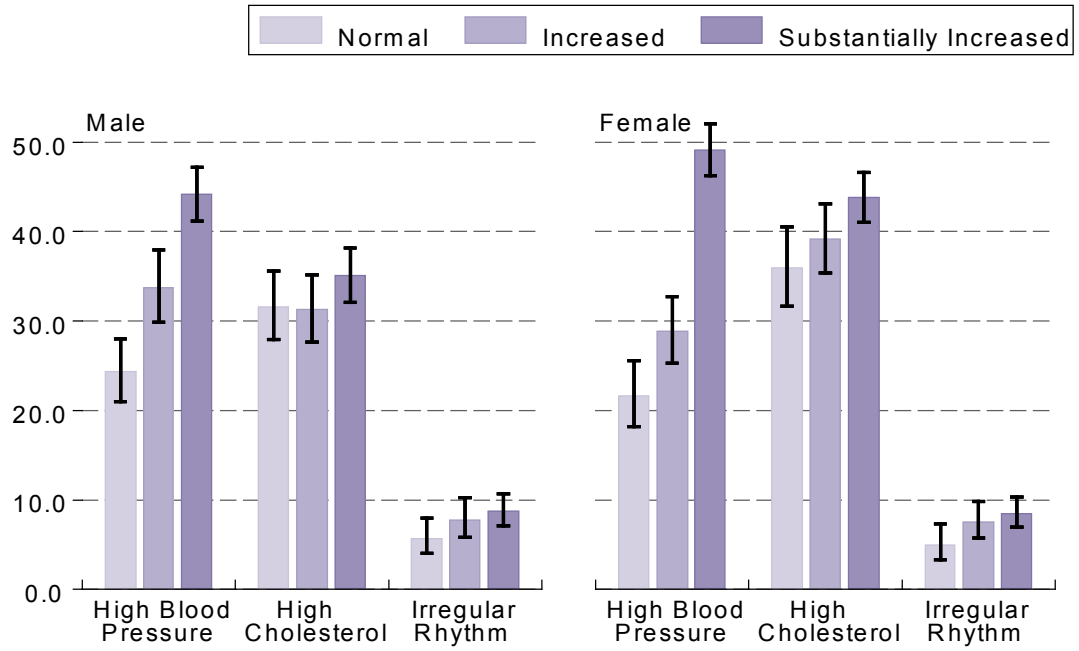
Note. N = 5349; Missing obs = 0; Error bars correspond to 95% confidence intervals

4.3.2 Obesity and prevalence of cardiovascular disease risk factors

Figure 4.6 shows the wave 2 prevalence of CVD risk factors (high blood pressure or hypertension, high cholesterol and irregular heart rhythm) by wave 1 WC classification and sex. Central obesity is strongly associated with high blood pressure. A higher proportion of men and women with both increased and substantially increased WC report a doctor's diagnosis of high blood pressure than adults with normal WC. For example, 49.1% of women with a substantially increased WC report high blood pressure compared to 21.7% of women with normal WC. Corresponding figures for men are 44.2% for substantially increased WC and 24.4% for normal WC.

No differences by sex are observed for the association with high blood pressure or irregular heart rhythm; however, a higher proportion of women with a substantially increased WC report high cholesterol compared to those with a normal WC (43.8% vs 36.0%). The associations presented here are consistent for BMI and can be seen in Appendix Table 4.A4.

Figure 4.6: Prevalence of cardiovascular disease risk factors at wave 2 by wave 1 waist circumference classification and sex



Note. N = 5349; Missing obs = 0; Error bars correspond to 95% confidence intervals

While CVD mortality rates have decreased over the last number of decades (see also Chapter 3), the increasing prevalence of obesity and associated disease risk is in danger of reversing this trend. In older Irish adults increased WC and BMI are strongly associated with an increased prevalence of diabetes, high blood pressure and heart attacks. Tackling the high rates of obesity must be a priority for public health intervention given its strong association with CVD.

4.4 Obesity and physical disability

4.4.1 Obesity and prevalence of physical disability

Disability is common in older adults and has important implications for individual quality of life and health and social care costs. There are many types of disability; but this report will focus specifically on difficulties in activities of daily living (ADLs) and instrumental activities of daily living (IADLs). ADLs include activities such as washing, eating and toileting, which are essential to daily life. IADLs include activities like preparing meals, managing money and household chores, which, while not fundamental to everyday functioning are important in maintaining independence (18, 19). This analysis includes only those difficulties for which comparable information was collected between waves, leaving a total of five ADLs

and six IADLs. Further discussion of ADL and IADL disability is presented in Chapters 5 and 6; however these analyses are based on slightly different sample sizes and are not comparable to the results outlined below.

Table 4.3: Changes in ADL and IADL disability between wave 1 and wave 2

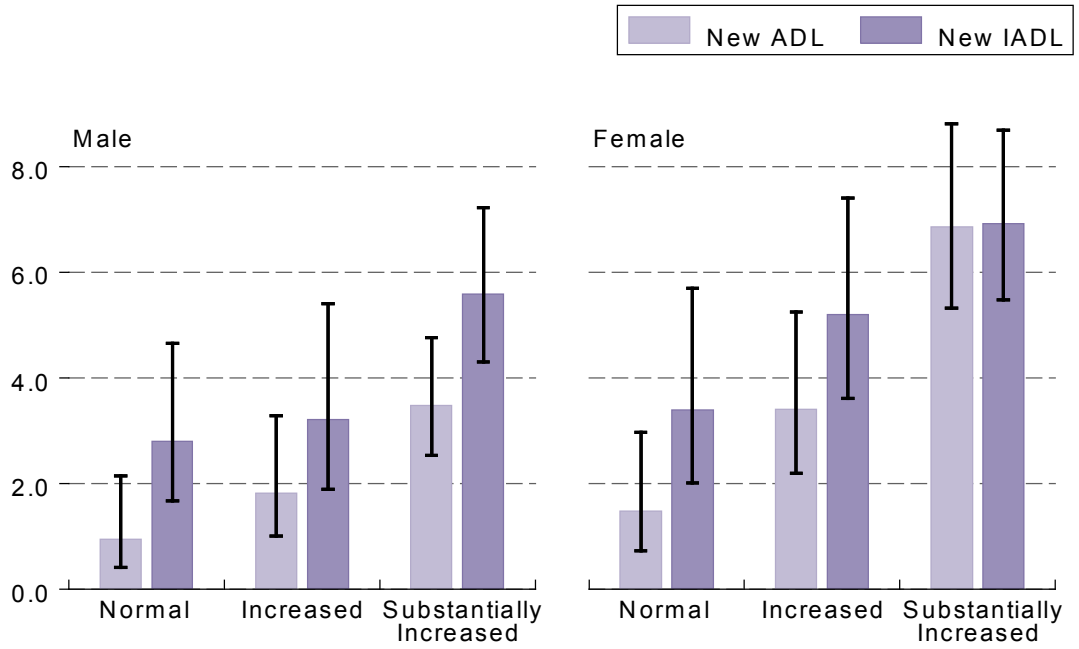
		wave 2			
		No ADL Disability		Any ADL Disability	
		%	(95%CI)	%	(95%CI)
wave 1	**No ADL Disability**	91.5	(90-92)	3.7	(3-4)
	Any ADL Disability	2.5	(2-3)	2.3	(2-3)
		No IADL Disability		**Any IADL Disability**	
	No IADL Disability	87.6	(86-89)	5.1	(4-6)
	Any IADL Disability	3.3	(3-4)	4.1	(3-5)

Table 4.3 summarises transitions in ADL and IADL disability status between wave 1 and wave 2. The majority of adults report no ADL or IADL disability at either wave. Just 2-4% report an ADL or IADL disability in both waves. These findings reflect the relatively young age profile of the TILDA population. Just over 2.5% of the population transitioned out of ADL disability between waves and 3.7% developed a new ADL disability by wave 2. Comparable trends are seen for IADL disabilities, with 3.3% of adults transitioning out of IADL disability and 4.1% developing a new IADL disability by wave 2.

