

## The “difficult” cadaver: weight bias in the gross anatomy lab

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### ABSTRACT

**Background:** The prevalence of overweight and obesity continues to rise and is associated with increased morbidity and mortality. Weight bias is common among physicians and medical students and limits the therapeutic alliance between providers and patients with overweight and obesity.

**Objective:** The authors sought to explore the relationship between the gross anatomy course and medical student attitudes towards weight and obesity.

**Design:** The authors employed a mixed-methods approach consisting of semi-structured interviews and anonymous web-based surveys of first-year medical students taking gross anatomy at one USA medical school. They analyzed transcripts of interviews and free-text survey responses using a grounded theory approach and performed tests of association to investigate the relationship between demographic information, responses to multiple-choice survey questions and weight bias.

**Results:** A total of 319 (52%) first-year medical students (2015–2018) completed the survey and 33 participated in interviews. Of survey respondents, 71 (22%) responded that the course had changed how they felt about people with overweight/obesity. These respondents were also more likely to affirm that the course had affected their views toward their own bodies ( $p < 0.001$ ). Qualitative data analysis identified three overarching themes within students’ descriptions of the effects of the gross anatomy lab on attitudes toward bodies perceived to have excess weight: these bodies were described as 1) difficult, 2) unhealthy, and 3) evoking disgust. Students extrapolated from their experiences with cadavers to imagined interactions with future patients, relying heavily on the narrative of the difficult patient.

**Conclusions:** At one USA medical school, students perceived their experiences in gross anatomy as shaping their attitudes toward individuals with overweight or obesity. Efforts to reduce medical student weight bias ought to target this previously unexplored potential site of weight bias.

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## Introduction


Physicians, like the general population, often hold negative attitudes toward those they perceive to have excess weight [1–3]. Doctors have been shown to view individuals with obesity as lazy, noncompliant, and unlikely to benefit from counseling [4–6]. They report less respect for these patients and less desire to help them, and they are more likely to view these clinical visits as a waste of time [4,5,7,8]. These attitudes constitute weight bias, defined as negative attitudes toward people based on perceptions about their weight/obesity [1–3], and adversely affect the doctor-patient relationship and the quality of patient care [7,9–12]. Addressing provider attitudes toward individuals with overweight and obesity – who constitute nearly three quarters of the USA’s population – is crucial to improving healthcare [13].

Medical students represent an important population in which to study the development of weight bias in

healthcare and to implement strategies to reduce it. Students exhibit implicit and explicit weight bias at all stages of medical school [14–20]. One large sample of first-year medical students found that 74% of students showed some level of implicit weight bias [19]. Third- and fourth-year medical students exposed to simulated patients with and without obesity rated the former as more responsible for causing their presenting complaints [18], less adherent [18,21], and less likely to respond to treatment [21]. Further, these students made less eye contact with these patients [18] and were less likely to want them in their clinics [21].

Gross anatomy has been identified as a major influence on students’ socialization and professional formation, in part due to its typical introduction at the beginning of medical school and because it is the first time many students interact with human bodies in a medical capacity [22–26]. The course may therefore be important in shaping students’ early

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professional attitudes toward larger bodies. However, to our knowledge, no prior study has examined how medical students perceive adipose tissue or the medical conditions of overweight and obesity within the context of the dissection experience.

We sought to examine how first-year medical students perceived the effect of the gross anatomy course upon their attitudes toward larger cadavers and living patients with overweight/obesity. This study builds on the results of the previously published report that examined professional development in one gross anatomy course [22].

## Materials and methods

All data collection took place at the Perelman School of Medicine (PSOM) at the University of Pennsylvania (Philadelphia, PA) and was approved by the Institutional Review Board. The gross anatomy course at the PSOM is taught during the first semester of medical school, and its structure is comparable to other anatomy programs in the USA [27]: the course lasts approximately three months and consists of 100–110 hours of instruction, of which nearly two-thirds are devoted to laboratory time, with anatomists and physicians as instructors and senior medical students serving as teaching assistants. All body donations are anonymous. PSOM's gross anatomy course is comprised of lectures, dissections, and examinations focused on anatomy, without accompanying reflective sessions, lessons on humanism or ethics [28], or interaction with donors' families [29,30], course elements utilized at some other medical schools in an attempt to teach humanism and professionalism through the gross anatomy experience.

