Understanding the confluence of injury and obesity in a Grade 2 obesity and above population

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Abstract

Objective: Obesity and injury are major inter-related public health challenges. The objective of this study was to explore the perceptions of injury in people with severe obesity.

Methods: A cross-sectional design was employed to capture injury perception and lifestyle habits via questionnaires. Weight (kg) and height (m) were measured by clinicians for patients attending a weight loss group program. Univariate, chi-square, ANOVA and ordinal regression analyses were undertaken.

Results: There were 292 participants (67.1% female), mean age 49.3 years and Body Mass Index 47.2 kg/m^2 (range 30.7–91.9 kg/m^2). Concern about having an injury was found in 83%, and 74.2% thought that weight would increase the likelihood of injury. A greater concern of being injured at baseline was associated with less weight loss at eight weeks (F=3.567; p=0.03). Depression, anxiety and sleepiness score were higher in those who reported greater 'Concern about having an injury'.

Conclusions: People with obesity fear injury and falling, which limits their willingness to exercise. Anxiety symptoms appear to exacerbate this connection.

Implications for public health: In individuals with obesity, anxiety, sleepiness and depression are associated with a fear of being injured. Addressing fear and reducing anxiety may decrease barriers to participating in physical activity.

Key words: obesity, injury, falls, fears, perception

Obesity and injury are both major public health challenges, with a growing body of literature suggesting that obesity increases the risk of having an injury and can complicate recovery.[1-3] Exercise is considered a necessary component of any weight loss program,[4] however, it has the potential to increase the risk of injury, especially falls, although this relationship is complex.[2] Furthermore, fear of injury may be a barrier to exercise, particularly among people with obesity.[5]

Obesity, most commonly determined by Body Mass Index (BMI),[6,7] provides a proxy measure of body adiposity with graduation from underweight (BMI<18.5 kg/m^2) to obese (BMI >30 kg/m^2). The risk of health complications increases with increased levels of adiposity.[8-10] There is a need for those with obesity to reduce their weight to improve their health and reduce the likelihood of sustaining an injury.[11-13]

Obesity rates are increasing worldwide and overtaking undernutrition globally.[14,15] In Australia, as in many other countries, more people's weight is classified as overweight or obese than healthy weight.[16] Although the percentage of people who have been classified as overweight or obese has almost doubled since 1990 (38% to 67%), it is the percentage of those living with obesity that has strikingly increased over this time, from 8% in 1990 to 31.3% in 2017-18.[16] Direct healthcare costs related to obesity were estimated at $5.4

Abbreviations
BAI, Beck Anxiety Inventory; BDI2, Beck Depression Inventory 2; BMI, Body Mass Index; M, Mean; SD, Standard deviation; 30CST, 30-second chair-stand test.

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billion in 2017-18, with a further $6.4 billion per year in indirect costs.[16]

Obesity has been linked to balance and postural instability, sleep disorders, fatigue, risk of falls, road injuries and overuse syndrome.[2] Obesity has also been shown to contribute to higher mortality following traumatic injury, increased length of stay in hospital and increased fracture risk.[2] The relationship between obesity and injury is complex. While exercise can increase the risk of falls, it reduces injury severity, particularly bone fractures, due to the potential increased bone density.[17] Fat mass can also act as cushioning in a fall incident.[2] Elderly populations with a high BMI are less likely to exercise due to a fear of falling or being injured,[18] although this effect is less clear for younger cohorts. This has significant ramifications for the way in which information about exercise is communicated to people living with obesity, particularly older populations. A growing body of work suggests that obesity increases the risk of injury, falls, stumbles and musculoskeletal damage, in addition to altering the pattern of injury, complicating recovery and increasing the risk of mortality.[2] However, most of the research into injury and falling has been in the older population (>65 years).

Injury is also a complex challenge,[19] with hospitalisation rates increasing over the last decade mainly due to increases in falls in the 65-plus age group.[19,20] The likelihood of falling increases steadily with age and rates are higher in women.[21] Falls in Australia in 2015-16 were responsible for $3.7 billion in healthcare expenditure.[22]

While obesity has significant adverse health implications, weight loss and its maintenance are often extremely difficult.[23-25] Weight loss will only occur if an energy deficit is created by either reducing energy intake or increasing energy expenditure. Better results are usually achieved when both approaches are implemented.[26] Physical activity has been shown to reduce morbidity and mortality, irrespective of weight loss[27-29] and, in older individuals, exercise has been shown to reduce the risk of falls.[30] However, if a person's ability to undertake physical activity is impaired, the full health benefits may not be realised.

