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# Exploring Pediatric Obesity Training, Perspectives, and Management Patterns Among Pediatric Primary Care Physicians

**Karen J. Campoverde Reyes, MD**[a,b,*], **Numa P. Perez, MD**[c,d,*], **Kathryn S. Czepiel, MD**[e], **Ashley Y. Shaw, MD,MBA**[e], **Fatima Cody Stanford, MD,MPH,MPA**[a,f,g]

[a]Neuroendocrine Unit, Massachusetts General Hospital and Harvard Medical School, Boston, MA

[b]Liver Research Center, Beth Israel Deaconess Medical Center, Boston, MA

[c]Department of General Surgery, Massachusetts General Hospital and Harvard Medical School, Boston, MA

[d]Healthcare Transformation Lab, Massachusetts General Hospital, Boston, MA

[e]Department of Pediatrics, Massachusetts General Hospital and Harvard Medical School, Boston, MA

[f]Pediatric Endocrinology, Massachusetts General Hospital and Harvard Medical School, Boston, MA

[g]Nutrition Obesity Research Center, Massachusetts General Hospital and Harvard Medical School, Boston, MA

## Abstract

**Objective:** Significant variability exists in the amount of formal obesity training obtained by physicians caring for pediatric patients. Our objective is to assess the relationship between formal obesity training and pediatric physicians' perceptions, practice patterns, overall knowledge, and confidence during management of pediatric obesity.

**Methods:** An anonymous survey was distributed via email from February 2020 through March 2020 at a large academic system. Internal medicine/pediatric (46) and pediatric (104) primary care providers were selected. Data on total amount of obesity-related training hours by quartiles, demographics, physicians' clinical practice patterns, knowledge about pediatric obesity management along with their perceptions, attitudes, and beliefs were collected.

**Results:** 73 survey participants completed the survey: 69% were female, 77% were older than 40 years old, and 74% were Caucasian. Physicians with highest training were most likely to feel confident when managing pediatric obesity. However, only 20% of all physicians felt confident

**Contact information:** Fatima Cody Stanford, MD, MPH, MPA, MGH Weight Center, 50 Staniford Street, Suite 430, Boston, MA 02114, fstanford@mgh.harvard.edu, Tel: 617-726-4400, Fax: 617-724-6565.

*These authors contributed equally and should be considered co-first authors.

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providing pre- and post-bariatric surgery care and just 6% of physicians self-reported achieving management success.

**Conclusions:** Increased obesity training improves physicians' confidence and leads to familiarity with management guidelines. Formal obesity training should be prioritized during residency and beyond so physicians who care for pediatric patients are better equipped to offer unbiased and effective care.

### Keywords

Pediatric obesity; obesity training; obesity care; obesity management

## Introduction

Obesity is one of the most prevalent pediatric health conditions and affects almost one-third of children and adolescents in the United States (1, 2). Childhood obesity increases immediate and long-term comorbidities and mortality rates(3–5). A lack of formal obesity training and inadequate widespread availability of treatment and referral options are likely to limit efforts to effectively treat obesity(6–8). A review of the literature reveals a paucity of obesity education with only a small percentage of curricula in medical schools, residencies, and fellowship programs involving obesity-specific content (7, 8). It has been reported that medical students feel unfamiliar with obesity prevention and treatment. Self-reporting by pediatricians and primary care physicians (PCPs) demonstrated they also feel unprepared to successfully provide care to children with obesity(9–11).

Solutions to address this educational gap have been proposed. It has been demonstrated that a lecture and video-based obesity curriculum explicitly targeting bias, diagnosis, and management of pediatric obesity improves post-intervention measures of implicit bias(12). Interprofessional coaching and online simulation technology addressing motivational interviewing skills seem to improve clinician and patient satisfaction in primary care and pediatric obesity-focused settings(13, 14). Hands-on skills training in an established chronic weight management program has been shown to improve physicians' adherence to established pediatric weight management guidelines(15). Physicians have also expressed interest in having clear obesity clinical decision tools embedded within their electronic health record (EHR)(16). Therefore, clinic-based, lecture-based, and online-based learning settings all seem useful. Belay and colleagues reported that compared to a cohort tested in 2006, pediatricians now feel more prepared when counseling and discussing obesity-related issues with children and their families(17), however, only a small proportion felt their training had been effective. Moreover, there was limited information about their perceived self-efficacy regarding their counseling efforts or whether or not their obesity knowledge and management tools were accurate and unbiased(17, 18). Therefore, this study aims to assess the relationship between formal obesity training and pediatric physicians' perceptions, clinical practice patterns, overall knowledge, and confidence during management of pediatric obesity and to learn their personal habits and perspectives on the major contributors of obesity.

