

## Obese patients and radiography literature: what do we know about a big issue?

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### Abstract

Obesity is a global health issue with obese patients requiring specialised diagnosis, treatment and care through the health service. The practical and social difficulties associated with medical imaging of obese patients are an increasingly common problem and it is currently unknown how student and qualified radiographers perceive and respond to these challenges. By better understanding challenges presented in providing quality imaging and care of imaging obese patients, education for both qualified and student radiographers can be enhanced. Radiographers are heavily reliant on visual and tactile senses to locate the position of anatomical structures for diagnostic imaging and determine radiation exposure through a delicate consideration of dose, image quality and anatomical attenuation. However, obese patients require modifications to routine radiographic practice in terms of movement/assisted positioning, equipment capabilities to take increased weight or coverage. These patients may also be subject to compromised radiological diagnosis through poor visualisation of structures. In this paper, the professional and educational literature was narratively reviewed to assess gaps in the evidence base related to the skill and care knowledge for obese patients. Literature was sourced relating to discrete radiographic considerations such as the technical factors of imaging obese patients, exposure and the impact of obesity on imaging departments' service provisions. The recent literature (post-2000 to coincide with the sharp increase in global obesity) on the perceptions of health professionals and student health practitioners has also been explored because there are no specific radiographer studies to report. By understanding the research in similar fields, we may identify what common attitudes qualified and student radiographer's hold and what challenges, technical and care related, can be prepared for.

## Introduction

Over the past few decades there has been an increasing prevalence of obese patients presenting to emergency departments and requiring medical imaging for acute and chronic conditions.<sup>1,2</sup> Obesity is a complex issue in health care because of extensive indirect effects and associated medical conditions such as type 2 diabetes, coronary artery disease, hypertension, asthma, stroke, gout, venous insufficiency, degenerative joint disease and sleep apnoea.<sup>2–5</sup> In addition, obesity has a large economic

impact with reported direct costs in Australia estimated at \$830 million.<sup>6,7</sup>

Obese patients require a tailored standard of care as radiographers must compensate for issues arising from both technical and patient care considerations. These include patients exceeding the weight limits of imaging equipment, motion artefacts due to increased exposure factors requiring elongated exposure time, insufficient coverage of the image receptor, difficulty in palpating anatomical landmarks and potential patient embarrassment. The adipose tissue also complicates the

balance between adequate radiation exposure and penetration and keeping the dose to as low as reasonably achievable (ALARA).<sup>1,2,7,8</sup> Failure to accommodate these issues results in sub-optimal imaging, possibly impeding an accurate and timely diagnosis. This is highlighted by a study by Katz in 2006, which found that radiologists reported greater difficulty in diagnosing cases involving obese patients.<sup>9</sup>

The purpose of this article is to review the current literature regarding the impact of obesity on imaging departments, the technical difficulties of imaging obese patients and the associated attitudes and perceptions of radiographers. Databases including Pubmed, Scopus, Medline and Cinahl were accessed and key words were used to extract entries. Key words included but were not limited to: obese, obesity, radiography, medical imaging, patients, perceptions, attitudes, education, physics, radiation, challenges, experiences, impact, equipment, students, practitioners and bias. Due to limited studies found in the medical imaging discipline, the scope was widened to include the attitudes and perceptions of allied health care professions, nursing and medical practitioners. By better understanding these attitudes and perceptions, translational research of imaging of obese patients can inform radiographer education.

## Statistics and Trends in Overweight and Obese Individuals in Society

A full in-depth review of factors and trends in the rising proportion of overweight and obese individuals in society is beyond the scope of this review. However, a brief overview will be provided for context and definition. The body mass index (BMI) is a common measure for determining the weight class of individuals and populations (underweight, normal, overweight, obese or morbidly obese). It is calculated by a formula of weight (kg) and height (cm) in a ratio of  $\text{kg}/\text{m}^2$ . Obesity is defined as a chronic condition of excess body fat disproportionate to one's height, quantified with a BMI higher than 30.<sup>2,4,10,11</sup> However, using BMI as a definition of obesity has several limitations. The key limitation is that it uses absolute weight and does not consider the type of fat, location of fat or the density of lean muscle mass. It provides a more accurate measure of body fat proportion than weight alone, but due to these limitations it may incorrectly under, or overestimate measurements in certain people.<sup>11–13</sup> This point aside, BMI is widely accepted in the literature, including the limited literature in medical imaging, as a good descriptor of obesity at a population level.<sup>12</sup>