## Interviews

During the final weeks of the PSOM gross anatomy course in 2012 and 2015, we sent emails to all first-year medical students ( $N = 319$ ; 148 female and 171 male) inviting them to participate in semi-structured in-person interviews exploring their emotional and early professional experiences during dissection; these invitations did not mention weight or weight bias. Interviews were conducted by one researcher, then a medical student (A.G.). A total of 33 medical students (21 female and 12 male) consented to be interviewed. Interviews lasted between 30 and 60 minutes and were recorded, transcribed verbatim, and de-identified. A preliminary interview guide focused on concepts identified by prior research as relevant to emotional and professional development in gross anatomy; these broad themes were addressed in a previously published report [22]. Questions about weight bias were not included in the preliminary interview guide (available as Supplemental Material 2).

However, several of the first ten students interviewed offered unexpected, unprompted comments about weight, body image, and obesity. We added additional questions to the interview guide to further explore these themes in the subsequent 23 interviews.

## Survey

We developed a survey based on interview responses to further explore themes related to weight, body image and obesity. The survey consisted of 12 multiple choice questions related to the anatomy lab experience, including two free text questions addressing body image and attitudes toward individuals with overweight or obesity (the survey is available as Supplemental Material 1). From 2015–2018, during the final weeks of each gross anatomy course, all 613 PSOM first-year medical students were invited to participate by email using the platform Qualtrics. All responses were anonymous. We continued survey data collection until theoretical saturation, a point where no new themes pertaining to body weight or body image arose.

## Quantitative analysis

The survey assessed baseline characteristics of age, gender, and survey year. We measured attitudes toward people perceived to have overweight or obesity with the question, 'Has the anatomy lab experience changed how you feel about people with overweight/obesity?' Prior to analysis, we selected several survey questions for bivariate analysis: 'Before the first day of anatomy lab, had you ever seen a dead body?'; 'Has the anatomy lab experience changed how you feel about your own weight?'; 'Which is more true for you: The cadaver is tissue/an inanimate object/a specimen' [or] 'The cadaver is a person who used to be alive;'; 'Overall, has the anatomy lab experience been positive?'; 'How upsetting was the first day of anatomy lab?'; and 'How upsetting is anatomy lab now?' For the two survey questions addressing feelings about people who have overweight/obesity and feelings about students' own weight, a 'yes' response prompted a free text response.

Survey data (2015–2018) was pooled; additionally, given a low response rate in 2017, survey analyses were repeated excluding responses collected in 2017. Student t-tests were used for continuous variables and chi-square or Fisher's exact tests were used for categorical variables, where appropriate. We used a level of significance of  $<0.05$  for all analysis and all t-tests were two-tailed. Statistical analysis was performed using STATA Version 12.1 (StataCorp LP, College Station, TX).

## Qualitative analysis

The qualitative portion of the study was exploratory in nature, intended to deepen conceptual understanding of the relationship between first-year gross anatomy and the development or transformation of views about those who are perceived to have overweight or obesity. Themes emerged from initial interviews. These were refined and validated through questions added to the interview guide and through free-text survey questions. Data were analyzed and theories developed as more interviews and surveys were collected and coded. Disconfirming cases were analyzed in light of their effect on the emerging theory.

Two readers, a resident physician who had received prior training in qualitative data analysis by a faculty member specializing in this methodology and had published previous qualitative studies (A.G.) and a medical student (L.R.), independently read all passages relating to weight, fat, body image, overweight and obesity from the in-person interviews and free-text survey responses and developed a codebook through an iterative process. The readers combined survey free text responses and interview data into a full textual dataset. They each coded this full dataset with rare disagreement, meeting to discuss emerging themes and patterns and to finalize a codebook. One researcher (A.G.) coded the full dataset using the codebook. The two researchers then analyzed and combined codes into three key themes discussed below, of which the central concept was ‘difficult, unhealthy bodies.’ Interview notes and reflexive memos were used to explore subjectivity within the analysis.

Finally, the two researchers independently labeled each free text survey response as containing overall a) positive; b) neutral; or c) negative feelings or attitudes. They found minimal disagreement between their labels and agreed upon a consistent labeling scheme. One researcher (L.R.) then applied one label to each free text survey response.