While exercise is considered an important component of any weight loss program, starting or increasing exercise has the potential to also increase the risk of injury and falls.[2] A fear of injury while exercising may also be a barrier to exercising, particularly for people living with obesity. The prevalence of a fear of falling has been shown to range from 12–65% in the older population depending on age, disease, sex and past experiences.[21] In a group of men and women aged 79 or older, participation in exercise was found to be associated with a fear of falling,[21] but little is known of the prevalence of fear of falling in younger people and those living with obesity.[31]

The 2020 Australian National Study of Mental Health and Wellbeing survey showed that 16.8% of the population had an anxiety disorder and 7.5% had affective disorder (which includes all forms of depression) in the previous 12 months.[32] There is consistent evidence of a bidirectional relationship between obesity and depression, with depression and or anxiety prevalence in those living with obesity being approximately one-third more likely compared to those with a healthy weight.[33,34] Depression and anxiety increase the likelihood of being concerned about or having a fear of injury and attributing weight gain to injury, and vice versa. The development of psychological problems, such as depression or anxiety, can be attributed to a failure to adapt to life situations. This is often reflected in impairments in cognitive, affective, motivational and behavioural processes characterised by errors in thinking, disproportionate emotional distress and unhelpful behavioural strategies that interfere with the attainment of goals.[35]

Currently, there is limited understanding of the occurrence and perception of injuries in people living with obesity in Australia and its link to weight, exercise patterns, depression and anxiety symptoms and muscle strength. Understanding perceptions around injury and its link with obesity should aid the development of prevention programs and more individualised treatment plans.

Aims

The aim of this paper is to explore perceptions of injury risk, impact and prevention among a cohort of people living with obesity and to identify if perception is related to: a) age, b) BMI, c) waist circumference, c) mental wellbeing, d) physical activity and e) weight loss.

Methods

A set of survey questionnaires and anthropometric data was used in a cross-sectional study design embedded into clinical practice to explore perceptions and impact of injury among adult (≥18 years) patients living with obesity. These data were collected from patients at the first, fourth and eighth sessions of an eight-session, once-weekly, lifestyle weight loss group program at a tertiary medical weight loss service in Sydney, Australia, between October 2013 and November 2015.

Inclusion and exclusion criteria

Participants were all patients seen at a tertiary weight management clinic who met the inclusion criteria. Participants' data were included in the analysis if they met the following criteria: i) they consented to participate, via a standard consent form, given to all patients as part of the clinic process; ii) they could read English; iii) they did not have a mental illness that prevented them from completing questionnaires; iv) they returned all questionnaires; and v) they had all anthropometry measured at baseline. These criteria were met in 61.5% of the patients who started the program.

Data

All data were collected on day one of the program. Weight only was also routinely measured at weeks four and eight of the program in those who attended the corresponding session.

The 12-question injury perception survey was designed by the authors and reviewed by clinicians and researchers working in obesity management (Supplementary File 1: Perceptions of Injury Survey). Questions 1–3 relate to concerns around injury, Questions 4–7 explore perceptions around injury and weight, and Questions 8–12 relate to injuries sustained. Likert scales were used to categorise answers, which were converted into numeric values.

Anthropometry was measured by trained clinicians and included height (cm) using a wall-mounted stadiometer; weight (Kg) with Wedderburn™ digital scales; waist circumference (cm) using a long tape measure; and, systolic and diastolic blood pressure (mmHg), using a manual sphygmomanometer.

Table 1: Patient demographics.