Obesity is a major health issue, reaching epidemic proportions in the western world.<sup>3</sup> The U.S population

saw a 74% increase in prevalence of obesity between 1991 and 2001 and 65% of the adult American population is now overweight or obese,<sup>1</sup> although a recent USA National Health and Nutrition Examination survey has suggested a plateau of rates.<sup>14</sup> These US trends are reflected in the Australian population with data collected between 1999 and 2000 estimating 60% of the adult population being either overweight or obese.<sup>6</sup> There has been a steady increase in the mean BMI of the Australian population over the past two decades.<sup>6,15</sup> These findings coincide with official census data from the Australian Bureau of Statistics (ABS) from 2011 to 2012 which classified 62.8% of Australian adults as either overweight or obese.<sup>16,17</sup> Additionally, these census statistics confirm an increase in the prevalence of obesity across all age groups between 1995 and 2008, rising from 56.3% to 61.2%.<sup>17</sup>

## The Impact of Obesity on Health care

The correlation between an increased prevalence of obesity and a rise in the number of obese patients requiring medical imaging has been explored in a study by Uppot et al. in 2006<sup>18</sup> where dictated radiology reports over a 3-year period were assessed retrospectively for the phrase "limited due to body habitus". This was correlated with the prevalence of obesity in the USA using a Pearson's correlation coefficient. The authors concluded that there was a positive correlation with a progressive increase in the number of obesity-compromised reports. Furthermore, studies explored obesity challenges across multiple modalities and found that general radiography was the second most commonly affected modality for poor image quality behind ultrasound.<sup>18,19</sup>

The increased prevalence of obesity places additional strain on imaging departments as doctors increasingly turn to medical imaging for efficient diagnosis.<sup>2,20,21</sup> Obesity is an important issue in health care due to extensive associated secondary conditions, especially venous insufficiency and degenerative joint disease, which are often the clinical context for plain radiography referrals.<sup>2–5</sup> The strain of carrying additional weight is especially prevalent on the knee and hip joints. The likelihood of developing osteoarthritis is up to seven times higher for obese individuals, compared with normal weight or underweight people.<sup>22</sup>

There are also economic impacts to population obesity with pressure on health facility resources, including departments requiring equipment to accommodate the wider girths and increased weight in beds, chairs, operating tables, floating radiology tables, and wheelchairs.<sup>21,23</sup> The aperture size of the gantry and table weight limits in computed tomography (CT) and

magnetic resonance imaging (MRI) must also be considered otherwise alternative arrangements to another suite/imaging facility with the appropriate wide bore equipment may be required.<sup>24,25</sup>

Physical strain and injury to health care workers attending to the transportation requirements of obese patients maybe a consideration if correct procedures are not followed.<sup>3</sup> Extended hospital stays are also a costly factor, and although the exact cost is not known, obese individuals tend to have longer stays than non-obese patients. The reasons for this increased length of stay are suggested to arise from the extra complexity from secondary conditions. Shorter stays in hospitals for obese patients may be negated by a higher probability requiring a transfer to another department with weight-appropriate equipment and specialist care incurring additional transportation costs.<sup>26,27</sup>

## Technical Challenges in Radiography Due to Obesity

Despite technical advancements in medical imaging, obese patients still present challenges in image quality and viable alternative imaging options are limited. The size of the patient and the anatomical region to be imaged (such as the abdominal and pelvic regions) have been found to be more important than weight or BMI alone in determining when protocols and techniques need to be adjusted.<sup>2,7</sup> Radiographic image quality of obese patients is mainly compromised by an inadequate signal to noise ratio due to additional radiation scatter caused by the thicker layer of adipose tissue.<sup>2</sup>

The common difficulties experienced by radiographers when imaging obese patients has been explored by several authors. These are provided as a summary of the professional literature in Table 1.

The skill set used in radiography is heavily reliant on visual and tactile senses to locate and palpate structures for imaging. A thick layer of adipose tissue obscuring bony landmarks hinders accurate positioning, making repeat projections due to positioning error more likely.<sup>1</sup> It is suggested that this particular error is becoming increasingly common as the proportion of obese patients presenting to the imaging department rises.<sup>6</sup> Consideration of technique modification and adjusting exposure parameters often comes with experience, however, very few adaptive techniques are listed in the literature or through learning resources, with the bulk of the professional literature being commentary in nature.