## Results

### Quantitative results

A total of 319 (52%) first-year medical students responded to the survey between 2015 and 2018. Response rate by year is shown in Table 1. In response to the statement, ‘The anatomy lab has changed how [I] feel about people with overweight/obesity,’ 22% of respondents marked ‘yes’ (Table 2). Analysis of the 63 free text responses (completed by 85–95%) revealed that for 70% of these students, the course had generated negative feelings or attitudes toward body fat or people with overweight/obesity; for 11%, the course had generated sympathy/empathy for people with overweight/obesity or anger toward those who made negative comments about larger bodies; and the remaining 19% left neutral comments (e.g., ‘fat affects every organ system’).

We found no significant relationship between the statement, ‘The anatomy lab experience has changed how [I] feel about people with overweight/obesity’ and survey year, age, or gender ( $P = \text{NS}$  for all comparisons, Table 3). We found a significant relationship between responses to the following two statements: ‘The anatomy lab experience has changed how [I] feel about people with overweight/obesity’ and ‘The anatomy lab experience has changed how [I] feel about [my] own weight’ (Pearson  $\chi^2 = 17.6$ ,  $p < 0.001$ ). Regarding the latter question, 26% of respondents marked ‘yes’ (Table 2). Of the 75 students who left free text responses, 84% indicated that the anatomy course had made a negative impact on their body image. We did not find a relationship between the statement ‘The anatomy lab experience has changed how [I] feel about people with overweight/obesity’ and any of the other pre-identified survey questions (Table 2). The results were not changed by excluding 2017 data from the analyses.

**Table 1.** First-year medical student class and survey demographics overall and by survey year, Perelman School of Medicine (PSOM) 2015–2018.

	Overall*	2015	2016	2017	2018
MS1 Class	613	156	146	159	152
Gender					
Female	308 (50)	74 (47)	73 (50)	80 (50)	81 (53)
Male	305 (50)	82 (52.6)	73 (50.0)	79 (49.7)	71 (47)
Age	24 ± 2	24 ± 2	24 ± 2	24 ± 2	24 ± 2
Survey Respondents	319 (52)	90 (57.7)	116 (79.5)	37 (23.3)	76 (50)
Gender					
Female	165 (52)**	45 (50)	54 (47)	23 (62)	43 (57)
Male	154 (48)**	45 (50)	61 (53)	14 (38)	34 (43)
Other	1 (0)	0	1(0.9)	0	0
Age	23.9 ± 2.1**	23.9 ± 2.1	23.8 ± 2.2	23.8 ± 1.9	23.9 ± 1.9

All values are means ± SD or n (%). MS1 = First-Year Medical Student Class

\*All survey data self-report, class size and demographic information provided by PSOM Registrar, \*\* Not significantly different from MS1 class ( $P = 0.67$ )

**Table 2.** Selected survey responses overall and by survey year, first-year medical students, Perelman School of Medicine 2015–2018.

	Overall*	2015	2016	2017	2018
'Before the first day of anatomy lab, [I] had ... seen a dead body'	193 (61)	65 (72)	71 (61)	20 (54)	37 (49)
'The cadaver is tissue/an inanimate object/a specimen'	97 (30)	24 (27)	43 (37)	10 (27)	20 (26)
'The cadaver is a person who used to be alive'	221 (69)	66 (73)	73 (63)	27 (73)	55 (72)
'The anatomy lab experience changed how [I] feel about people with overweight/obesity'	71 (22)	21 (23)	26 (22)	11 (30)	13 (17)
'The anatomy lab experience changed how [I] feel about [my] own weight'	83 (26)	25 (28)	32 (28)	8 (22)	18 (24)

All values are means  $\pm$  SD, n (%). \* Reported N (%) indicate a 'yes' response

**Table 3.** Significance (P-value) of associations between selected survey responses, first-year medical students, Perelman School of Medicine (2015–2018).

	The anatomy lab experience changed how [I] feel about people with overweight/obesity'	The anatomy lab experience changed how [I] feel about [my] own weight'
Year	0.48	0.81
Age	0.10	0.46
Female	0.82	0.30
'The anatomy lab experience changed how [I] feel about [my] own weight'	<0.0001	N/A
'The anatomy lab experience changed how [I] feel about people with overweight/obesity'	N/A	<0.0001
'Before the first day of anatomy lab, [I] had ... seen a dead body'	0.16	0.13
'The cadaver is a person who used to be alive'/The cadaver is tissue/an inanimate object/a specimen'	0.39	0.30
'Overall the anatomy lab experience has been ... ' (Not at all and Somewhat positive vs. Very positive)	0.24	0.36
'How upsetting was the first day of anatomy lab?' (Not at all upsetting vs. Somewhat and Very upsetting)	0.62	0.17
'How upsetting is anatomy lab now?' (Not at all upsetting vs. Somewhat and Very upsetting)	0.13	0.08

All results are P-values from Chi-square or t-tests.