4.4.2 Obesity and prevalence of new disabilities

Figure 4.7 shows the relationship between WC at wave 1 and disability at wave 2. Compared to those with a normal WC, having a substantially increased WC is associated with the development of ADL disability in both men and women. Associations between WC and IADL disability are evident for women only, where 6.9% of those with a substantially increased WC developed a new IADL at wave 2 compared to 3.4% of women with a normal WC. No association was observed between BMI at wave 1 and new disability at wave 2 (see Appendix Table 4.A5). As only a small number of participants reported a new disability at wave 2 it was not possible to carry out further analyses by age group.

Figure 4.7: Proportion reporting new ADL and IADL disabilities at wave 2 by wave 1 waist circumference classification and sex



Note. N = 5349; Missing obs = 0; Error bars correspond to 95% confidence intervals

Despite the low frequency of physical disabilities in the older Irish population, substantially increased WC is associated with a higher incidence of ADL disability in both men and women and a higher incidence of IADL disability in women. This finding, coupled with the high prevalence of obesity in this population, highlights the importance of appropriate weight management strategies for older adults to improve health and function and maintain independence in later life.

4.5 Obesity and mental health

High levels of both obesity and mental health difficulties were found among older Irish adults at wave 1 (20). A burgeoning field of research suggests that this may be more than simple coincidence reflecting a complex interplay of biological, psychological and social phenomena (21-24).

Depression that presents for the first time in late life may share some of the same risk factors as heart disease and stroke (25). Eating habits and lifestyle choices which adversely affect BMI and WC may therefore also have a detrimental effect on the brain and in turn negatively impact mood.

At wave 1 , depressive symptoms were measured with the 20-item Center for Epidemiologic Studies Depression (CES-D) scale which assesses depressive symptoms over the previous week (26). Symptoms of anxiety were measured at wave 1 using the anxiety subscale of the Hospital Anxiety and Depression Scale (HADS-A), a self-report questionnaire, which assesses the frequency of anxiety symptoms over the last week (27). High levels of depressive and anxiety symptoms were observed among older Irish adults (20).

In response to these findings a more in-depth measure of depression and anxiety was introduced at wave 2 to gain a more accurate estimate of the true burden of these conditions in older Irish adults. The Composite International Diagnostic Interview – Short Form (CIDI-SF) is designed to be used by lay interviewers for the assessment of mental disorders according to well established definitions and criteria. It can be used to classify individuals as having 'probable' Major Depressive Disorder (MDD) or General Anxiety Disorder (GAD) and more closely reflects the way a doctor would diagnose a mental illness (28).

4.5.1 Obesity and depression

Table 4.4a and 4.4b show depression at wave 2 by wave 1 WC and BMI. According to the CIDI-SF, 6.1% of adults aged 52 and over met criteria for a MDD within the last year. The prevalence of MDD is higher in older adults who have a substantially increased WC or who are obese according to their BMI. Interestingly, adults who have moderate levels of obesity, as defined by increased WC or overweight, report the lowest prevalence of MDD.

Table 4.4a: Depression at wave 2 by wave 1 waist circumference classification

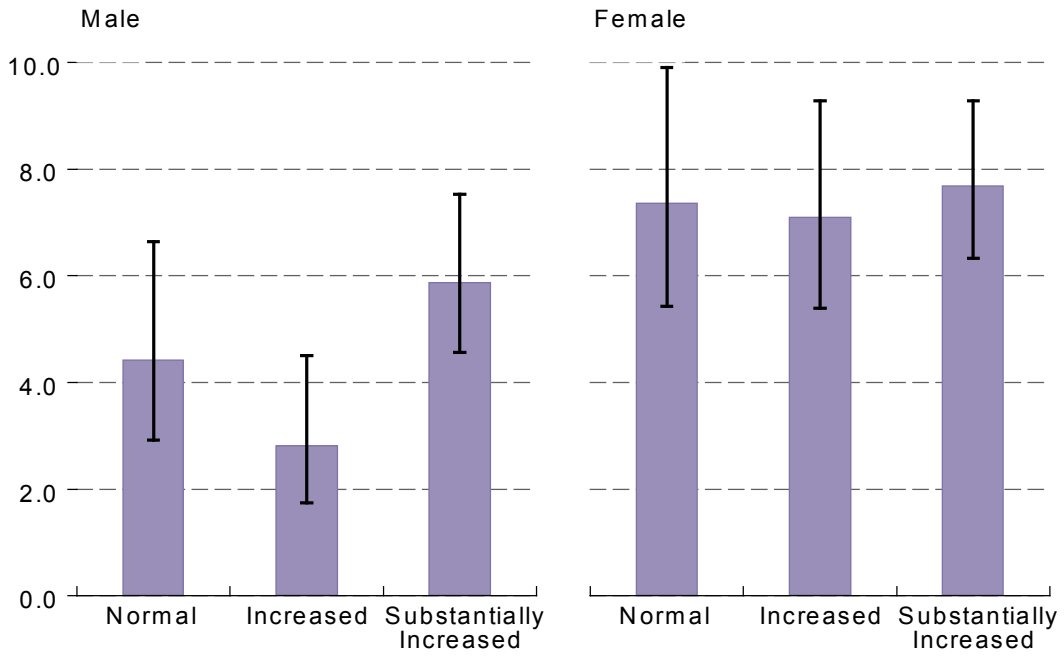
	Major Depressive Disorder	
	%	(95% CI)
Normal	5.8	(5-7)
Increased	4.9	(4-6)
Substantially Increased	6.9	(6-8)
Total	6.1	(6-7)

Table 4.4b: Depression at wave 2 by wave 1 body mass index classification

	Major Depressive Disorder	
	%	(95% CI)
Normal	5.5	(4-7)
Overweight	5.2	(4-6)
Obese	7.7	(7-9)
Total	6.1	(6-7)

Figure 4.8 shows wave 2 prevalence of depression by WC at wave 1 in men and women. Although group numbers are small when the analysis is stratified by sex, there is evidence that WC is associated with depression in men but not in women. Men with a substantially increased WC have a higher prevalence of MDD (5.9%) than men who have an increased WC (2.8%), although there is no difference between men with substantially increased WC and men with a normal WC. There are no associations with age. A similar pattern is observed with BMI and can be seen in Appendix Table 4.A6.

Figure 4.8: Depression at wave 2 by wave 1 waist circumference classification and sex



Note. N = 5349; Missing obs = 0; Error bars correspond to 95% confidence intervals

4.5.2 Obesity and anxiety

The CIDI-SF for Generalised Anxiety Disorder (GAD) was also included in wave 2 to gain a better understanding of the true prevalence of clinical anxiety in older Irish adults. Again, this is an interview-based approach which better reflects how a mental health professional would diagnose an anxiety disorder.