Common successful techniques in imaging obese patients, as discussed in Table 1, include increasing the mAs, employment of grids or use of the automated exposure control to overcome reduced image receptor

signal. However, these techniques come with an increased radiation dose to the patient and the literature does not give comprehensive information on how changes to exposures can be optimised to reduce dose for obese patients. Buckley *et al.*<sup>12</sup> make the point that dose reference levels (DRLs) are standardised to a 70 kg person with an upper limit of 90 kg. However in 2008, the BMI of the average European was classified as “overweight” and the consideration may be made that separate DRLs for obese patients may be warranted due to the increasing presentation of bariatric patients. A method for overcoming poor photon penetration as itemised in Table 1 is to increase the kVp. Again, however, the trade-off is the reduction in image contrast that may mean this technique is unsuitable to answer the clinical question. “The holistic question of whether altering kVp in combination with mAs has not been adequately explored, as previous studies have only considered each parameter in isolation. Furthermore, in the same way that paediatric exposures are studied and modified to optimise technique and reduce dose, a standardised approach to obesity needs to be considered due to the increasing presentation of bariatric patients. For student radiographers without experience, the problem of positioning obese patients can be exacerbated by the exemplars of correct positioning technique. Common textbooks used throughout Australian diagnostic radiography/medical imaging degree programs, such as ‘*Textbook of Radiographic Positioning and Anatomy*’<sup>33</sup> and ‘*Merrill’s Atlas of Radiographic Positioning and Procedures*’,<sup>34</sup> use thin patients in their photographic illustrations of positioning. The latter includes a chapter on imaging obese patients in its latest edition, but it is not comprehensive and does not discuss the limits of physics of imaging modalities. These resources become less applicable as anatomical landmarks are increasingly obscured by adipose fat and patient mobility becomes limited. Overall the current theoretical teaching of radiographic positioning based on physically fit, thin patients does not reflect the increasing proportion of obese patients presenting to medical imaging departments.<sup>35,36</sup> Some adjustments to positioning via surface anatomy landmarks are suggested in Table 1 for areas such as the abdomen and these articles may be useful for educational purposes although they do not have a sound evidence base. These include the use of adjacent structures where the location of the structure (e.g. the elbow crease) is unaffected but approximately close to desired positioning landmark which is obscured (such as the iliac crest). Overall, there are limited peer-reviewed publications that focus on optimising radiography for obese patients from a radiographer’s perspective, a medical-physics perspective or a patient perspective.

**Table 1.** Summary of the common radiographic challenges as identified in the literature.

Author(s)	Technical issue	Cause of technical challenges	Literature recommendations for improved practice	Complication of practice suggestions
Buckley <i>et al.</i> <sup>12</sup> Carucci <sup>1</sup> Glanc <i>et al.</i> <sup>7</sup> Modica <i>et al.</i> <sup>2</sup> Reynolds <sup>4</sup> Yanch <i>et al.</i> <sup>8</sup>	Poor photon penetration	Reduced photon penetration due to larger patient thickness	Increase kVp Compress patient tissue (reduce thickness)	Reduced image contrast and increased scatter Compression may be uncomfortable
Buckley <i>et al.</i> <sup>12</sup> Carucci <sup>1</sup> Glanc <i>et al.</i> <sup>7</sup> Modica <i>et al.</i> <sup>2</sup> Reynolds <sup>4</sup> Uppot <i>et al.</i> <sup>21</sup>	Low receptor signal	More photons being attenuated by the adipose layer	Increase the current (mA) Use a longer exposure time AEC (automated exposure control) if appropriate	Increased mAs increases patient dose Possible motion artefacts AEC must be used correctly, may reach backup time
Buckley <i>et al.</i> <sup>12</sup> Carucci <sup>1</sup> Glanc <i>et al.</i> <sup>7</sup> Modica <i>et al.</i> <sup>2</sup> Uppot <i>et al.</i> <sup>21</sup> Yanch <i>et al.</i> <sup>8</sup>	Radiation scatter	Increased soft tissue thickness increases likelihood of photon interaction and scatter	Collimate primary beam Use anti-scatter grid	Grid typically absorb 85–95% of scattered photons but also 40–50% of the primary beam Radiation exposure is increased to compensate Increased radiation dose
Buckley <sup>10</sup> Buckley <i>et al.</i> <sup>12</sup> Carucci <sup>1</sup> Reynolds <sup>4</sup> Uppot <i>et al.</i> <sup>21</sup> Yanch <i>et al.</i> <sup>8</sup>	Incomplete coverage of anatomy	Patient size exceeds cassette dimensions	Use several projections over multiple cassettes	Increased radiation dose
Buckley <sup>10</sup> Carucci <sup>1</sup> Glanc <i>et al.</i> <sup>7</sup> Uppot <i>et al.</i> <sup>21</sup>	Exceeded table weight limits	Patient too heavy or equipment weight limit insufficient	Reschedule where appropriate equipment is available Awareness of equipment limits and alternatives	Inconvenience, delays and transportation issues Alternatives not always available
Buckley <i>et al.</i> <sup>12</sup> Carucci <sup>1</sup> Glanc <i>et al.</i> <sup>7</sup> Uppot <i>et al.</i> <sup>21</sup>	Poor visualisation of structures	Combination of above factors	Digital manipulation and post-processing to improve contrast	None listed
Carucci <sup>1</sup>	Difficulty positioning and centring	Anatomical landmarks obscured	Estimate iliac crest height at elbow level, bend hip for interior margin of cassette placement	None listed