### Qualitative results

In total, 133 students provided qualitative data (33 interviews and 109 unique students leaving free-text survey responses). Three major themes emerged from the analysis: 1) Difficult Bodies; 2) Unhealthy Bodies; and 3) Disgust. These themes played out across students' descriptions of: a) Cadavers, b) Patients/Living Individuals, c) Students' Own Bodies, and d) The Classroom Environment (Table 4). These interconnected themes supported the development of an explanatory model in which students saw the value of a body as related to the ease with which information could be extracted from it, and where students framed negative attitudes toward larger bodies as concern for the health consequences of overweight and obesity.

#### Cadavers

**Difficult bodies.** To identify anatomical structures, adipose tissue had to be removed – a process students called 'cleaning up.' Larger cadavers were thereby seen as requiring extra work. Students repeatedly described the dissection of larger cadavers as 'difficult,' using the word to mean technically challenging, time consuming, unproductive, and 'frustrating.' Those assigned to larger cadavers described themselves as 'unlucky' and feared that they were learning less than their classmates. 'This person donated their body for this great cause,' said one student, 'but there are some dissection days when my team will walk

away having learned almost nothing ... it was almost a waste' (Male, 2012 interview).

This same logic made thinner cadavers objects of envy. Students dissecting larger cadavers looked across the room at what one student called 'the people with the perfect body, where they do one cut and bam, that's everything they should be seeing' (Male, 2012 interview). 'You would go to another cadaver and you would see ... beautiful muscles, beautiful nerves,' said another, 'and you were just like, 'Wow' (Female, 2012 interview). Students assigned to thinner cadavers described feeling 'fortunate' and 'grateful.'

**Unhealthy bodies.** Students knew very little about the donors' histories; they received only a tag with the donor's age and cause of death. Yet interacting with larger bodies led many to conclude that they understood excess adipose as an agent of disease. They described learning from the cadavers 'how much damage obesity' does to the body, 'how the fat physically affects the organs,' and 'how serious being overweight can really be on the inside of your body,' and cited 'seeing' 'comorbidities' and 'internal complications' related to obesity. Conversely, students described thinner donors as 'in shape,' 'healthy,' and 'well-developed.'

**Disgust.** Students described adipose as 'gross,' 'disgusting,' and 'disturbing.' One wrote, 'dead fat smells



**Table 4.** Selected quotations describing attitudes about body weight in four domains: Cadavers, Patients/Living Individuals, Students' Own Bodies, and the Classroom Environment, first-year medical student interviews (2012, 2015) and surveys (2015–2018).