According to the CIDI-SF, 3.1% of adults aged 52 and over met diagnostic criteria for GAD within the past year. Rates of GAD decline with age, from 3.9% in those aged 52-65 to just 1.1% in adults aged 75 and over (see Appendix Table 4.A7) and are higher among women (see Figure 4.9) (Appendix Tables 4.A8 and 4.A9 show the same relationships for BMI). Tables 4.5a and 4.5b shows anxiety at wave 2 by wave 1 WC and BMI. Regardless of the measure of obesity, no association with anxiety is observed.

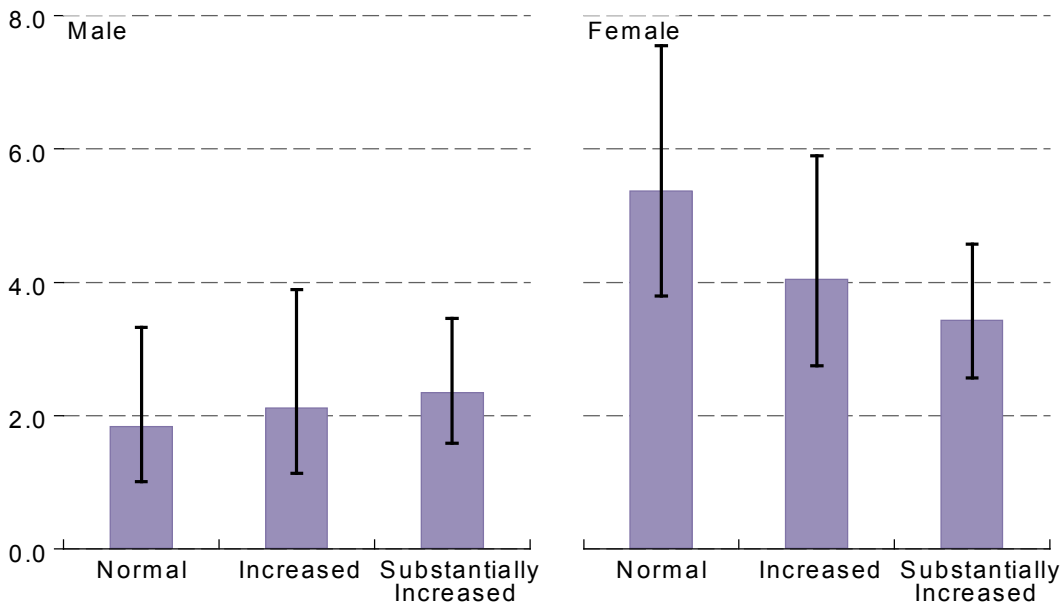
Table 4.5a: Anxiety at wave 2 by wave 1 waist circumference classification

	General Anxiety Disorder	
	%	(95% CI)
Normal	3.5	(3-5)
Increased	3.1	(2-4)
Substantially Increased	3.0	(2-4)
Total	3.2	(3-4)

Table 4.5b: Anxiety at wave 2 by wave 1 body mass index classification

	General Anxiety Disorder	
	%	(95% CI)
Normal	3.3	(2-4)
Overweight	2.8	(2-4)
Obese	3.3	(2-4)
Total	3.1	(3-4)

Figure 4.9: Anxiety at wave 2 by wave 1 waist circumference classification and sex



Note. N = 5349; Missing obs = 0; Error bars correspond to 95% confidence intervals

4.6 Obesity and health behaviours

Obesity is caused by an energy imbalance, whereby more calories are consumed than spent. An increase in calorie consumption through the availability of high energy convenience foods, combined with increasingly sedentary lifestyles, has coincided with the increased rates of obesity worldwide (1). Previous research indicates that energy intake does not increase with ageing, therefore changes in energy balance and body weight are mainly believed to be due to decreased physical activity (29). This was reflected in the findings from wave 1 where the prevalence of 'high' physical activity decreased from 40% in adults aged 50-64 to 18% in adults aged 75 and over (20). In addition to its effects on body weight, higher levels of physical activity are associated with lower rates of CVD mortality, disability and depressive symptoms in older adults (30-32). Research also shows that smoking and alcohol consumption impact upon food intake and eating habits (33, 34).

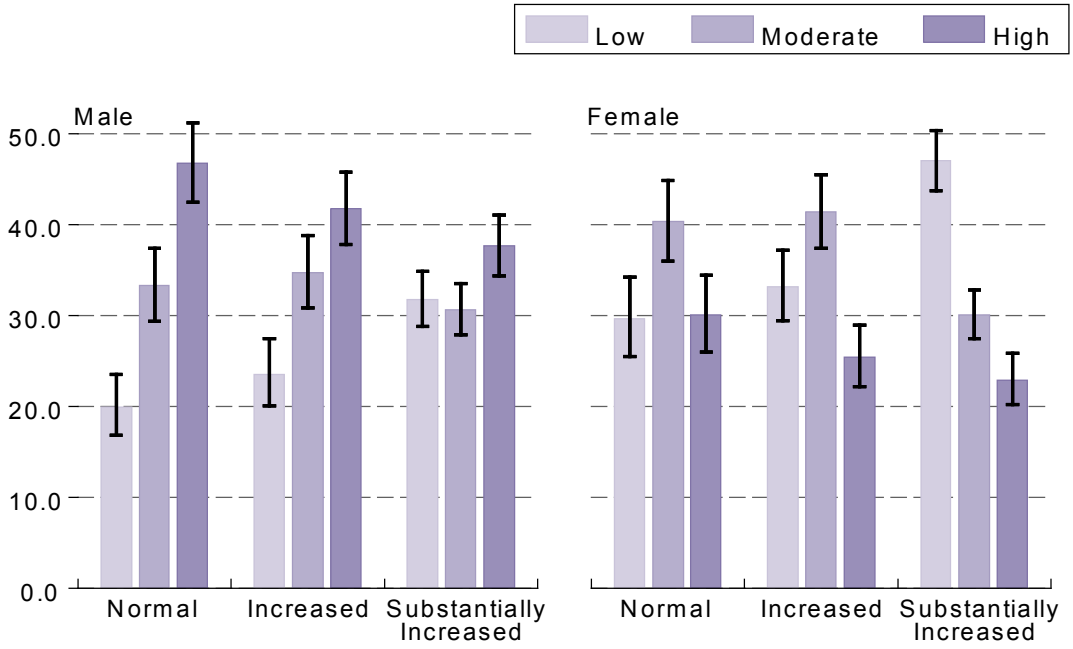
4.6.1 Obesity and physical activity

Physical activity is assessed in TILDA using the International Physical Activity Questionnaire (IPAQ), which classifies individuals as having 'low', 'medium' or 'high'

levels of physical activity. Figure 4.10 shows wave 2 physical activity level by wave 1 WC category and sex. 32% of men with a substantially increased WC report 'low' levels of physical activity compared to 20% of men with a normal WC. Corresponding figures for women are 47% and 30%. For all age groups, the lowest levels of physical activity were reported in those with a substantially increased WC (see Appendix Table 4.A10).