## Methods

### Subjects and data collection

We designed a brief online survey which we distributed via the Research Electronic Data Capture (REDCap), a web-based tool that supports customized data collection for research studies in a secure platform that complies with Health Insurance Portability and Accountability Act (HIPAA) regulations(19). Physicians who provide primary care for children and adolescents affiliated within Partners Healthcare System, a not-for-profit large unified health care system, consisting of two large academic medical centers, three community teaching hospitals, and other affiliated specialty facilities and community health centers in the US northeast, were targeted. We selected internal medicine/pediatrics (46) and general pediatrics (104) primary care providers available through the Partners website. Data was collected anonymously, and 150 surveys were sent via email from February 18, 2020 through March 17, 2020. Participants who completed the survey were offered $20 in the form of a gift card as a remuneration for their time. A total of 8 subjects did not provide electronic consent or expressed not feeling qualified to complete the survey. A total of 73 survey participants completed the survey and these responses were used for analyses. As per American Association for Public Opinion Research (AAPOR) Outcome Rate Calculator, we obtained a 49% response rate, with a 5% refusal rate and 90% cooperation rate(20). The Institutional Review Board (IRB) of the Massachusetts General Hospital approved this study.

### Survey Instrument

We developed a survey to ascertain obesity training in pediatricians. In this survey, we collected self-identified demographic data, such as gender, racial/ethnic background, age, weight, height, country of origin, type of medical degree obtained, primary medical specialty, and year of medical school graduation. Additionally, data on known personal history of chronic illnesses such as overweight or obesity, asthma, diabetes mellitus, dyslipidemia, gastroesophageal reflux disease (GERD), coronary artery disease (CAD), hypertension (HTN), non-alcoholic fatty liver disease (NAFLD), obstructive sleep apnea (OSA), osteoarthritis (OA), polycystic ovarian syndrome (PCOS), and depression were collected. We gathered information on the pediatrician respondents' clinical practice as we collected data on frequency of recording a diagnosis of overweight or obesity in their EHRs, physicians' rapport with patients with overweight or obesity, and physicians' knowledge about pediatric obesity management along with their perceptions, attitudes, and beliefs. In order to ascertain their obesity education, we queried the duration and type of obesity training during their medical career and asked general knowledge questions regarding obesity management. Likewise, the pediatricians were asked to disclose if they had a history of having overweight/obesity and their personal health habits to manage their weight. This included elements such as the nutritional preferences, physical activity, stress reduction methods, and use of smartphone applications to manage weight. As per Center for Disease Control and Prevention (CDC) guidelines, body mass index (BMI) is a measure used to determine childhood overweight and obesity. Overweight in pediatrics is defined as growth chart percentile ≥85% and obesity as growth chart percentile ≥95% (21).

### Statistical Analysis

All statistical analyses were conducted using Stata (version 15.1; StataCorp LP, College Station, TX, USA). Univariate statistics were obtained using Student's t-test and Chi-squared analyses. Obesity training was characterized into 4 categorical variables based on the quartiles ( ≤7.5, 7.5 – 15, 15–25, >25 ) of the total amount of hours dedicated to lectures, online training, group discussions, and topic courses focused on weight management and clinical hours of obesity-focused hospital rotation. Multivariable analyses were performed using ordered (i.e. ordinal) logistic regression models adjusted for training hours quartiles, BMI class (normal, overweight, and obesity), and personal history of having overweight or obesity in the past and specialty (pediatrics (Peds) and internal medicine/pediatrics (Med/Peds)).

## Results

### General characteristics of study sample

Table 1 summarizes the demographics of our cohort stratified by obesity training hours (quartiles). A total of 73 surveys (71% Peds and 29% Med/Peds) were analyzed. All were primary care providers and none of the responders reported having another medical specialty or subspecialty. Only 1 reported a master's in public health as further graduate training. The majority were female (69%), older than 40 years old (77%), and Caucasian (74%). Most physicians were born in the United States (84%). More than half (53%) reported having a normal BMI at the time of the survey with 50% having experienced overweight/obesity in the past. Chronic diseases did not differ among quartiles and were reported in 52% of the physicians. Adjusted analyses demonstrated that physicians who had graduated more recently were more likely to have received additional obesity-specific training when compared to older colleagues (OR 1.05 [95%CI, 1.0 – 1.1], p=0.03). Male and pediatric physicians were also more likely to have received increased obesity-related training overall (OR 2.8 [95%CI, 1.0 – 7.7], p=0.05) and (OR 3.5 [95%CI, 1.3 – 9.4], p=0.02) respectively (Table 2).