Theme	Difficult Bodies	Unhealthy Bodies	Disgust
Cadavers	All of the nerves run through it and were enveloped in it. The heart was enveloped. Everything was just very difficult (Female, 2012 interview). I get frustrated in anatomy a lot of times. Sometimes I'm not getting everything. My cadaver was fairly obese and has a lot of medical issues that distorts much of the anatomy, so it's been difficult, especially when we've been doing the musculoskeletal system to see a lot of the anatomy you're supposed to be seeing. You know, some cadavers are quote-unquote 'better' than others (Male, 2012 interview).	Seeing the fat inside has made me see what fat actually does to the internal organs (Female, 2016). The first time that I saw a cadaver that was overweight it was a pretty visceral experience of like, oh, wow, I can totally understand why being overweight would be bad for your internal organs and bad for your health (Female, 2015 interview).	Seeing how thick and heavy the fat is has been a little eye-opening and it grosses me out to think that that is what's inside people (Female, 2016 survey).
Patients/Living Individuals	I can see how surgeons have difficulty operating on people with obesity (Male, 2015 survey). It has made me more worried about working with overweight/obese people because I think it will be more difficult to diagnose/complete procedures due to the excess adipose (Female, 2015 survey).	The negative health implications associated with being obese are more apparent now. (Male, 2015 survey).	I think anatomy lab does make you feel more negatively about trying to treat bigger patients, because in class, the fat is so gross and makes it hard to find things, and it seems like that would be true in terms of feeling parts on a live person as well (Female, 2015 survey).
Students' Own Bodies	I imagine if someone cut me open one day and saw all of my fat and had to dissect through it (Female, 2015 survey). I would be so unsatisfying to dissect (Female, 2017 survey).	I worry more about becoming overweight and developing comorbidities (Female, 2016 survey). It's helped me see some of the damage I'm doing to myself; I'm obese (Male, 2017 survey). I have started eating healthier and exercising more because of my cadaver. I have begun worrying much more about being overweight and I constantly picture how thick my Camper's fascia would be! (Female, 2016 survey). Having seen what it does to you, I will never be overweight (Male, 2018 survey).	It's disturbing to see how fat truly invades your body. It makes me never want to be overweight and to encourage others to not be overweight (Female, 2015 survey). Admittedly, I've thought that I would look ugly in a midsagittal sternum to pubic symphysis cut (Male, 2016 survey).
The Classroom Environment	I actually heard this: 'The TAs [teaching assistants] will neglect you if your body is bad. You don't learn the way that your peers are learning if they have a better body than you' (Female, 2012 interview). Some of the physicians who would come around would be like, 'Oh this is so difficult.' And we hadn't really labeled it as difficult because it was the only thing we had known. But I was like, I don't want to be considered difficult. It wasn't really a cosmetic concern. It was like, I don't want someone to do an appendectomy and be complaining about all of my fat (Female, 2015 interview).	I've heard people say this: 'My body is useless. My cadaver is so fat I can't see anything. The muscles are totally atrophied. There's fat all over the kidneys, we couldn't even see the renal artery,' and so on and so forth (Female, 2012 interview).	Frequently the statements of, 'Oh my body is fat, we have all this fat to get through. It's gross, disgusting ... I wish I had a skinnier body.' People say that: 'I wish I had a skinnier and smaller body to work with' (Male, 2015 interview).

awful.' When adipose was abundant, particularly in unexpected places like in the cheeks and around the organs, its abundance heightened students' disgust: they described adipose 'everywhere' and 'invading' the tissues, which became 'studded,' 'covered,' and 'enveloped' in fat. 'There was so much fat in our body that literally there were times where we were just digging through fat and taking it out in handfuls like it's Play-Doh, like scooping it out,' one student recalled (Female, 2012 interview).

### *Patients/living individuals*

**Difficult bodies.** Students connected the difficulty of dissecting larger cadavers to imagined challenges and frustrations faced by medical providers caring for patients with obesity. They imagined future procedures and physical exams on patients with obesity and worried about their ability to perform these tasks effectively. One student wrote, 'Just seeing ... the amount of effort that a surgeon needs to go through in order to fix a problem, or physically the weight that they're carrying around just in terms of pure adipose. That was something that I'd never seen before, *how heavy it is, how much it is, how it just gets everywhere*' [emphasis added] (Female, 2015 interview). One student concluded that gross anatomy illustrated 'why surgeons don't like operating on obese people' (Male, 2017 survey).

**Unhealthy bodies.** Students imagined how their new, perceived 'understanding' of the health effects of adipose tissue would shape their future interactions with patients. Some imagined themselves counseling patients around weight loss: 'I feel more motivated to really encourage my future patients to lead healthy lifestyles,' wrote one student (Female, 2015 survey). What this imagined counseling would look like was infrequently described, but one student noted: 'Obese people should see what their bodies will look like [on the dissecting table] for an incentive to lose weight' (Female, 2015 survey).

Throughout these remarks, students framed obesity and overweight as controllable states that could be managed or prevented by being 'health conscious,' 'avoid[ing] fatty foods,' and exercising. No student cited socioeconomic factors contributing to obesity, while one student mentioned biological factors, writing, 'Seeing the fat inside ... has made me more judgmental of people who allow that to happen to themselves and their body (i.e., those who are not overweight due to medical complications but those who choose to not exercise and/or not eat well)' (Female, 2016 survey).

**Disgust.** Several students indicated that the disgust they felt in response toward adipose tissue within cadavers had generated feelings of disgust toward

adipose tissue located within the bodies of living people. One student wrote, 'I am more disgusted with the amount of fat that is in an overweight person. I am constantly reminded of the image, consistency, and smell of emulsified fat' (Male, 2018 survey). While no student explicitly described feeling disgust directed at *people* with overweight and obesity, several did describe feeling disgust toward living individuals' bodies. For example, one student described her attempts to resist this association: "There was some aspect of dissecting our own, quite large, cadaver that made me feel disgusted by all the fat we had to dig through. I try not to associate that with living people, but I can't help but see images of the many inches of fat we dug through when I see a round abdomen (Female, 2018 survey). Another student simply wrote, 'You can now picture the layers of slimy greasy fat under their skin' (Female, 2018 survey).