Overall, only a third of older adults are classified as having 'high' levels of physical activity. Men with a normal WC have the highest levels of physical activity (47%), whereas lowest levels of physical activity are seen in women with a substantially increased WC (23%). Similar associations are seen for BMI and physical activity and can be seen in Appendix Table 4.A11.

Figure 4.10: Physical activity levels at wave 2 by wave 1 waist circumference classification and sex



Note. N = 5298; Missing obs = 51; Error bars correspond to 95% confidence intervals

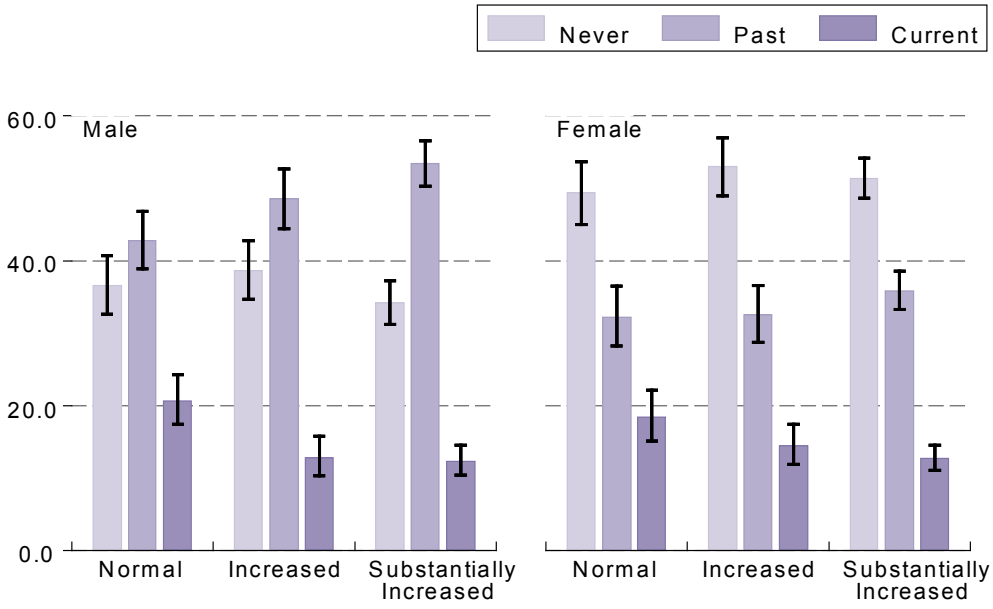
Given that the IPAQ is based on self-report, participants are likely to overestimate physical activity (35), so the proportion of the population engaging in high levels of physical activity is likely to be even lower than the results presented here. An objective measure of physical activity will be incorporated into wave 3 of the TILDA study to facilitate a more robust examination of the relationship between obesity and physical activity and inform intervention strategies for obesity that are based on physical activity.

4.6.2 Obesity and smoking

Figure 4.11 shows smoking behaviour at wave 2 by wave 1 WC classification and sex. In men, a history of smoking is associated with obesity, with 53% of men classified as having a substantially increased WC being past smokers, compared to 43% of men with normal WC.

Current smoking is strongly associated with having a normal WC in both men and women. For example 21% of men with a normal WC smoke compared to 12% with a substantially increased WC. Corresponding figures for women are 18% and 13%. Similar findings are observed between BMI and smoking (Appendix Table 4.A12).

Figure 4.11: Smoking behaviour at wave 2 by wave 1 waist circumference classification and sex

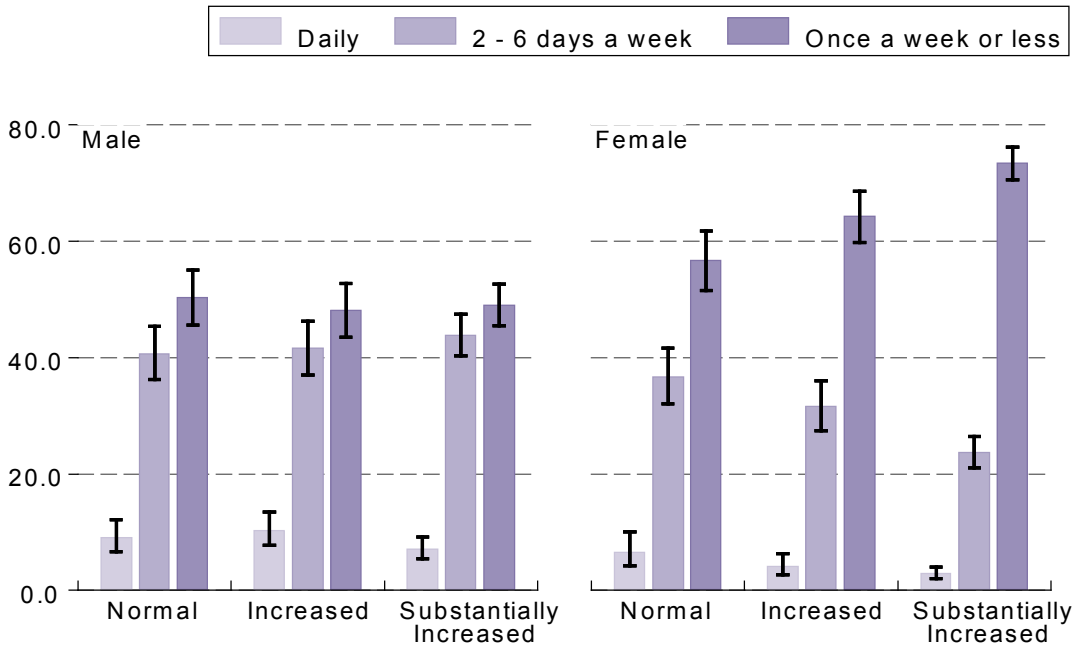


Note. N = 5349; Missing obs = 0; Error bars correspond to 95% confidence intervals

4.6.3 Obesity and alcohol consumption

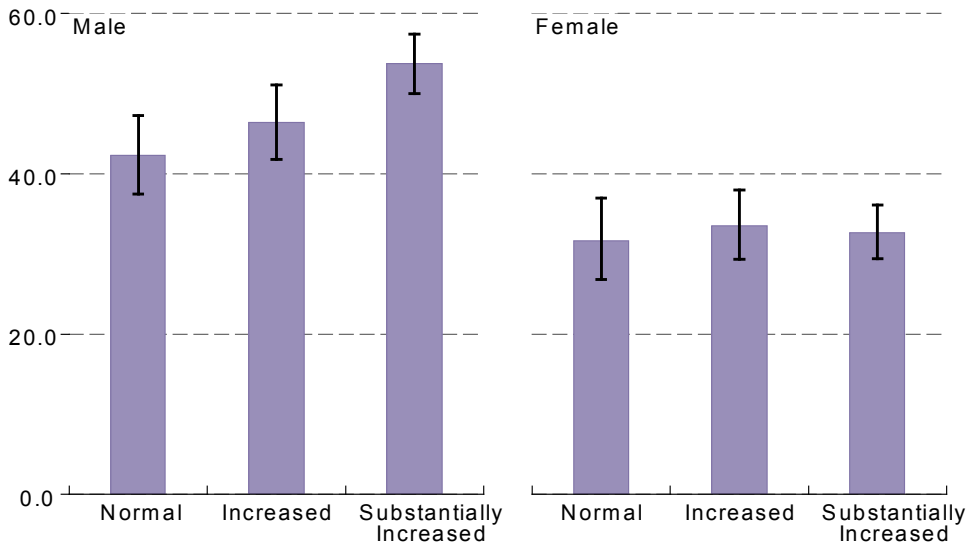
In wave 2 of the TILDA study, participants were asked about how frequently they consumed alcohol, and if they had reduced their alcohol intake since wave 1. Figure 4.12 shows frequency of alcohol consumption at wave 2 by wave 1 WC classification and sex. In women, obesity is associated with lower alcohol consumption. 3% of women with a substantially increased WC report daily consumption of alcohol compared to 7% with a normal WC. No association was observed between WC and alcohol consumption in men.