## Perceptions and Attitudes of Health Professionals Towards Obese Patients

Obesity has underlying psychosocial dimensions and it is essential that radiographers and students are able to customise their approach to obese patients. Health care professionals may hold their own attitudes and weight bias and how explicitly these attitudes are perceived in practice have important impact on patient satisfaction.<sup>19,28–31</sup> A study by Destounis found that 53% of obese mammography patients believed they had experienced inappropriate comments directed towards them.<sup>23</sup> Further studies have shown that self-conscious obese or overweight patients who experience embarrassment in

health care scenarios may choose to avoid subsequent medical examinations, essentially placing their health at risk.<sup>13,32</sup>

Table 2 provides a summary of the literature regarding the attitudes and perceptions of health professionals and health professional students towards obese patients. Due to the lack of studies within radiography/medical imaging, the scope of the search was expanded to include allied health disciplines, nursing and medicine. Studies published post-2000 have been included to coincide with ABS data on the marked increase in the prevalence of obesity in Australia. Some meta-analyses of obesity perceptions by health practitioners raise the awareness of the wider issue of obesity, with these reviews noting

**Table 2.** Literature review (post-2000) on the attitude and perception of student and qualified health professionals on obesity and their impacts.

Author(s)	Aim/purpose	Design	Main limitations	Sample	Key findings
Kushner et al. <sup>37</sup>	Evaluation of student's attitudes and beliefs about obesity following a clinical encounter with an overweight standardised patient (SP)	16 item questionnaire administered before and after the SP encounter	No control group. Self-reporting Long-term changes are unknown	127 medical students (first years)	An encounter with an overweight SP lead to a significant short-term decrease in negative stereotyping and a longer term increase in empathy Student confidence in counselling was the most improved area
Swift et al. <sup>38</sup>	Assessment of factors of weight bias among UK trainee health dieticians, doctors, nurses and nutritionists	Cross sectional, Self-reporting questionnaire	Self-reporting Desirability bias	1130 allied health and medical students	Found high levels of weight bias among the students Results suggest levels are higher for the lower years Recommends future education interventions on the causes of obesity
Forhan and Ramos <sup>39</sup>	Literature review: impact of weight bias on patient treatment	Literature review	NA	NA	Social stigma of weight bias negatively affects patient treatment. This bias exists in the general population and within health professions. Greater understanding of obesity is linked with lower bias levels
Miller et al. <sup>40</sup>	To investigate the prevalence of weight related biases among medical students and their self-awareness	Self-administered Weight implicit association test (IAT) and a semantic differential item	Participant weight not considered IAT test complexity	310 medical students (third year students)	Majority of students held negative weight bias. 33% showed a significant 'moderate' or 'strong' explicit anti-fat bias. No results showed an explicit anti-thin bias. 39% showed a significant implicit anti-fat bias and 17% of students had an anti-thin bias. Most (67%) were unaware of these biases
Pantenburg et al. <sup>41</sup>	Investigate attitudes of medical students towards overweight and obese individuals	Cross sectional survey with case study vignettes	Vignettes not randomised Data relied on self-reported data	671 medical students	Weight stigma was prevalent among its sample Suggests raising awareness by teaching student's aetiology and factors. Weight stigma in health care is detrimental to patients
Budd et al. <sup>42</sup>	Review: 15 studies exploring health provider attitudes towards obesity and their methods	Literature Review	NA	NA	Levels of negative attitudes have improved in recent years. Although these biases still exist, most of the research indicates that there is not a large impact on patient care. Professional education is needed to change views
Gudzune et al. <sup>43</sup>	Investigation of physician respect levels from the perspective of obese patients	Questionnaires and audio recordings of physician-patient interactions	Measurement of respect subjective Impressions from short encounters unknown	39 physicians and 199 patients	Preliminary results found overestimation of respect significantly increased with higher BMI. This was hypothesised due to past experiences desensitising obese patients to disrespectful behaviours