### *Students' own bodies*

**Difficult/unhealthy bodies.** One feature of dissection was its revelation of bodily structures hidden from everyday view, which several students termed 'x-ray vision.' Students imagined fat within their own bodies – not just the 'superficial' fat they knew they had, but also 'pockets of fat' in deep places they hadn't considered before. Students mused about 'scraping off' or 'peeling off' their own adipose, as they might do to a cadaver. They linked their own fat with illness, saying that 'seeing' fat motivated them want to 'be' – or to 'stay' – healthy.

Of the 75 students who responded to the free text survey question about their own body weight and 33 students who participated in interviews (N = 108), three described new appreciation for their bodies in response to gross anatomy. In contrast, 40 students commented that gross anatomy made them 'worry' about their body weight, feel 'afraid' that they had too much fat, feel more self-conscious, or feel 'worse' about themselves. Several students reported that they perceived themselves to have excess weight and imagined their bodies on the dissecting table: 'As someone who is obese,' one student wrote, 'I think about how hard it must be to go through all the fascia before getting to my organs, and how the fat is suffocating my organs' (Female, 2017 survey).

Eighteen students said that dissection made them want to lose weight and nine mentioned exercising or wanting to exercise more. 'I joined a gym the first day of anatomy after seeing all the fat,' reported one student, who reported losing '6 pounds in 4 weeks' (Female, 2012 interview). 'I'm 5'2" and 115 pounds, and I've started dieting and try to exercise more,' wrote another (Female, 2015 survey). Eight students described dieting or wanting to diet: 'Seeing where the fats are deposited,' said one, 'I don't want to eat.

And then I get hungry and actually eat. But there are moments where I give a second thought as to whether I should eat' (Male, 2015 interview). Seven students described a fear of gaining weight. 'I'm a skinny person, but seeing all the adipose just made me think I should never become fat,' wrote one student (Male, 2016 survey).

**Disgust.** For several students, this drive to lose weight was coupled with a feeling of disgust directed at adipose tissue in their own bodies. As one student wrote, "My own fat absolutely disgusts me (both superficial and, newly, viscerally) and I'm having trouble losing my weight despite really trying. It really stresses me out almost every day (Male, 2016 survey). Another wrote, 'I feel strongly motivated to lose a few pounds and get more physically fit because of how I was affected by the experience of dissecting our cadaver's fat layer. It made me look at my own belly fat as 'gross' like the fat we dissected' (Female, 2018 survey).

### **The classroom environment**

**Disgust/unhealthy bodies.** Students described blunt classroom commentary about body weight. Several reported hearing other students describe adipose tissue as 'gross' and 'disgusting.' Other comments labeled larger cadavers and their anatomical structures as abnormally 'big,' 'fat,' atrophic, or covered in adipose. 'Our man had an enormously swollen parotid gland,' one student recalled. 'It was the size of my fist and should have been the size of two quarters. And one of our professors came up and she's like, "You would expect a parotid gland to be swollen in a cadaver like this because he's so large and you need a lot of spit to chew your food!"' (Female, 2015 interview).

**Difficult bodies.** Students recalled instructors describing dissection of larger cadavers as difficult. 'Some of the [professors] who would come around would be like, 'Oh, this is so difficult,' said one student assigned to a larger cadaver (Female, 2015 interview). 'The back was really hard for us,' said another, 'and the gluteal, perineal region was pretty terrible, and professors would come over and say, 'Why are you even looking at this? Go look at the prosection.' The same student recalled a professor likening the challenges of dissecting larger cadavers to surgery 'in the current American population' (Female, 2012 interview).

Some students took their classmates' and instructors' negative comments about larger cadavers and applied them to their own bodies. 'I imagine if someone cut me open one day and saw all of my fat and had to dissect through it,' wrote one student. 'I wonder if the students dissecting me would complain'

(Female, 2015 survey). Another student remarked, 'I feel pressured to lose weight based on comments about cadavers.' (Male, 2018 survey).