Figure 4.12: Frequency of alcohol consumption at wave 2 by wave 1 waist circumference classification and sex



Note. N = 3785; Missing obs = 1564; Error bars correspond to 95% confidence intervals

Figure 4.13: Proportion reporting reduction in alcohol use by wave 1 waist circumference classification and sex



Note. N = 3687; Missing obs = 1662; Error bars correspond to 95% confidence intervals

A higher proportion of men with substantially increased WC have reduced their alcohol intake between waves (54%) than men with a normal WC (42%). There is no change in reported alcohol reduction among women (see Figure 4.13). Similar associations are observed for BMI and alcohol consumption (see Appendix Tables 4.A13 and 4.A14).

Recent research has demonstrated that poor health behaviours may compound the effects of obesity on health, specifically CVD (37, 38). Results presented here suggest that low physical activity and being a past smoker are associated with obesity in older Irish adults however no association was observed for alcohol.

4.7 Conclusion

Data presented in this chapter indicate that obesity, measured either by waist circumference or body mass index, is highly prevalent among older Irish adults. 35% of TILDA participants are classified as obese according to their body mass index; a further 44% are overweight. Using the WHO waist classification, 53% of this population have a waist circumference measurement placing them at substantially increased risk of cardiac and metabolic disease. This finding is confirmed by the higher prevalence of diabetes, heart attack (men only) and angina (women only) in adults who had an increased BMI or waist circumference.

Irish rates of obesity are among the highest in Europe, and show no sign of decline (2). Obesity is currently estimated to cost the Irish economy over €1bn per year in work absenteeism, premature mortality and increased health service usage. For example, an obese person incurs 25% higher health expenditures than a person of normal weight in any given year (2, 39).

This chapter has documented an association between a number of negative health outcomes and obesity. Specifically obesity is strongly associated with heart attacks, diabetes and disability. Differences between men and women are also observed for a number of conditions and behaviours. In particular obese men have the highest rates of cardiovascular disease, while a higher proportion of obese women report low physical activity levels and increased physical disability.

The strong associations observed between obesity and health behaviours are difficult to disentangle using just two waves of data and future waves of TILDA will add to our understanding of these complex relationships. Detailed information on food consumption will be collected during wave 3 of the study along with an objective measure of physical

activity. This will further add to our understanding of the interplay between obesity, disease and health behaviours in older adults.

Obesity is associated with poor physical and mental health outcomes and health behaviours in older Irish adults. Public health campaigns aimed at educating older Irish adults to the importance of maintaining a healthy body weight could greatly reduce the burden of ill-health and disability associated with obesity, and lessen consequent demands on the healthcare system.

References

1. WHO. Obesity: preventing and managing the global epidemic. Report of a WHO Consultation (WHO Technical Report Series 894). Geneva: World Health Organisation, 2000.
2. OECD. Obesity Update 2012. Organisation for Economic Co-operation and Development, 2012.
3. IUNA. National Adult Nutrition Survey Summary Report. Irish Universities Nutrition Alliance 2011
4. Lee CM, Huxley RR, Wildman RP, Woodward M. Indices of abdominal obesity are better discriminators of cardiovascular risk than BMI: a meta-analysis. Journal of Clinical Epidemiology. 2008;61:646-53.
5. Blaum CS, Xue QL, Michelon E, Semba RD, Fried LP. The Association Between Obesity and the Frailty Syndrome in Older Women: The Women's Health and Aging Studies. J Am Geriatr Soc. 2005;53:927-34.
6. Arterburn D, Westbrook EO, Ludman EJ, Operskalski B, Linde JA, Rohde P, et al. Relationship between obesity, depression, and disability in middle-aged women. Obesity Research & Clinical Practice. 2012;6(3):e197-e206.
7. Katsiki N, Ntaios G, Vemmos K. Stroke, obesity and gender: A review of the literature. Maturitas. 2011;69(3):239-43.
8. Magnani JW, Hylek EM, Apovian CM. Obesity begets Atrial Fibrillation : A Contemporary Summary. Circulation. 2013;128:401-5.
9. Mokdad AH, Ford ES, Bowman BA, Dietz WH, Vinicor F, Bales VS, et al. Prevalence of Obesity, Diabetes, and Obesity-Related Health Risk Factors, 2001. JAMA. 2003;289:76-9.

10. Jackson AS, Janssen I, Sui X, Church TS, Blair SN. Longitudinal changes in body composition associated with healthy ageing men, aged 20-96 years. Br J Nutr. 2012;107:1085-91.

11. WHO. Waist Circumference and Waist-Hip Ratio: Report of a WHO Expert Consultation. Geneva, Switzerland: World Health Organization, 2008.

12. Preston S, Stokes A. Contribution of Obesity to International Differences in Life Expectancy. Am J Public Health. 2011;101(11):2137-43.

13. Reuser M, Bonneux LG, Willekens FJ. Smoking Kills, Obesity Disables: A Multistate Approach of the US Health and Retirement Survey. Obesity. 2009;17(4):783-9.

14. CSO. Statistics: Fourth Quarter and Yearly Summary 2012. 2013.

15. Marinou K, Tousoulis D, Antonopoulos AS, Stefanadi E, Stefanadis C. Obesity and cardiovascular disease: From pathophysiology to risk stratification. International Journal of Cardiology. 2010;138:3-8.

16. de Koning L, Merchant AT, Pogue J, Anand SS. Waist circumference and waist-to-hip ratio as predictors of cardiovascular events: meta-regression analysis of prospective studies. European Heart Journal. 2007;28(7):850-6.

17. Wajchenberg BL. Subcutaneous and Visceral Adipose Tissue: Their Relation to the Metabolic Syndrome. Endocrine Reviews. 2000;21(6):697-738.

18. Katz S, Ford AB, Moskowitz RW, Jackson BA, Jaffe MW. Studies of illness in the aged, the index of ADL: A standardised measure of biological and psychosocial function. JAMA. 1963;21(185):914-9.

19. Lawton MP, Brody EM. Assessment of Older People: Self-Maintaining and Instrumental Activities of Daily Living The Gerontologist. 1969;9(3 Part 1).

20. Barrett A, Savva G, Timonen V, Kenny RA. Fifty Plus in Ireland 2011: First Results from The Irish Longitudinal Study on Ageing. Trinity College Dublin, 2011.

21. van Reedt Dortland AK, Giltay EJ, van Veen T, Zitman FG, Penninx BW. Longitudinal relationship of depressive and anxiety symptoms with dyslipidemia and abdominal obesity. Psychosomatic Medicine. 2013;75(1):83-9.