*(Continued)*

**Table 2.** Continued.

Author(s)	Aim/purpose	Design	Main limitations	Sample	Key findings
Puhl <i>et al.</i> <sup>44</sup>	Investigate attitudes of obesity among dietetic students and the impact on treatment decisions and health evaluations	Self-administered online surveys (Fat Phobia Scale) with mock case study	Patient interaction impacts unknown. Low sample diversity (majority Caucasian females with low BMI). 144 (38.7%) responses excluded due to inadequate answers	297 dietetics students	Majority of students showed a moderate amount of fat phobia. A statistically significant portion of students rated obese patients less likely to comply with treatment. Students also rated obese patients as having poorer diets despite case studies suggesting no such difference
Poon and Tarrant <sup>45</sup>	Investigate attitudes of nurses (students and registered) towards obesity and how it influences the management of obese patients	Self-administered questionnaire	Social desirability. Self-reporting. Confined convenience sample may limit generalisability	352 student nurses and 198 registered nurses	Results found average levels of fat phobia and neutral attitudes towards obese patients. Registered nurses had significantly higher levels of fat phobia and negative attitudes. Over half of participants stated obese patients should be placed on diets whilst in hospital. Authors concluded both registered and student nurses have negative perceptions of obesity and were unlikely to attribute them with positive characteristics
Wear <i>et al.</i> <sup>46</sup>	Investigation of medical students perception and derogatory behaviour towards patients	Focus groups	None listed	58 medical students	The study found 5 main categories from the analysis; the patients being the object of humour, location of humour, the humour game, not-funny humour and motives for humour
Brown <sup>47</sup>	Review Literature: attitudes of nurses towards adult or overweight patients and identify patterns and methods used	Literature review	The review suggests further research with more rigorous sampling and consistence of measurement.	NA	Found limited research on the attitudes of nurses towards overweight and obese patients. Study had poor measurements and sampling methods. Found nurses generally had complex, multi-faceted negative attitudes
Schwartz <i>et al.</i> <sup>48</sup>	Determine the level of anti-fat biases of health professionals specialising in obesity and to identify associated factors	Self-reported questionnaire and IAT test	IAT test complexity. 10 responses (13.6%) excluded due to incompleteness or inadequacy	389 researchers and health professionals	Results found significant implicit anti-fat bias and more commonly associated laziness, stupidity and worthlessness to obese people (both explicitly and implicitly). Factors of being male, having more friends who are obese, weighing more personally and holding a more positive emotional outlook correlated with a lower weight bias

*(Continued)*

**Table 2.** Continued.

Author(s)	Aim/purpose	Design	Main limitations	Sample	Key findings
Hebl and Xu <sup>49</sup>	Examine how patient's weight affects physician's attitude and treatment choices.	Mailed survey (each received one of six possible case studies)	Correlation of results with clinical impacts unknown.	122 physicians	Results showed patient weight was a statistically significant factor in treatment management More negative views were associated with heavier patients, physicians tended to prescribe those more tests and spend less time with them
Wigton and McGaghie <sup>50</sup>	Investigate if decision making process of medical students is influenced by patient weight	Case studies with simulated patients (similar to SP)	Findings with simulated patients may not be generalisable. Did not demonstrate negative impacts.	72 medical students (none obese)	Study found no significant difference in treatment of obese patients and normal weight patients Students rated obese patients as being less attractive, less compliant, more depressed and less likely to change their lifestyles
Teachman and Brownell <sup>51</sup>	Investigate negative implicit attitudes and beliefs of obesity in health professionals specialising in obese patient	Self-reported questionnaire and an IAT test	Low sample diversity (mainly middle aged, Caucasian males)	84 health professionals (majority physicians)	Study found that health professionals specialising in obese patient care show a strong implicit weight biases. These levels were lower than the general population. Personal weight was a moderate factor in reduced weight bias

weaknesses in the reported literature methodology and failure to utilise robust testing and standardised, consistent measures when considering attitudes and perceptions.<sup>47–52</sup> For example, the review by Vitolins *et al.*<sup>52</sup> found only five studies that included interventional and evaluation methodologies, hence the ability to translate evidence into practice and care for obese patients is lacking