### Clinical practice patterns, perceptions, and barriers of pediatric obesity management

Overall, 97% of the physicians agreed that obesity is a chronic disease. We assessed the physician's perceptions in each of the quartiles (Table 3). Most physicians disagreed with the perception that it is too difficult for children, adolescents, and young adults to change their behavior and 73% disagreed that these patients are not generally interested in improving their weight status. Most physicians (77%) were likely to record a diagnosis of pediatric overweight or obesity in the EHRs more than 75% of the time. Overall, 56% of physicians agreed that they do not receive adequate reimbursement for assessing patients with obesity. Among the major barriers to evaluating and managing patients, 82% of physicians agreed that there is a lack of adequate referral services for diet, physical activity, and weight management, and 62% identified long wait times for referrals to an obesity medicine specialist. Around 70% of the physicians agreed with feeling that there is a lack of effective tools and information to distribute to pediatric patients regarding obesity. More than two-thirds of the physicians agreed with feeling that there is a lack of effective pediatric obesity treatment options. Over half of all physicians (52%) had the perception that a

pediatric patient would be less likely to trust physicians if they had overweight or obesity; among these, 58% had a normal BMI and 54% had overweight or obesity in the past. Only 38% of all physicians agreed to fearing offending the patient or parents when speaking about weight management. Finally, approximately 16% of the physicians thought that pediatric patients are generally not interested in improving their weight status.

Adjusted analyses revealed that, compared to Med/Peds, Peds are less likely to disagree with the statements that "I feel it is too difficult for children, adolescents, and young adults to change their behavior" and "I think patients are generally not interested in improving their weight status" (OR 0.33 [95%CI, 0.1 – 0.9], p=0.03) and (OR 0.21 [95%CI, 0.1–0.7], p=0.01), respectively (Table 4). Peds were nearly five times more likely to record a diagnosis of obesity in the EHR than Med/Peds (OR 4.9 [95%CI, 1.4–16.5], p=0.01). Physicians in the 4$^{th}$ quartile of training were most likely to disagree with the statements that "there is a lack of information" (OR 4.93 [ 95%CI, 1.4 – 17.9], p=0.02) "or treatment options (OR 4.14 [95%CI,1.1–15.3], p=0.03) to treat patients with obesity," and were less likely to agree with the statement that "they would treat obesity more regularly if there was reimbursement set aside for that purpose" (OR 0.3 [95%CI 0.1–1.0], p=0.05).

## Confidence in treatment of obesity

Overall confidence levels were low for the eight categories in our survey that evaluated confidence during obesity management. Specifically, only 60% of physicians felt well trained to provide exercise counseling, 51% felt they were well trained to provide nutrition counseling, and 37% felt they could provide motivational interviewing to patients. Notably, only 14% of physicians felt confident discussing weight loss medications as a treatment option, and an even smaller proportion (12%) felt confident discussing potential eligibility for bariatric surgery. Lastly, 20% of all physicians felt confident providing pre- and post-bariatric surgery care. Overall, only 6% of all the respondents felt generally successful in treating pediatric patients with obesity (Supplementary Table 1).

Adjusted analyses demonstrated that physicians in the 4$^{th}$ quartile of obesity training were most likely to feel confident with most modalities of treatment, and that Peds are significantly less likely to be confident when utilizing weight loss medications, and when discussing bariatric surgery and follow up care when compared to Med/Peds (Table 5).

## Metabolic bariatric surgery knowledge in pediatric patients

While 60% of the survey respondents agreed that they would recommend evaluation by a bariatric surgeon if a patient met the standard criteria for metabolic bariatric surgery (MBS), just 41% agreed that MBS is a safe option and only 51% considered it a useful tool to treat pediatric obesity. A total of five questions were focused on MBS knowledge and overall. Only 59% were answered correctly (Table 6). Only 67% of all physicians were able to answer at least three out five questions correctly and Peds were less likely to achieve this when compared to Med/Peds (OR 0.30 [95%CI, 0.1–1.0], p=0.05) (Table 7).