22. van Reedt Dortland AK, Vreeburg SA, Giltay EJ, Licht CM, Vogelzangs N, van Veen T, et al. The impact of stress systems and lifestyle on dyslipidemia and obesity in anxiety and depression. Psychoneuroendocrinology. 2013;38(2):209-18.

23. Rivenes AC, Harvey SB, Mykletun A. The relationship between abdominal fat, obesity, and common mental disorders: results from the HUNT study. Journal of Psychosomatic Research. 2009;66(4):269-75.

24. Pagoto S, Schneider KL, Whited MC, Oleski JL, Merriam P, Appelhans B, et al. Randomized controlled trial of behavioral treatment for comorbid obesity and depression in women: the Be Active Trial. International Journal of Obesity. 2013;37:1427-34.

25. Allan CL, Sexton CE, Kalu UG, McDermott LM, Kivimäki M, Singh-Manoux A, et al. Does the Framingham Stroke Risk Profile predict white-matter changes in late-life depression? International Psychogeriatrics. 2012;24(4):524-31.

26. Beekman AT, Deeg DJ, van Limbeek J, Braam AW, de Vries MZ, van Tilburg W. Criterion validity of the Center for Epidemiologic Studies Depression scale (CES-D): results from a community-based sample of older subjects in The Netherlands. Psychological Medicine. 1997;27:231-5.

27. Zigmond AS, Snaith RP. The hospital anxiety and depression scale. Acta Psychiatrica Scandinavica. 1983;67(6):361-70.

28. Kessler RC, Andrews G, Mroczek D, Ustun TB, Wittchen H-U. The World Health Organization Composite International Diagnostic Interview Short Form (CIDI-SF). International Journal of Methods in Psychiatric Research. 1998;7(4):171-85.

29. Villareal DT, Apovian CM, Kushner RF, Klien S. Obesity in Older Adults: Technical Review and Position Statement of the American Society for Nutrition and NAASO, The Obesity Society. Obesity Research. 2005;13(11):1849-63.

30. Reddigan JI, Ardren CI, Riddell MC, Kuk JL. Relation of Physical Activity to Cardiovascular Disease Mortality and the Influence of Cardiometabolic Risk Factors. Am J Cardiol. 2011;108:1426-31.

31. Tak E, Kuiper R, Chorus A, Hopman-Rock M. Prevention of onset and progression of basic ADL disability by physical activity in community dwelling older adults: A meta-analysis. Ageing Research Reviews. 2013;12:329-228.

32. Morgan K, O' Farrell J, Doyle F, McGee H. Physical activity and core depressive symptoms in the older Irish adult population. Centre for Ageing Research and Development in Ireland (CARDI), 2011.

33. Filozof C, Fernandez-Pinalla MC, Fernandez-Cruz A. Smoking Cessation and weight gain. Obesity Reviews. 2004;5(2):95-103.

34. Yeomans MR. Alcohol, appetite and energy balance: Is alcohol intake a risk factor for obesity? Physiology & Behavior. 2010;100:82-9.

35. Rzewnicki R, Vanden Auweele Y, De Bourdeaudhuji I. Addressing overreporting on the International physical acticity questionnaire (IPAQ) telephone survey with a population sample. Public Health Nutr. 2003;6:299-305.

36. Sulander T, Rahkonen O, Nissinen A, Uutela A. Association of smoking status with obesity and diabetes among elderly people. Archives of Gerontology and Geriatrics. 2007;45:159-67.

37. Luo W, Guo Z, Hao C, Yao X, Zhou Z, Wu M, et al. Interaction of current alcohol consumption and abdominal obesity on hypertension risk. Physiology & Behavior. 2013;122:182-6.

38. Ma J, Jemal A, Flanders D, Ward EM. Joint association of adiposity and smoking with mortality among U.S. adults. Preventative Medicine. 2013;56:178-84.

39. Safefood. The cost of overweight and obesity on the island of Ireland. 2012.

Appendix 4: Tables on Obesity and Health Outcomes in Older Irish Adults

Table 4.A1: Prevalence of normal, overweight and obesity at wave 1 by age and sex

	Normal		Overweight		Obese		Total	Number in sample
	%	95% CI	%	95% CI	%	95% CI		
Male								
52-64	16	(14-19)	48	(45-51)	36	(34-39)	100	1271
65-74	13	(11-16)	46	(42-50)	41	(38-45)	100	759
>=75	17	(13-22)	47	(42-53)	36	(31-41)	100	429
Total	*15*	*(14-17)*	*47*	*(45-49)*	*38*	*(36-40)*	*100*	*2459*
Female								
52-64	28	(25-30)	40	(38-43)	32	(30-35)	100	1577
65-74	24	(21-27)	42	(38-45)	34	(31-38)	100	858
>=75	27	(22-32)	39	(34-45)	34	(29-39)	100	455
Total	*27*	*(25-28)*	*40*	*(38-43)*	*33*	*(31-35)*	*100*	*2890*
Total								
52-64	22	(20-24)	44	(42-46)	34	(32-36)	100	2848
65-74	19	(17-21)	44	(41-46)	38	(35-40)	100	1617
>=75	23	(20-26)	43	(39-47)	35	(31-38)	100	884
Total	*21*	*(20-22)*	*44*	*(42-45)*	*35*	*(34-37)*	*100*	*5349*

Note. CI = confidence interval; Missing observations = 0.00%

Table 4.A2: Prevalence of normal, increased and substantially increased waist circumference at wave 1 by age and sex

	Normal		Increased		Substantially Increased		Total	Number in sample
	%	95% CI	%	95% CI	%	95% CI		
Male								
52-64	28	(25-31)	28	(26-31)	44	(41-46)	100	1271
65-74	22	(19-25)	24	(21-28)	54	(50-57)	100	759
>=75	21	(17-25)	25	(21-30)	54	(49-59)	100	429
Total	*25*	*(23-27)*	*27*	*(25-29)*	*48*	*(46-50)*	*100*	*2459*
Female								
52-64	23	(21-26)	27	(24-29)	50	(47-53)	100	1577
65-74	17	(14-19)	25	(22-28)	59	(55-62)	100	858
>=75	15	(12-19)	19	(15-23)	66	(61-71)	100	455
Total	*19*	*(18-21)*	*24*	*(23-26)*	*56*	*(54-58)*	*100*	*2890*
Total								
52-64	26	(24-28)	27	(26-29)	47	(45-49)	100	2848
65-74	19	(17-21)	24	(22-27)	56	(54-59)	100	1617
>=75	17	(15-20)	21	(19-24)	61	(57-65)	100	884
Total	*22*	*(21-23)*	*25*	*(24-27)*	*53*	*(51-54)*	*100*	*5349*

Note. CI = confidence interval; Missing observations = 0.00%

Table 4.A3: Prevalence of cardiovascular disease at wave 2 by wave 1 body mass index classification and sex