	Female					Male					Total			Statistics	
	M	N	SD	Min	Max	M	N	SD	Min	Max	M	N	SD	F	Sig
Age (Years)	49.2	196	12.5	18.0	78.0	49.5	96	13.7	18.0	77.0	49.3	292	12.9	0.0	0.859
Anthropometric measurement															
Weight (Kg)	123.8	196	27.7	79.0	226.6	144.6	96	34.5	84.8	286.0	130.7	292	31.6	30.5	0.000
Height (m)	1.6	196	0.1	1.5	1.8	1.8	96	0.1	1.5	1.9	1.7	292	0.1	215.3	0.000
BMI (kg/m^2)	47.3	196	10.1	30.7	91.9	46.8	96	9.4	32.3	79.2	47.2	292	9.9	0.2	0.649
Waist (Cm)	123.5	195	15.2	87.0	171.0	139.3	95	17.8	101.0	193.5	128.7	290	17.7	61.5	0.000
Physical activity															
Total Exercise Score	6.9	158	1.6	3.1	11.9	6.9	80	1.6	3.6	12.0	6.9	238	1.6	0.0	0.906
30CST Score	12.7	145	4.5	0.0	29.0	11.3	65	3.9	0.0	20.0	12.3	210	4.4	5.0	0.027
Mental wellbeing															
BDI 2 score	19.2	170	12.3	0.0	50.0	19.3	83	12.7	0.0	56.0	19.2	253	12.4	0.0	0.949
BAI Score	19.5	170	13.3	0.0	62.0	18.8	83	14.5	0.0	58.0	19.3	253	13.7	0.1	0.714
Sleepiness Scale	7.3	183	4.9	0	20	9.5	92	5.1	0	23	8.0	275	5.1	12.6	0.000
Weight Loss															
Week 4 % Weight Loss*	-0.8	128	2.0	-8.6	10.6	-1.1	62	1.6	-5.4	2.1	-0.9	190	1.9	1.1	0.298
Week 8 % Weight Loss*	-1.4	144	2.6	-11.5	8.4	-2.6	62	5.6	-41.3	2.0	-1.8	206	3.8	4.2	0.041

M = mean, N = number of participants, SD = standard deviation, Min = minimum value, Max= maximum value, * a negative score indicates weight loss and positive score indicates weight gain, BDI 2 Beck Depression Inventory 2, BAI= Beck Anxiety Inventory

The 30-second chair-stand test (30CST) was used as a proxy measure of strength.[36] Self-reported exercise was determined using the Modified Baecke Questionnaire,[37] with a higher score indicating greater physical activity. Self-reported anxiety and depression were measured using the Beck Anxiety Inventory (BAI)[38] and Beck Depression Inventory-II (BDI2),[39] with higher scores indicating greater anxiety and depression symptoms. Sleepiness was measured using the Epworth's Sleepiness Scale with a higher score indicating a greater risk of sleep apnoea.[40,41]

Data coding and analysis

IBM SPSS Statistics Version 27 was used to analyse the results. A fear of falling was reclassified into "yes" or "no", ignoring the degree of fear. For analysis purposes, the Likert scales used in the injury survey were collapsed into the following categories for Questions 1: "agree", "disagree" and "don't know"; Questions 2 and 3 "not at all", "a little to somewhat", "a lot to a great deal" and "unsure"; and, Questions 4 to 12 "yes", "no" and "unsure or don't know". All options on the Likert scale were considered "yes" except "unsure" or "not at all", which were considered "no". Univariate and chi-square analyses were undertaken. ANOVA and ordinal regression were used to determine associations and significance was set at $p<0.05$. Due to the number of missing results for the 30CST (82; 28%), ordinal regression was applied with and without the 30CST score. Adding 30CST strengthened the associations; results with 30CST included have been reported.

Results

There were 292 (67.1% females) participants with a mean age of 49.3 years, BMI of 47.2 Kg/m^2 and waist circumference of 128.7 cm (Table 1). As expected, weight and waist circumference differed by sex ($p<0.001$) but not when adjusted for height (BMI); see Table 1. There was a significant difference in the Epworth Sleepiness Scale with males having a higher score (9.5 vs. 7.3, $p<0.000$) and males performed better in the 30CST ($p=0.027$). Prior to week 4, 61 (20.9%) participants dropped out of the program, with another 41 (14%) dropping out before week 8. Of the 206 subjects who had a weight measurement at week 8, 165 also had a weight measurement at week 4, there were a further 25 people who had a weight measurement at week 4 only. There were no sex differences in weight loss at week 4, but by week 8 males had lost more weight (-2.6% vs. -1.4%, $p=0.041$); see Table 1. Concern about having an injury significantly impacted weight loss at 8 weeks with those who responded "A lot/A great deal" having the lowest mean weight loss (-0.78%, F=3.567; $p=0.03$).