In Australia and many similar Western countries, there is an association between attractiveness and slimness which is reinforced through mass media.<sup>29,44</sup> Being overweight or obese can be seen as a 'liability'<sup>28</sup> and obese patients are more commonly stereotyped and associated with negative traits such as laziness and having low motivation and will power.<sup>39,53,48</sup> Some studies have found that even overweight or obese individuals share these views of themselves.<sup>54</sup> The majority of the articles in Table 2 found health care professionals held negative weight biases, including those professionals who specialise in obese patient care.<sup>39,42,47,51</sup> Interestingly, research has shown that many health care practitioners may not even be aware of these implicit attitudes.<sup>40</sup> It is important that health providers can empathetically address weight issues with patients as they can have a significant impact on overweight and obese patients instigating healthier lifestyles and seeking health care.<sup>55,56</sup> Again, if these biases lead to an insensitive experience, patients may decide to seek an alternative physician or delay treatment.<sup>57–60</sup>

Despite weight biases being prevalent, it is unclear exactly how these attitudes affect patient treatment. Forhan<sup>39</sup> describes how weight biases reduce the quality of care by providers spending less time with obese patients, reduced patient engagement and recommending fewer interventional procedures than non-obese patients. However, Budd<sup>42</sup> stated that despite the existence of these biases most of the studies exploring the impacts of obesity in practice did not demonstrate a lower level of care outcome. Most of the studies in Table 2 confined their research to a single geographic location and it is unknown to what extent these findings could be applied to different groups or can be generalised across health professions.

The visual and tactile skill set employed by radiographers is unique, includes more emphasis on diagnosis and has a shorter care time than other allied health professions. Thus, while cross reference to other health practice is often useful for comparisons and enlightenment, the issue of weight bias is difficult to generalise. Radiographic learning is more practical in nature, for example, accredited radiography degrees in Australia have many more weeks of clinical placement (approximately 48–60) than other similar health degrees such as physiotherapy (approximately 20–25 weeks) (<http://www.medicalradiationpracticeboard.gov.au/Accreditation.aspx>, <http://www.physiotherapyboard.gov.au/Accreditation.aspx>). A recent Australian pilot study has suggested that student radiographers are influenced by

negative weight biases from qualified radiographers and often observe degrading behaviour and dialogue towards obese patients.<sup>61</sup> This study, giving preliminary qualitative data, demonstrates the need for an in-depth investigation of how radiographers perceive and act towards obese patients in order to highlight any poor practices and enhance good practices.

## Conclusion and Future Research

Further research is required in identify the degree of weight bias in the radiographic community, how practitioner attitudes/skills influence care and imaging approaches, and what are the available education and training resources. Although the intention of this review was to identify current literature on the perceptions and attitudes of qualified and student radiographers, no articles were found. The literature is more established in other health disciplines although these studies were also noted to be insufficient. Although a number of specific radiology/radiographic articles were found that highlighted the difficulties of imaging obese patients, these were generally commentary in nature and lack explicit and robust evidence.

## Conflict of Interest

The authors declare no conflict of interest.