	Angina		Heart Attack		Diabetes	
	%	(95% CI)	%	(95% CI)	%	(95% CI)
Male						
Normal	4.6	(2.6-7.8)	5.4	(3.4-8.6)	4.8	(2.9-7.9)
Overweight	4.5	(3.3-6.0)	8.2	(6.6-10.3)	8.2	(6.6-10.0)
Obese	6.6	(5.0-8.6)	10.1	(8.1-12.4)	15.3	(13.0-17.9)
Total	*5.3*	*(4.4-6.4)*	*8.5*	*(7.3-9.8)*	*10.3*	*(9.1-11.7)*
Female						
Normal	3.9	(2.5-6.1)	2.5	(1.4-4.3)	2.6	(1.6-4.2)
Overweight	3.8	(2.6-5.6)	2.9	(1.9-4.4)	4.5	(3.2-6.3)
Obese	6.4	(4.5-9.0)	3.2	(2.1-5.0)	12.1	(10.0-14.7)
Total	*4.7*	*(3.7-5.9)*	*2.9*	*(2.2-3.8)*	*6.5*	*(5.6-7.6)*
Total						
Normal	4.1	(2.9-5.8)	3.5	(2.4-5.0)	3.4	(2.4-4.7)
Overweight	4.1	(3.2-5.3)	5.7	(4.6-6.9)	6.4	(5.3-7.7)
Obese	6.5	(5.2-8.1)	6.7	(5.5-8.2)	13.8	(12.2-15.5)
Total	*5.0*	*(4.2-5.8)*	*5.6*	*(4.9-6.4)*	*8.3*	*(7.6-9.2)*

Table 4.A4: Prevalence of cardiovascular disease risk factors at wave 2 by wave 1 body mass index classification and sex

	High Blood Pressure		High Cholesterol		Irregular Rhythm	
	%	(95% CI)	%	(95% CI)	%	(95% CI)
Male						
Normal	23.2	(18.9-28.0)	31.4	(26.6-36.7)	7.6	(5.1-11.0)
Overweight	32.8	(29.8-35.9)	32.2	(29.4-35.2)	6.4	(5.0-8.2)
Obese	46.5	(42.9-50.0)	35.1	(31.8-38.6)	9.4	(7.6-11.6)
Total	*36.4*	*(34.4-38.6)*	*33.2*	*(31.2-35.3)*	*7.7*	*(6.7-8.9)*
Female						
Normal	23.7	(20.4-27.4)	37.1	(33.2-41.1)	7.5	(5.7-10.0)
Overweight	37.9	(34.6-41.3)	42.9	(39.6-46.3)	7.2	(5.6-9.2)
Obese	52.3	(48.5-56.2)	42.3	(38.7-45.9)	8.0	(6.1-10.5)
Total	*38.9*	*(36.8-41.1)*	*41.2*	*(39.1-43.3)*	*7.6*	*(6.5-8.8)*
Total						
Normal	23.5	(20.8-26.5)	35.1	(32.0-38.3)	7.5	(6.0-9.5)
Overweight	35.3	(32.9-37.7)	37.4	(35.1-39.8)	6.8	(5.7-8.1)
Obese	49.3	(46.7-52.0)	38.6	(36.1-41.3)	8.7	(7.3-10.4)
Total	*37.7*	*(36.2-39.3)*	*37.3*	*(35.8-38.9)*	*7.6*	*(6.8-8.5)*

Table 4.A5: Proportion reporting new ADL and IADL disabilities at wave 2 by wave 1 body mass index category and sex

	New ADL		New IADL	
	%	(95% CI)	%	(95% CI)
Male				
Normal	1.1	(0.5-2.8)	4.1	(2.4-7.1)
Overweight	2.3	(1.5-3.4)	3.5	(2.4-5.0)
Obese	3.1	(2.1-4.6)	5.3	(3.8-7.2)
Total	*2.4*	*(1.9-3.1)*	*4.3*	*(3.4-5.3)*
Female				
Normal	4.1	(2.7-6.2)	5.8	(4.1-8.3)
Overweight	4.3	(2.9-6.2)	5.1	(3.7-6.9)
Obese	6.5	(4.8-8.9)	6.7	(5.0-8.9)
Total	*5.0*	*(4.0-6.2)*	*5.8*	*(4.8-7.0)*
Total				
Normal	3.1	(2.1-4.5)	5.3	(3.9-7.1)
Overweight	3.2	(2.4-4.3)	4.3	(3.3-5.5)
Obese	4.8	(3.7-6.1)	6.0	(4.8-7.4)
Total	*3.7*	*(3.2-4.4)*	*5.1*	*(4.4-5.9)*

Table 4.A6: Prevalence of major depressive disorder at wave 2 by wave 1 body mass index classification and sex

	Major Depressive Disorder	
	%	(95% CI)
Male		
Normal	5.5	(3.4-8.8)
Overweight	3.0	(2.1-4.3)
Obese	6.5	(5.0-8.4)
Total	*4.7*	*(3.8-5.8)*
Female		
Normal	5.6	(4.1-7.5)
Overweight	7.6	(6.1-9.4)
Obese	8.9	(7.0-11.2)
Total	*7.5*	*(6.5-8.6)*
Total		
Normal	5.5	(4.3-7.2)
Overweight	5.2	(4.3-6.3)
Obese	7.7	(6.4-9.1)
Total	*6.1*	*(5.5-6.9)*

Table 4.A7: Prevalence of generalised anxiety disorder at wave 2 by wave 1 waist circumference classification and age

	Generalised Anxiety Disorder	
	%	(95% CI)
52-64		
Normal	4.5	(3.1-6.5)
Increased	4.0	(2.8-5.7)
Substantially Increased	3.6	(2.7-4.8)
Total	*3.9*	*(3.2-4.8)*
65-74		
Normal	3.3	(1.8-6.0)
Increased	3.3	(1.7-6.4)
Substantially Increased	3.0	(2.0-4.5)
Total	3.1	(2.3-4.2)
>=75		
Normal	0.0	(.-.)
Increased	0.0	(.-.)
Substantially Increased	1.8	(0.8-3.8)
Total	*1.1*	*(0.5-2.3)*
Total		
Normal	3.5	(2.5-4.7)
Increased	3.1	(2.2-4.3)
Substantially Increased	3.0	(2.3-3.8)
Total	*3.1*	*(2.6-3.7)*

Table 4.A8: Prevalence of generalised anxiety disorder at wave 2 by wave 1 body mass index classification and age

	Generalised Anxiety Disorder	
	%	(95% CI)
52-64		
Normal	4.6	(3.1-6.6)
Overweight	3.6	(2.6-4.8)
Obese	4.0	(2.9-5.5)
Total	*3.9*	*(3.2-4.8)*
65-74		
Normal	3.6	(1.9-6.6)
Overweight	2.7	(1.6-4.3)
Obese	3.4	(2.1-5.6)
Total	*3.1*	*(2.3-4.2)*
>=75		
Normal	0.0	(.-.)
Overweight	1.3	(0.4-4.1)
Obese	1.5	(0.6-4.2)
Total	*1.1*	*(0.5-2.3)*
Total		
Normal	3.3	(2.4-4.5)
Overweight	2.8	(2.2-3.7)
Obese	3.3	(2.5-4.3)
Total	*3.1*	*(2.6-3.7)*

Table 4.A9: Prevalence of generalised anxiety disorder at wave 2 by wave 1 body mass index classification and sex

	Generalised Anxiety Disorder	
	%	(95% CI)
Male		
Normal	2.0	(0.9-4.2)
Overweight	2.0	(1.3-3.2)
Obese	2.4	(1.6-3.6)
Total	*2.2*	*(1.6-2.9)*
Female		
Normal	3.9	(2.8-5.6)
Overweight	3.7	(2.7-5.1)
Obese	4.3	(3.1-5.9)
Total	*4.0*	*(3.3-4.8)*
Total		
Normal	3.3	(2.4-4.5)
Overweight	2.8	(2.2-3.7)
Obese	3.3	(2.5-4.3)
Total	*3.1*	*(2.6-3.7)*