The mean (SD) BAI and BDI2 scores, respectively, were 19.3 (13.7) and 19.2 (12.4) Table 1. Of the 253 people who completed the depression questionnaire, 65 (25.7%) had scores in the normal range, 65 (25.7%) had mild-to-moderate, 67 (26.5%) had moderate-to-severe, and 56 (22.1%) had severe depression scores. Of the 253 people who undertook the anxiety questionnaire, 60 (23.7%) reported minimal anxiety, 59 (23.3%) reported mild, 53 (20.9%) reported moderate and 81 (32.0%) reported severe anxiety scores. Those who reported severe depression scores were also more likely to have severe anxiety scores and vice versa ($X^2=121.83$; $p<0.001$).

Injury Perception

Thirty six per cent ($n=105$) did not think injuries were preventable with a further 8.9% ($n=26$) unsure or did not know (Question 1); 83.0% ($n=242$) were concerned about having an injury (Question 2); 74.2% ($n=216$) were concerned about having a fall, with females more concerned than males ($X^2=12.5$, $p=0.006$) (Question 3); 35.1% ($n=102$) thought that a previous injury contributed to their weight gain (Question 4); 62.7% ($n=184$) thought that their weight contributed to the likelihood of being injured (Question 5); 50.7% ($n=149$) thought their shape contributed to the likelihood of being injured (Question 6); 62.4% ($n=181$) thought that their fitness contributed to the likelihood of being injured (Question 7); 100 (34.2%) said that a fear of injury stopped them from exercising (Question 8); 126 (43.2%) had experienced an injury while exercising (Question 9); 39.1% ($n=114$) had (at some stage in their life) sustained an injury at work (Question 10); 56.7% ($n=166$) were not working (Question 11); and 30.5% ($n=89$) reported an injury in the last 12

Table 2: Number, mean, differences between means and standard deviation for responses to the survey by BMI, Baecke Total, 30CST, anxiety score, sleepiness scale and age.