## References

- Carucci L. Imaging obese patients: Problems and solutions. *Abdom Imaging* 2013; **38**: 630–46.
- Modica MJ, Kanal KM, Gunn ML. The obese emergency patient: Imaging challenges and solutions. *Radiographics* 2011; **31**: 811–23.
- Mattarella A. Medical imaging's role in bariatric surgery. *Radiol Technol* 2011; **82**: 347–64.
- Reynolds A. Obesity and medical imaging challenges. *Radiol Technol* 2011; **82**: 219–39.
- Lemanowicz A, Serafin Z. Imaging of patients treated with bariatric surgery. *Pol J Radiol* 2014; **79**: 12–19.
- Thorburn AW. Prevalence of obesity in Australia. *Obes Rev* 2005; **6**: 187–9.
- Glanc P, O'Hayon BE, Singh DK, Bokhari SAJ, Maxwell CV. Challenges of pelvic imaging in obese women. *Radiographics* 2012; **32**: 1839–62.
- Yanch JC, Behrman RH, Hendricks MJ, McCall JH. Increased radiation dose to overweight and obese patients from radiographic examinations. *Radiology* 2009; **252**: 128–39.
- Katz A. Obesity impedes medical imaging. *New Haven Register* 2006.
- Buckley O. Challenges of imaging the obese patient. *Irish Medical Times* 2008; **42**: 36.
- World Health Organisation. BMI Classification 2014. [updated 8th April 2014; cited 2014 8th April]. Available from: [http://apps.who.int/bmi/index.jsp?introPage=intro\\_3.html](http://apps.who.int/bmi/index.jsp?introPage=intro_3.html).
- Buckley O, Ward E, Ryan A, Colin W, Snow A, Torreggiani WC. European obesity and the radiology department. What can we do to help? *Euro Radiol* 2009; **19**: 298–309.
- Merrill EL. *Women's stories of their experiences as overweight patients* [Ph.D.]. Texas Woman's University, Ann Arbor, 2007.
- Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of childhood and adult obesity in the United States, 2011–2012. *JAMA* 2014; **311**: 806–14.
- Walls HL, Magliano DJ, Stevenson CE, et al. Projected progression of the prevalence of obesity in Australia. *Obesity* 2012; **20**: 872–8.
- Australian Bureau of Statistics. Gender Indicator: Overweight/Obesity 2013. [updated 26th August 2013; cited 2014 8th April]. Available from: <http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/4125.0~Jan%202013~Main%20Features~Overweight%20and%20obesity~3330>.
- Australian Bureau of Statistics. Profiles of Health, Australia: Overweight and Obesity 2013. [updated 7th June 2013; cited 2014 8th April]. Available from: <http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/4338.0~2011-13~Main%20Features~Overweight%20and%20obesity~10007>.
- Uppot RN, Sahani DV, Hahn PF, Kalra MK, Saini SS, Mueller PR. Effect of obesity on image quality: Fifteen-year longitudinal study for evaluation of dictated radiology reports. *Radiology* 2006; **240**: 435–9.
- Lucignani G. Customized imaging for children and obese people: Key issues and strategies. *Eur J Nucl Med* 2006; **33**: 1364–8.
- Taggart HM, Mincer AB, Thompson AW. Caring for the orthopaedic patient who is obese. *Orthop Nurs* 2004; **23**: 204–10.
- Uppot RN, Sahani DV, Hahn PF, Gervais D, Mueller PR. Impact of obesity on medical imaging and image-guided intervention. *AJR* 2007; **188**: 433–40.
- Ackerman IN, Osborne RH. Obesity and increased burden of hip and knee joint disease in Australia: Results from a national survey. *BMC Musculoskeletal Disord* 2012; **13**: 254.
- Destounis S, Newell M, Pinsky R. Breast Imaging and Intervention in the overweight and obese patient. *AJR* 2011; **196**: 296–302.
- Campbell N, Buckley O, McGlone B, O'Shea D, Torreggiani WC. Obesity in Ireland in 2008: What