Table 4.A10: Physical activity levels at wave 2 by wave 1 waist circumference classification and age

	Low		Moderate		High		Total	Number in sample
	%	95% CI	%	95% CI	%	95% CI		
52-64								
Normal	20	(17-23)	36	(32-40)	44	(40-48)	100	741
Increased	23	(20-27)	38	(35-42)	38	(35-42)	100	779
Substantially Increased	32	(29-35)	29	(26-32)	39	(36-42)	100	1306
Total	*27*	*(25-29)*	*33*	*(31-35)*	*40*	*(38-43)*	*100*	*2826*
65-74								
Normal	23	(18-28)	39	(34-45)	38	(32-44)	100	314
Increased	28	(23-33)	39	(34-45)	33	(28-38)	100	402
Substantially Increased	39	(35-43)	35	(32-38)	27	(23-30)	100	885
Total	*33*	*(30-36)*	*37*	*(34-39)*	*30*	*(28-33)*	*100*	*1601*
>=75								
Normal	43	(34-52)	34	(27-43)	23	(16-30)	100	161
Increased	44	(37-52)	35	(28-42)	21	(15-27)	100	211
Substantially Increased	57	(52-62)	28	(23-32)	15	(11-20)	100	499
Total	*52*	*(48-56)*	*30*	*(27-34)*	*18*	*(15-21)*	*100*	*871*
Total								
Normal	24	(22-27)	36	(34-39)	39	(36-42)	100	1216
Increased	28	(26-31)	38	(35-41)	34	(31-36)	100	1392
Substantially Increased	40	(38-43)	30	(28-32)	29	(27-32)	100	2690
Total	*34*	*(32-36)*	*34*	*(32-35)*	*33*	*(31-35)*	*100*	*5298*

Note. CI = confidence interval; Missing observations = 0.95%

Table 4.A11: Physical activity levels at wave 2 by wave 1 body mass index classification and sex

	Low		Moderate		High		Total	Number in sample
	%	95% CI	%	95% CI	%	95% CI		
Male								
Normal	22	(18-27)	38	(32-43)	40	(35-46)	100	373
Overweight	25	(22-27)	32	(29-35)	44	(40-47)	100	1158
Obese	31	(28-35)	31	(28-34)	38	(35-42)	100	907
Total	*27*	*(25-29)*	*32*	*(30-34)*	*41*	*(39-44)*	*100*	*2438*
Female								
Normal	33	(29-37)	40	(36-44)	27	(24-31)	100	804
Overweight	39	(36-43)	35	(32-39)	25	(22-29)	100	1154
Obese	47	(43-52)	30	(27-33)	23	(19-26)	100	902
Total	*40*	*(38-43)*	*35*	*(33-37)*	*25*	*(23-27)*	*100*	*2860*
Total								
Normal	29	(26-32)	39	(36-42)	32	(29-35)	100	1177
Overweight	32	(29-34)	34	(31-36)	35	(32-37)	100	2312
Obese	39	(36-42)	30	(28-33)	31	(28-33)	100	1809
Total	*34*	*(32-36)*	*34*	*(32-35)*	*33*	*(31-35)*	*100*	*5298*

Note. CI = confidence interval; Missing observations = 0.95%

Table 4.A12: Smoking behaviour at wave 2 by wave 1 body mass index classification and sex

	Never		Past		Current		Total	Number in sample
	%	95% CI	%	95% CI	%	95% CI		
Male								
Normal	35	(30-40)	39	(34-45)	26	(22-31)	100	379
Overweight	37	(34-40)	51	(48-54)	13	(11-15)	100	1168
Obese	36	(32-39)	52	(49-56)	12	(10-15)	100	912
Total	*36*	*(34-38)*	*49*	*(47-52)*	*15*	*(13-16)*	*100*	*2459*
Female								
Normal	48	(44-51)	34	(30-38)	19	(16-22)	100	812
Overweight	53	(50-56)	34	(31-37)	13	(11-15)	100	1167
Obese	52	(49-56)	36	(32-39)	12	(10-14)	100	911
Total	*51*	*(49-53)*	*34*	*(32-36)*	*14*	*(13-16)*	*100*	*2890*
Total								
Normal	43	(40-46)	36	(33-39)	21	(19-24)	100	1191
Overweight	45	(42-47)	42	(40-45)	13	(12-15)	100	2335
Obese	44	(41-46)	44	(42-47)	12	(10-14)	100	1823
Total	*44*	*(42-46)*	*42*	*(40-43)*	*14*	*(13-16)*	*100*	*5349*

Note. CI = confidence interval; Missing observations = 0.00%

Table 4.A13: Alcohol consumption at wave 2 by wave 1 body mass index classification and sex

	Daily		2 - 6 days a week		Once a week or less		Total	Number in sample
	%	95% CI	%	95% CI	%	95% CI		
Male								
Normal	14	(10-20)	39	(33-45)	46	(40-53)	100	259
Overweight	9	(7-11)	43	(40-47)	48	(44-52)	100	850
Obese	6	(4-8)	42	(38-47)	52	(48-56)	100	637
Total	*8*	*(7-10)*	*42*	*(40-45)*	*49*	*(47-52)*	*100*	*1746*
Female								
Normal	6	(4-9)	35	(31-39)	59	(54-63)	100	593
Overweight	4	(3-6)	30	(26-33)	66	(63-70)	100	842
Obese	2	(1-3)	21	(18-25)	78	(74-81)	100	604
Total	*4*	*(3-5)*	*28*	*(26-31)*	*68*	*(66-70)*	*100*	*2039*
Total								
Normal	9	(7-12)	36	(33-40)	55	(51-58)	100	852
Overweight	6	(5-8)	37	(34-40)	57	(54-59)	100	1692
Obese	4	(3-5)	32	(30-35)	64	(61-67)	100	1241
Total	*6*	*(5-7)*	*35*	*(33-37)*	*59*	*(57-60)*	*100*	*3785*

Note. CI = confidence interval; Missing observations = 29.24%

Table 4.A14: Proportion reporting reduction in alcohol use by wave 1 body mass index classification and sex

	0		Yes		Total	Number in sample
	%	95% CI	%	95% CI		
Male						
Normal	57	(50-63)	43	(37-50)	100	261
Overweight	54	(50-58)	46	(42-50)	100	844
Obese	46	(42-50)	54	(50-58)	100	634
Total	*51*	*(49-54)*	*49*	*(46-51)*	*100*	*1739*
Female						
Normal	66	(61-70)	34	(30-39)	100	574
Overweight	69	(65-72)	31	(28-35)	100	800
Obese	67	(63-71)	33	(29-37)	100	574
Total	*67*	*(65-70)*	*33*	*(30-35)*	*100*	*1948*
Total						
Normal	62	(58-66)	38	(34-42)	100	835
Overweight	61	(58-63)	39	(37-42)	100	1644
Obese	55	(52-58)	45	(42-48)	100	1208
Total	*59*	*(57-61)*	*41*	*(39-43)*	*100*	*3687*

Note. CI = confidence interval; Missing observations = 31.07%