	BMI			Baecke Total Score			30CST			Depression Score			Anxiety Score			Sleepiness Scale			Age		
	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
Q1. All Injuries are preventable																					
Agree	161	47.6	10.5	130	7.0	1.6	118	12.7	4.6	142	18.8	12.9	143	19.1	13.7	150	8.2	5.3	161	48.9	13.3
Don't Know	26	46.6	10.5	22	6.5	1.4	17	10.7	2.6	20	19.4	13.9	20	22.7	16.2	24	9.2	4.7	26	50.5	11.3
Disagree	105	46.6	8.7	86	6.9	1.7	75	12.0	4.2	91	19.9	11.3	90	18.8	13.2	101	7.5	4.9	105	49.6	12.7
Total	292	47.2	9.9	238	6.9	1.6	210	12.3	4.4	253	19.2	12.4	253	19.3	13.7	275	8.0	5.1	292	49.3	12.9
Q2. Concerned about having an injury																					
Not al all	41	47.4	9.8	37	6.9	1.4	32	13.6	3.9	37	14.7	12.1	38[a]	14.6[a]	12.7[a]	38	7.1	5.7	41	48.7	11.6
A little / somewhat	151	46.2	9.8	124	6.9	1.6	117	12.2	4.4	134	17.7	11.3	134[a]	16.3[a]	11.7[a]	143	7.2	4.8	151	49.8	13.8
A lot / A great deal	89	48.4	10.3	68	6.9	1.7	54	12.0	4.2	71	24.6	11.7	70[a]	26.9[a]	13.8[a]	83	9.9	4.8	89	48.7	12.1
Total	281	47.1	10.0	229	6.9	1.6	203	12.4	4.3	242	19.2	12.1	242[a]	19.1[a]	13.4[a]	264	8.0	5.1	281	49.3	13.0
Q3. Concerned about falling																					
Not al all	72[a]	45.3[a]	8.1[a]	61	7.0	1.5	55	13.9	3.8	63	15.1	11.1	63[a]	13.1[a]	11.1[a]	70	6.3	4.7	72	45.5	13.6
A little / somewhat	133[a]	46.2[a]	9.6[a]	109	6.9	1.6	98	11.6	4.6	118	19.0	12.0	119[a]	18.5[a]	13.1[a]	121	7.7	4.9	133	52.1	12.3
A lot / A great deal	83[a]	50.4[a]	11.2[a]	65	6.9	1.7	56	12.0	4.1	68	23.0	12.8	67[a]	25.5[a]	13.9[a]	80	9.7	5.2	83	48.0	12.5
Total	288[a]	47.2[a]	9.9[a]	235	6.9	1.6	209	12.3	4.4	249	19.1	12.3	249[a]	19.0[a]	13.6[a]	271	7.9	5.1	288	49.3	12.9
Q4. Previous injury contributed to weight gain																					
Yes	102	46.4	9.2	80	6.9	1.7	63	11.0	3.6	85	21.9	12.4	83[a]	23.5[a]	15.1[a]	94	8.8	5.3	102	51.1	12.3
No	143	48.0	10.3	122	6.9	1.6	111	13.0	4.7	126	18.1	12.1	128[a]	15.8[a]	11.5[a]	137	7.6	5.0	143	47.4	13.6
Don't Know / Unsure	46	46.1	10.0	35	7.0	1.5	36	12.4	4.0	41	16.9	12.6	41[a]	20.8[a]	13.8[a]	43	7.4	4.9	46	51.1	11.5
Total	291	47.1	9.9	237	6.9	1.6	210	12.3	4.4	252	19.2	12.4	252[a]	19.1[a]	13.6[a]	274	8.0	5.1	291	49.3	12.9
Q5. Your weight contributes to the likelihood of being injured																					
Yes	183	47.9	10.1	146	6.7	1.6	127	12.6	4.6	159	20.7	12.3	160	19.5	13.9	171	8.6	5.2	183[b]	47.6[b]	12.4[b]
No	67	46.2	9.6	53	7.2	1.6	50	12.4	3.6	57	15.4	11.1	55	18.9	13.5	65	7.2	5.1	67[b]	51.3[b]	14.2[b]
Don't Know / Unsure	42	45.4	9.3	39	7.3	1.6	33	11.1	4.4	37	19.0	13.7	38	18.7	13.5	39	6.8	4.2	42[b]	53.8[b]	11.6[b]
Total	292	47.2	9.9	238	6.9	1.6	210	12.3	4.4	253	19.2	12.4	253	19.3	13.7	275	8.0	5.1	292[b]	49.3[b]	12.9[b]
Q6. Your shape contributes to the likelihood of being injured																					
Yes	148	49.0	10.2	117	6.7	1.5	101[a]	12.7[a]	4.6[a]	129	22.0	12.1	130	22.2	13.8	139	9.1	5.3	148	46.9	12.2