### Major contributors of obesity from the physicians' perspective

The major contributors to obesity according to the survey respondents are the overconsumption of food (96%), followed by physical inactivity (86%) poor nutritional habits (84%), consumption of sugar/sweetened beverages (82%), eating at restaurant/fast food (74%), genetic factors (70%), psychological problems (55), repeated dieting with weight cycling (22%), lack of willpower (21%), osteoarthritis (21%), medications (19%), and metabolic defect or an endocrine disorder (15%). There were no significant differences between training quartiles (Supplementary Table 2).

### Personal habits of physicians

Physicians were asked four questions regarding their personal health habits and their responses were divided into frequently/almost always, sometimes, and infrequently/almost never. 84% of physicians disclosed frequently/almost always having good nutritional habits and 71% perform regular physical activity of at least 150 minutes of moderate intensity or 75 minutes of vigorous activity weekly. 47% disclosed infrequently/almost never using stress-reduction techniques and only 27% used them almost always/frequently. Just 26% sometimes use any technique like yoga, meditation or prayer. Finally, 78% disclosed almost never/infrequently using a smartphone application to help manage their weight, while 12% sometimes use it and only 10% disclosed to frequently/almost always using it (Supplementary Table 3). Those with overweight were less likely to consider themselves to have good nutritional habits or to perform regular exercise when compared to those in the other BMI groups (OR 0.17[95%CI, 0.0 – 0.8] p=0.03) and (OR 0.09 [95%CI, 0.0–0.5], p=0.004), respectively. Peds were also less likely to perform regular exercise when compared to Med/Peds (OR 0.32 [95%CI, 0.1–0.9], p=0.04). Finally, physicians with obesity were six times more likely to use a smartphone application to manage their weight (OR 6.03, [95%CI, 1.4–25.8], p=0.02) (Table 8).

## Discussion

In this study we elucidate the relationships between obesity training and physician perceptions, clinical patterns, and confidence when managing pediatric obesity. We assessed physician knowledge regarding MBS and major contributors to obesity and explored if their perspectives were significantly influenced by their specialty training and current or prior weight status.

Our study found that pediatric physicians with more obesity training felt more successful and confident when treating obesity and discussing treatment options that include nutrition, physical activity, and MBS. While a majority of physicians perceive a lack of effective tools and educational obesity information for pediatric patients(22–26), our study found that having more obesity-specific training made physicians more likely to disagree with such statements and less likely to expect monetary compensation for obesity management. These findings suggest that more obesity training could decrease knowledge gaps and increase pediatric physicians' confidence in treating pediatric overweight and obesity.

As the prevalence of pediatric obesity rises, the need for studies that appropriately address its management has become critical(8, 27). Similar to results from adult studies (6, 28), our study found that pediatric physicians who graduated more recently were more likely to have received increased obesity-related training. Our data also suggest that primary care physicians focused on the pediatric population perceive that a lack of adequate referral services for diet, physical activity, and weight management are barriers to achieve a successful obesity management. These perceptions align with the current literature that report limited geographic availability of pediatric obesity-trained physicians and other concerns that come with the lack of affiliation with teaching hospitals and serving low-income families(7, 29–31). A study focused on the American Board of Obesity Medicine (ABOM) found that only 38% of physicians who held this certification had a pediatric background,(7) which is insufficient to meet the high demand of pediatric patients with overweight and obesity.

Moreover, it is alarming that only 6% of all respondents felt generally successful in treating pediatric patients with obesity. Overall confidence levels were low, especially with motivational interviewing, discussing weight loss medications, and potential eligibility for MBS. Furthermore, less than 60% of the questions regarding MBS were answered correctly. Motivational interviewing has a positive impact in clinical practice and helps to reduce BMI in children (18, 32). There are medications available to treat childhood obesity and should be considered in concurrence with other multidisciplinary approaches(24–26). Additionally, MBS is an effective and safe tool to achieve sustained weight loss in adolescents(26, 33, 34). Given that obesity-related morbidities are more intractable and persistent after adolescence (35), a greater depth of education on how to utilize these tools to treat it in the pediatric population is needed.

In our study, we also adjusted our data to compare between two common specialties that manage pediatric obesity in the primary care setting: Peds and Med/Peds. We found that Peds are more likely to have obesity-related training than Med/Peds physicians. It has been reported that pediatricians are better than other physicians from other specialties at recording a diagnosis of obesity in the medical record (17), which held true in our study. However, our findings also suggest that pediatricians may more likely perceive that pediatric patients are not interested in improving their weight status and that it is too difficult for them to change their behaviors when compared to Med/Peds specialty. Though it is possible that this latter perception may vary based on the age of the patient, it is necessary to be aware that physician’s personal biases, assumptions, and expectations might influence pediatric weight management(12, 36). Awareness of weight stigma is essential at all stages of training to encourage the best, unbiased clinical practices.