- radiological equipment is available to image the obese patient? *Ir Med J* 2009; **102**: 116–17.
25. Ginde AA, Foianini A, Renner DM, Valley M, Camargo Jr CA. The challenge of CT and MRI imaging of obese individuals who present to the emergency department: A national survey. *Obesity* 2008; **16**: 2549–51.
  26. Hauck K, Hollingsworth B. The impact of severe obesity on hospital length of stay. *Med Care* 2010; **48**: 335–40.
  27. Zizza C, Herring AH, Stevens J, Popkin BM. Length of hospital stays among obese individuals. *Am J Public Health* 2004; **94**: 1587–91.
  28. Puhl R, Brownell KD. Bias, discrimination, and obesity. *Obes Res* 2001; **9**: 788–805.
  29. Puhl RM, Brownell KD. Psychosocial origins of obesity stigma: Toward changing a powerful and pervasive bias. *Obes Rev* 2003; **4**: 213–27.
  30. Puhl RM, Heuer CA. The stigma of obesity: A review and update. *Obesity* 2009; **17**: 941–64.
  31. Ferraro K, Schafer M. Obesity, perceived discrimination and health. *Gerontologist* 2008; **48**: 150.
  32. Ross JM. Obesity perception by health care providers—can it influence patient safety? *J PeriAnesthesia Nurs* 2013; **28**: 174–6.
  33. Bontrager K, Lampignano J. Textbook of Radiographic Positioning and Related Anatomy, 7th edn. Elsevier, St Louis, 2009.
  34. Frank E, Long B, Smith B. Merrill's Atlas of Radiographic Positioning and Procedures, 12th edn. Mosby, Portland, 2012.
  35. Mitchell MT. Bariatric imaging: Technical aspects and postoperative complications. *Appl Radiol* 2008; **37**: 10–14, 6-8, 20, 2.
  36. Miller AN, Krieg JC, Chip Routh ML Jr. Lateral sacral imaging in the morbidly obese. *J Orthop Trauma* 2013; **27**: e122–4.
  37. Kushner RF, Zeiss DM, Feinglass JM, Yelen M. An obesity educational intervention for medical students addressing weight bias and communication skills using standardized patients. *BMC Med Educ* 2014; **14**: 53.
  38. Swift JA, Hanlon S, El-Redy L, Puhl RM, Glazebrook C. Weight bias among UK trainee dietitians, doctors, nurses and nutritionists. *J Hum Nutr Diet* 2013; **26**: 395–402.
  39. Forhan M, Salas XR. Inequities in Healthcare: A review of bias and discrimination in obesity treatment. *Can J Diabetes* 2013; **37**: 205–9.
  40. Miller DP Jr, Spangler JG, Vitolins MZ, et al. Are medical students aware of their anti-obesity bias? *Acad Med* 2013; **88**: 978–82.
  41. Pantenburg B, Sikorski C, Lupp M, et al. Medical students' attitudes towards overweight and obesity. *PLoS ONE* 2012; **7**: e48113.
  42. Budd GM, Mariotti M, Graff D, Falkenstein K. Health care professionals' attitudes about obesity: An integrative review. *Appl Nurs Res* 2011; **24**: 127–37.
  43. Gudzone KA, Huizinga MM, Cooper LA. Impact of patient obesity on the patient-provider relationship. *Patient Educ Couns* 2011; **85**: e322–5.
  44. Puhl R, Wharton C, Heuer C. Weight bias among dietetics students: Implications for treatment practices. *J Am Diet Assoc* 2009; **109**: 438–44.
  45. Poon M-Y, Tarrant M. Obesity: Attitudes of undergraduate student nurses and registered nurses. *J Clin Nurs* 2009; **18**: 2355–65.
  46. Wear D, Aultman JM, Varley JD, Zarconi J. Making fun of patients: Medical students' perceptions and use of derogatory and cynical humor in clinical settings. *Acad Med* 2006; **81**: 454–62.
  47. Brown I. Nurses' attitudes towards adult patients who are obese: Literature review. *J Adv Nurs* 2006; **53**: 221–32.
  48. Schwartz MB, Chambliss HO, Brownell KD, Blair SN, Billington C. Weight bias among health professionals specializing in obesity. *Obes Res* 2003; **11**: 1033–9.
  49. Hebl MR, Xu J. Weighing the care: Physicians' reactions to the size of a patient. *Int J Obesity* 2001; **25**: 1246–52.
  50. Wigton RS, McGaghie WC. The effect of obesity on medical students' approach to patients with abdominal pain. *J Gen Intern Med* 2001; **16**: 262–5.
  51. Teachman BA, Brownell KD. Implicit anti-fat bias among health professionals: Is anyone immune? *Int J Obes Relat Metab Disord* 2001; **25**: 1525–31.
  52. Vitolins MZ, Crandall S, Miller D, Ip E, Marion G, Spangler JG. Obesity educational interventions in U.S. medical schools: A systematic review and identified gaps. *Teach Learn Med* 2012; **24**: 267–72.
  53. Hayran OMD, Akan HMD, Özkan ADP, Kocaoglu BP. Fat Phobia of University Students: Attitudes toward obesity. *J Allied Health* 2013; **42**: 147–50.
  54. Wang SS, Brownell KD, Wadden TA. The influence of the stigma of obesity on overweight individuals. *Int J Obesity* 2004; **28**: 1333–7.
  55. Rose SA, Poynter PS, Anderson JW, Noar SM, Conigliaro J. Physician weight loss advice and patient weight loss behavior change: A literature review and meta-analysis of survey data. *Int J Obes* (2005). 2013; **37**: 118–28.
  56. Chisholm A, Hart J, Mann KV, Harkness E, Peters S. Preparing medical students to facilitate lifestyle changes with obese patients: A systematic review of the literature. *Acad Med* 2012; **87**: 912–23.
  57. Puhl R, Peterson JL, Luedicke J. Motivating or stigmatizing? Public perceptions of weight-related language used by health providers. *Int J Obes* 2013; **37**: 612–19.
  58. Brown I, Psarou A. Literature review of nursing practice in managing obesity in primary care: Developments in the UK. *J Clin Nurs* 2008; **17**: 17–28.

59. Marzen-Groller KD, Cheever KH. Facilitating students' competence in caring for the bariatric surgical patient: The case study approach. *Bariat Nurs Surg Patient Care* 2010; 5: 117–25.
60. Poustchi Y, Saks NS, Piasecki AK, Hahn KA, Ferrante JM. Brief intervention effective in reducing weight bias in medical students. *Fam Med* 2013; 45: 345–8.
61. Le NTT, Lewis SJ, Robinson JW. How Prepared are student radiographers for imaging obese patients? Australian Institute of Radiography Student Paper Day. 1st November. Westmead Hospita, NSW, Australia, 2014.