No	77	45.4	9.5	61	7.0	1.6	56[a]	12.9[a]	4.3[a]	67	14.1	10.3	65	14.2	12.2	74	6.6	5.0	77	50.4	14.1
Don't Know / Unsure	67	45.1	8.8	60	7.2	1.7	53[a]	10.9[a]	3.8[a]	57	19.1	13.6	58	18.3	13.5	62	7.2	4.2	67	53.4	11.9
Total	292	47.2	9.9	238	6.9	1.6	210[a]	12.3[a]	4.4[a]	253	19.2	12.4	253	19.3	13.7	275	8.0	5.1	292	49.3	12.9
Q7. Your fitness contributes to the likelihood of being injured																					
Yes	179	47.2	9.7	147	6.8	1.6	126	12.3	4.2	157	19.9	12.4	156	20.3	14.4	171	8.6	5.2	179	49.1	12.7
No	50	46.5	8.3	40	7.0	1.6	38	13.4	4.4	43	14.9	10.6	43	15.3	10.9	48	6.3	4.9	50	48.1	13.4
Don't Know / Unsure	58	47.4	11.5	47	7.1	1.6	43	10.9	4.6	49	20.7	13.3	50	18.7	12.8	53	7.6	4.5	58	51.3	13.1
Total	287	47.1	9.9	234	6.9	1.6	207	12.2	4.4	249	19.2	12.4	249	19.1	13.7	272	8.0	5.1	287	49.4	12.9
Q8. Fear of being injured stops you exercising																					
Yes	100	49.5	10.9	74	6.5	1.4	63	11.2	3.9	82	21.2	13.8	82[a]	23.7[a]	15.0[a]	91	9.2	5.3	100	49.7	12.7
No	152	45.8	8.8	129	7.2	1.6	115	12.8	4.8	135	17.4	11.0	136[a]	16.0[a]	12.2[a]	145	7.2	4.8	152	48.9	13.0
Don't Know / Unsure	37	46.5	10.7	32	6.9	1.7	30	12.7	3.1	33	21.2	12.5	32[a]	21.0[a]	12.7[a]	36	8.0	5.2	37	49.4	13.4
Total	289	47.2	9.9	235	6.9	1.6	208	12.3	4.4	250	19.1	12.3	250[a]	19.2[a]	13.6[a]	272	8.0	5.1	289	49.3	12.9
Q9. Experienced injury while exercising																					
Yes	126[c]	47.1[c]	10.4[c]	101	6.9	1.7	91	12.7	4.8	108	21.4	11.7	109	22.0	14.1	123	8.8	5.0	126	48.7	12.9
No	138[c]	47.3[c]	9.4[c]	115	6.9	1.5	99	11.7	4.1	121	16.7	12.3	119	17.0	13.0	130	7.3	5.0	138	50.0	13.1
Total	264[c]	47.2[c]	9.9[c]	216	6.9	1.6	190	12.2	4.4	229	18.9	12.2	228	19.4	13.8	253	8.0	5.0	264	49.3	13.0
Q10. Sustained an injury at or due to work																					
Yes	113	47.1	9.7	96[b]	7.1[b]	1.6[b]	78	12.5	4.4	101	20.7	12.7	101	20.5	14.2	105	8.2	5.1	113	50.0	12.6
No	157	47.2	10.4	124[b]	6.7[b]	1.5[b]	115	12.1	4.5	134	17.7	12.2	134	17.9	13.5	148	7.6	5.0	157	48.9	13.4
Total	270	47.2	10.1	220[b]	6.9[b]	1.6[b]	193	12.2	4.5	235	19.0	12.5	235	19.0	13.8	253	7.8	5.1	270	49.3	13.1
Q11. Currently do paid or unpaid work																					
Yes	126	46.8	8.7	98	7.0	1.6	91	13.2	4.2	107	17.1	10.6	109[a]	15.9[a]	11.6[a]	120	7.6	4.9	126[a]	45.7[a]	12.6[a]
No	165	47.5	10.7	139	6.8	1.6	118	11.7	4.3	145	20.8	13.4	143[a]	21.9[a]	14.6[a]	154	8.4	5.2	165[a]	51.9[a]	12.5[a]
Total	291	47.2	9.9	237	6.9	1.6	209	12.4	4.3	252	19.3	12.4	252[a]	19.3[a]	13.7[a]	274	8.0	5.1	291[a]	49.2[a]	12.9[a]
Q12. Sustained an injury last 12 months requiring medical attention																					
Yes	89	47.7	9.2	69[b]	7.1[b]	1.6[b]	56	12.5	3.9	74	22.4	13.1	74	22.4	14.0	83	8.8	5.1	89	49.3	10.8
No	193	47.0	10.2	160[b]	6.8[b]	1.5[b]	145	12.0	4.4	169	17.6	11.8	169	17.4	13.3	184	7.6	5.1	193	49.5	13.9
Total	282	47.2	9.9	229[b]	6.9[b]	1.6[b]	201	12.2	4.2	243	19.1	12.4	243	19.0	13.7	267	8.0	5.1	282	49.4	13.0