While some students openly talked about adipose as 'disgusting' and larger cadavers as 'difficult,' others remarked that such comments led them to feel angry, defensive, and 'protective' of larger donors. 'I think this experience highlighted the stigma that obese people face. Even after death, these men and women are ridiculed and dismissed as making more work for the medical community/trainee' (Female, 2017 survey). One student summarized, 'It made me realize that the fat shaming that goes on in life continues in death' (Female, 2015 survey).

### **Discussion**

Our analysis of interview and survey data suggests that students perceived gross anatomy as influencing their feelings and attitudes about fat through a complex process wherein academic pressure and classroom commentary that cast adipose tissue as 'disgusting' and dissecting larger bodies as 'difficult' amplified their pre-existing weight biases and body image issues. Students described anatomy as equipping them with new standards by which to evaluate bodies: not just by their outward appearances, but also by how easy they were to manipulate, how freely they gave academic knowledge, and how 'healthy' or unhealthy they appeared to be. Bodies containing substantial adipose were viewed as negative in all of these categories: difficult to manipulate, withholding of knowledge, and unhealthy. These attitudes were linked to self-consciousness and shame around body weight, a drive for thinness, and anxiety about the imagined difficulties of caring for patients with obesity. Our findings are consistent with prior studies which have found explicit weight bias among first-year medical students [14,19,31,32], and expand on those findings by identifying a possible, previously unidentified site of weight bias learning and socialization.

We identify the anatomy lab as a key context in which bodies, particularly larger bodies, become coded as good or bad depending on how 'difficult' the practitioner perceives them to be. Many students in this study likened technical difficulties of dissecting larger cadavers to technical difficulties of performing surgery on patients with obesity, and concluded that gross anatomy had taught them about challenges they would later encounter when examining and proceduralizing patients with obesity. Several studies have found that obesity increases rates of surgical wound infection, intraoperative blood loss and operative time – complications that might well be described as making such surgeries more 'difficult' [33–36]. Gross anatomy might then be seen as preparing students for technical

challenges they might face later in training. Yet students in this study did not view these technical difficulties as either educational or emotionally or morally neutral: instead, they frequently described dissecting larger bodies as less educational, requiring extra work, and a waste of time. This observation – that students saw ‘difficult’ bodies as less educationally valuable – is concerning, and echoes the narrative of the ‘difficult patient’ [20], which decenters the patient and centers the frustration and labor of the medical practitioner. Medical students and physicians have been shown to view patients with obesity as ‘difficult’ in a variety of ways: lacking control, less compliant, less likely to benefit from treatment, and a waste of time. These negative attitudes may lead to weight discrimination in health care [3–5,7,12,18–21,37,38]. Our findings reveal the cadaver as one possible early target of the ‘difficult’ patient narrative, which may be harmful to the doctor-patient relationship. Further, students made causal associations between ‘seeing’ adipose tissue in the bodies they dissected and ‘understanding’ causes of illness and death, an assumption that could lead to overestimation of the relationship between weight and health status.

We view weight bias as an issue of medical professionalism, for it poses an obstacle to the ethical care of patients with overweight or obesity. Gross anatomy is an important early site of professionalism education. Cutting into a deceased human body challenges students’ previously held moral beliefs and evokes fears about illness and mortality [24,39]; how they reconcile these existential and moral dilemmas is thought to shape their cognitive and emotional responses to future dilemmas in patient care [28,29,40]. Gross anatomy courses have the potential to teach ethical reasoning and professional virtues [28,41], but the dissection experience may alternatively foster unwanted attitudes and behavior, ranging from depersonalization, to jokes at the donors’ expense or disrespectful handling of dead bodies [26,42,43]. Our results suggest that students’ interactions with larger cadavers and adipose tissue had the potential to tip them in either direction: some students perceived the experience as strengthening a commitment to protect and respect the donor, while other students perceived the experience as fueling negative attitudes toward larger bodies and anxiety about caring for individuals with overweight and obesity.