Note: Yellow is significantly related p<0.05 for ANOVA; For ordinal regression: [a] is significant with 30CST in and out, [b] is significant when the 30CST is removed but not significant when it is in, [c] is significant when 30CST is in but not when it is removed.

months that required medical attention (Question 12). Those who answered that they had a fear of being injured while exercising were more likely to report having sustained an injury while exercising (62.9% vs. 36.9%, $p<0.001$). Data are not shown – Supplementary File 1 shows exact questions and answer options in the survey.

Of the 89 people who experienced an injury requiring medical attention in the last 12 months, 86 provided information about the type of medical attention they received. Most commonly ($n=51$) they received medical attention from a doctor in the community (with or without first aid or other health professional intervention); however, 28 participants presented to a hospital, and of these, 17 were hospitalised for more than 24 hours. One person received only first aid and six were treated by a health professional who was not a doctor (data not shown).

Table 2 describes the means, differences between the means and the ordinal regression for each response by age, BMI, Baecke total activity,

30CST, depression, anxiety and sleepiness scale scores. Mental health factors were more likely to differentiate responses to the injury survey, e.g. greater concern about injury was associated with higher depression, anxiety and sleepiness scale scores. However, when ordinal regression was undertaken, the anxiety score was the only significant variable associated with being concerned about having an injury.

Based on the ordinal regression, the following were significant ($p<0.05$) for their impact on the responses to the injury questions: anxiety score for Questions 2 (concerned about having an injury), 3 (concerned about falling), 4 (injury contributed to weight gain), 8 (fear of being injured stops exercise) and 11 (currently working); BMI for Questions 3 (concerned about falling) and 9 (experienced an injury); Baecke activity total score for Questions 10 (sustained an injury at work) and 12 (required medical attention) but only when 30CST is removed; 30CST for Question 6 (body shape contributes to injury); and age for Questions 5 (weight contributes to injury), 6 (shape contributes to injury) and 11 (currently working) and for Question 5 (weight contributes to injury) ordinal regression when 30CST is removed and Question 11 (currently working) only when 30CST is included in the ordinal regression. (Table 2).

Discussion

To our knowledge, this is the first study in Australia that examines attitudes to and experiences of injury in people with obesity. While BMI was a predictor of some attitudes, depression and anxiety scores were the main differentiators. Participants' beliefs about the preventability of injury were mixed, with just under half the group (45%) unsure or believing that injury could not be prevented. Physical functioning (i.e. 30CST and Baecke Total Activity Score) was not a good predictor of attitudes. However, one-third reported that fear of injury stopped them from exercising. One-third to one-half were unaware that weight, shape and fitness impacted the likelihood of injury. Furthermore, a greater concern for injury led to less weight loss by week 8 of the program. Addressing ways injuries can be prevented in people with obesity may be required to help people limit their fears, thus increasing their willingness to participate in physical activity and weight loss in weight management programs.

Depression and anxiety

Depression and anxiety results were similar to those reported in the literature for people with obesity.[42,43] Depression and anxiety have previously been linked to increased fear of injury.[31] Our study supports this, despite it only measuring symptoms. Faulty information processing has been proposed as a mechanism by which people may develop depression and anxiety.[44] When information processing provides faulty information, other systems – including affective, motivational and behavioural systems – no longer function adaptively.

Health models, such as the stress and coping model of Lazarus and Folkman,[45] suggest that the variation in responses to a stressor is dependent on how the stressor is appraised by the individual. Cognitive appraisal models are widely accepted as a means of explaining psychological reactions to injury, particularly as they take individual differences into consideration.[46,47] One such cognitive appraisal model of stress and injury[48] was developed to explain the psychology underlying the occurrence of sports injuries. Inherent in this model is the presumption that the likelihood of injury is influenced by the cognitive assessment of stress, which is influenced by personality, stress history and coping resources.

These models and our findings support the notion that people with obesity and comorbid depression and anxiety symptoms may experience an exaggerated fear of future negative outcomes via faulty information processing. As a result, physical activity may be considered threatening and potentially harmful. A similar pattern of cognitive appraisal and emotional and behavioural responses may occur after an injury. Studies in child and adult populations demonstrate that those who have been injured are more likely to be depressed[49] and anxiety has been correlated with a fear of movement.[50]

These findings suggest that depression and anxiety are potentially modifiable factors contributing to a fear of being injured and concerns that an injury contributed to weight gain, and vice versa. Given the importance of physical activity in health outcomes (including weight management), this suggests the need for: i) adequate screening for mental health conditions, including mood and anxiety disorders; ii) patients and healthcare providers to understand the relationship between depression, anxiety symptoms, injury and recovery; and iii) the provision of effective treatment to address mental health conditions that may otherwise interfere with the ability to undertake a physical activity program.[51,52]

Fear of injury

Approximately 2% (2,148 per 100,000 population) of the Australian population require hospital treatment for an injury per annum. In this cohort, 5.8% required a stay in hospital of more than 24 hours, triple the total population rate.[53] As previously reported,[54-56] the majority of participants had some fear of being injured (85.4%) or falling (75.0%) with one in three reporting that fear of injury stopped them from exercising. Fear of injury has also been found to increase anxiety about pain, and in this study, those who were more anxious were also more likely to have a concern about having an injury or fall. Conversely, those who experienced an injury in the last 12 months were more anxious. These findings have implications for future injury prevention and obesity programs as anxiety about being injured needs to be addressed to help increase physical activity.

This study also shows differences between fear of injury and fear of falling. Fear is not general but more nuanced and fears around specific injury events warrant exploration. For those with a fear of falling, there can be a number of factors that may contribute to making standing up after falling more difficult (i.e. being older, having a higher BMI, and a lower 30CST score – a proxy measure of strength).

Body shape is another factor that may contribute to the fear of injury and the likelihood of exercising through its effect on the ease of movement.[57] While it is known that weight, shape and fitness all contribute to the likelihood of injury,[57,58] these were not recognised by one-third to one-half of all participants. Thus, while this group of patients with obesity feared injury in relation to exercise, many had little awareness of these factors increasing the likelihood of injury or falling.

Obesity

Obesity is a risk factor for injury and complicates recovery from an injury; fear of falling should be taken into consideration when treating

obesity, particularly when discussing exercise. This inter-relationship between obesity, injury and exercise is further supported by the current findings which showed those who reported the greatest fear achieved the least amount of weight loss at eight weeks. After bariatric surgery, a reduction in the fear of injury has been reported,[55] likely related to reduced body weight, and supports our findings that those with increased BMI have a greater concern about falling and being injured. We also postulate that a fear of falling may be related to challenges in standing up after a fall, although this needs to be further explored. Further exploration is needed to fully understand the impact of the fear of injury and falling and their relationship to weight loss.

Strengths and limitations

The strengths of this study include its uniqueness, in it being the only known study to survey people with substantial obesity (mean BMI 47.2 kg/m^2) in Australia about their perceptions around injury; additionally, having participants of a younger age compared to other injury perception cohorts.[59,60] Our investigation of perception with other self-reported variables that were measured with validated questionnaires permits a greater understanding of the interplay of these factors in this population.

There are also limitations to this study. The injury questionnaire has not been validated and focused on the fear of injury impacting exercise without specifically asking participants whether it was the fear of falling that stopped them from exercising. Although injuries and falls may be seen as the same, people may fall without injuring themselves and vice versa. 'Injury' was not defined in the survey; this was purposeful as we investigated perception and wanted participants to interpret injury in their own way. However, because of this, we cannot know what injury meant to the individual.

The participants of this study were people with obesity seeking treatment and were also at the higher end of the weight spectrum, therefore the results captured here may not be representative of all people with obesity or of those with obesity who are not seeking treatment. This study did not capture all medical comorbidities nor did it ask about pain, which may have modified or mediated perceptions. The 30CST had mixed results and needs further exploration as a tool to understand attitudes towards injury. Further research is required to understand the impact of a wider range of medical conditions on injury perception. Although this study measured depression and anxiety symptoms and rated the symptoms as mild, moderate or severe, a formal diagnosis was not made; this would overestimate the prevalence and severity.[42]

This study was embedded into usual clinical practice; there were missing data for some variables, including weight and 30CST, which may have strengthened or weakened the associations analysed. Finally, due to requiring de-identified data for analysis, no information is available on those who did not return the questionnaires. We urge caution when applying these results to the wider populations as there may be bias in the participating population and we recommend further studies to understand the role that obesity plays in injury perception and its prevention.

Conclusion

Most people with obesity fear injury and falling and this has the potential to limit their desire and willingness to exercise and their ability to lose weight. Anxiety appears to exacerbate this connection. Addressing fear and reducing anxiety at both a community and clinical level may help with greater engagement in physical activity and weight loss in this cohort.

Ethics

Ethics was obtained through the Royal Prince Alfred Hospital Research and Development Ethics committee Protocol X13-0239 HREC/13/RPAH/30.

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Conflict of interest

None.

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Appendix A Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.anzjph.2022.100008.