Our analysis highlights ways in which informal teaching in the anatomy lab – an element of the medical school ‘hidden curriculum’ – might frame and legitimize negative attitudes toward patients with overweight or obesity. Medical training is a process of moral and emotional socialization, in which students gradually adopt aspects of medical culture and its value systems [26,44]. In this process,

there is a tension between elements of formal and ‘other-than-formal’ learning – implicit, unintended, or tacit learning that particular attitudes or behaviors are normative [45,46]. The formal anatomy curriculum at PSOM (lectures, dissection guide, etc.) made no claims about the relative educational value of cadavers of various sizes. Yet students in this study reported that their anatomy instructors made informal comments about the ‘difficulty’ of larger cadavers, set low expectations for students’ interactions with patients with overweight/obesity (‘Why are you even looking at this?’/‘This is what surgery is actually like in the current American population’) and, in a few instances, made negative comments and jokes. Phelan and colleagues have found that students who observed faculty make negative or discriminatory comments about patients with obesity had higher levels of explicit weight bias [32]. Our study is the first to identify the gross anatomy course as a possible location of informal learning around weight bias. However, we did not directly measure the effect of faculty commentary on medical student weight bias, and thus the effect of such commentary remains uncertain.

Our study suggests a connection between the development of negative attitudes toward patients with overweight and obesity and the development, or solidification, of negative attitudes directed at the students’ own bodies. These concerns – described elsewhere as ‘fear of fat’ – are associated with explicit weight bias, including among medical students [19,47]. This subject merits particular attention because it affects not only bias but also student wellness. Self-stigma has been shown to be common among medical students with overweight and obesity, and has been associated with worse health, lower body esteem, loneliness, and substance use [48].

Our results suggest that for schools committed to reducing weight bias, the anatomy laboratory may be an overlooked site of intervention. Prior interventions around medical student weight bias have shown mixed results [49,50]. Positive interactions with patients with obesity seem to decrease explicit weight bias, while negative interactions enhance weight bias, leading some researchers to suggest that interventions to reduce weight bias ought to provide positive first encounters with these patients [32,51]. These results suggest that it may be important to design positive experiences around the dissection of larger donors. Many schools have implemented ‘humanistic anatomy’ curricula to teach ethics, professional skills and humanistic, patient-centered attitudes and behaviors [28,39,52,53]. Future studies should explore whether such efforts affect students’ weight bias. Additionally, our results suggest a potential opportunity to use positive role-modeling to address weight bias. How



instructors use the word ‘difficult’ merits particular attention, as there is evidence that the ‘difficult patient’ framework is counterproductive for reducing weight bias [32]. Finally, given the interaction we found between students’ attitudes toward larger cadavers and their attitudes toward their own bodies, anatomy instructors as well as school administrators should offer support to students who may be struggling with poor body image and disordered eating or compensatory behaviors.

This study has several limitations. All data collection took place at one USA medical school where the gross anatomy curriculum did not incorporate formal teaching around professionalism or ethics. Assessment of the generalizability of our findings is limited by the paucity of national survey data on the prevalence of such professionalism curricula in the USA [39,54]. However, articles in the popular press suggest that students and anatomy instructors at other institutions hold similar views that dissecting larger cadavers is ‘unpleasant’ and ‘difficult’ [55,56]. Selection bias may have influenced our observations, since participation in both surveys and in-person interviews were voluntary and response rates varied. Additionally, as with any study involving interviews, our work is limited by potential researcher bias. To address this limitation, the research team assessed the interview transcripts and codes for subjectivity prior to analytic and thematic coding. Finally, because we did not include pre- and post-course assessments of weight bias, we cannot make conclusions about the effect of the gross anatomy course on students’ views of adipose, overweight and obesity – rather, we have only assessed students’ *perceived* effect of the course upon those views. Future investigations ought to include pre-post assessments of weight bias. Given the questions raised by this study about socialization, future investigations might also assess weight bias among gross anatomy faculty.

The study also has significant strengths. More than 350 first-year medical students participated in surveys and interviews. By using a mixed methods approach, we were able to address possible confounders and interactions while also exploring individuals’ responses to dissection in depth. To our knowledge, our study is the first to identify gross anatomy as a possible contributor to the development of weight bias in medical education.

## Conclusions

The stigmatization of individuals who are perceived to have overweight or obesity has been shown to create further disparities in health outcomes. Our results should not be interpreted as simply about problematic attitudes held by medical students and anatomy instructors; many broader organizational and sociopolitical forces contribute to the attitudes

discussed here. We believe that the anatomy laboratory, where medical students act upon their so-called ‘first patients,’ is an important and previously unexplored potential space in the development of weight bias. Confronting the biases nurtured in gross anatomy may be an important component in the multifaceted approach that will be necessary to address physicians’ bias against individuals with overweight and obesity.

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## Disclosure statement

No potential conflict of interest was reported by the authors.

## Ethical approval

Ethical approval has been waived by the University of Pennsylvania Institutional Review Board.

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