Furthermore, pediatricians as a group, seem less confident with managing weight-loss medications, the stages of MBS, and seem less likely to have accurate MBS knowledge. This might explain the low rates of MBS utilization in the pediatric population(33, 37); though other factors such as the lack of insurance coverage, scarcity of qualified multidisciplinary centers(34) and racial and socioeconomic disparities(38) may also influence its low use. It is crucial for all primary care physicians to comprehend and be updated regarding the benefits and availability of such tools for obesity management in order to improve their confidence,

especially in such a vulnerable population. We also found that pediatricians seem less likely to regularly engage in physical activity. Whether or not disclosing their personal habits influences their clinical practice and the behaviors of their patients remains unknown.

Obesity during childhood not only increases comorbidities and leads to higher mortality rates in adulthood but is often associated with weight stigma that increases the likelihood of depression, anxiety, eating disorders, decreased physical activity and avoidance of medical services(39, 40). It was encouraging that our findings placed “lack of willpower” at the lower end of the major contributors of obesity, suggesting that physicians may be aware that obesity is the result of multiple factors. It is critical to recognize obesity as a chronic disease and prioritize education of pediatric physicians in managing obesity to provide an unbiased medical evaluation. Further efforts are necessary to address the gaps in obesity training received by residents and fellows who provide care throughout childhood.

To our knowledge this is the first study to formally assess pediatric physicians’ perceptions, practice patterns, confidence and knowledge while adjusting for obesity-related training hours in a not-for-profit large academic system. This study revealed objective areas that may contribute to the educational gaps that currently exist in the treatment of pediatric obesity. One primary limitation in this study is its modest sample size. Also, it was not possible to estimate the percentage of pediatric patients that Med/Peds see in their practice or the age range of pediatric patients under the care of the surveyed primary care physicians in both specialty groups. It would be shortsighted to generalize these results to all pediatric primary care providers given that our respondents have access to a large tertiary multidisciplinary weight center and their perceptions did not take into consideration age-groups. Moreover, our survey did not provide a definition for “success”, which could be interpreted in multiple ways such as weight loss, psychological benefit, waist circumference changes, improved cardiometabolic function outside of weight loss, etc.; which could explain why such a low percentage of clinicians reported feeling successful in treating pediatric patients for obesity. However, our survey ascertained several interesting findings; and while some of the responses might not be fully representative of those of pediatric primary care physicians throughout the United States, the large amount of ground covered in our manuscript presents the opportunity for further research on pediatric obesity caregivers to elaborate on these findings.

In conclusion, pediatric physicians have some confidence in counseling and discussing obesity-related issues with children and their families; however, there exists an overall lack of confidence in managing pediatric obesity supported by the low success rates that were self-reported in our study. This appears more marked among pediatricians, who also seem to hold more negative beliefs about the prospect of changing a child’s behavior given a lack of interest in improving his or her weight status, which could lead to intrinsically biased management. Nevertheless, increased obesity training seems to improve physician confidence, and leads to better familiarity with guidelines and management options. Formal obesity training should be prioritized during residency and beyond, so physicians who care for pediatric patients are better equipped and able to offer unbiased and effective obesity-specific care.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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## Study Importance

**What is already known about this subject?**

- The amount of formal obesity training may limit obesity management and influence physicians' perceptions, clinical practice patterns, familiarity with guidelines, and confidence.
- While obesity training has been studied in adult physicians, little is known about how obesity-related training affects pediatric physicians in their care for pediatric patients with obesity.

**What are the new findings in your manuscript?**

- Physician perceptions, clinical practice patterns, and confidence in management of pediatric obesity are influenced by the amount of obesity-related training as well as physician specialty.
- General knowledge of bariatric surgery appears limited as well as pediatric pre and post-operative management care confidence.

**How might your results change the direction of research or the focus of clinical practice?**

- Our results suggest that formal obesity training increases familiarity with guidelines as well as confidence in management, though specialty-related practice patterns also play a role.
- Further training on all aspects of management is required to provide pediatric patients the best treatment options for this severe and increasingly widespread disease.

**Table 1:**

Physician Demographics

| | Obesity training hours (Quartiles) | | | | |
|---|---|---|---|---|---|
| | **1st** | **2nd** | **3rd** | **4th** | **Overall** |
| | **N=22** | **N=18** | **N=16** | **N=17** | **N=73** |
| **Age, n** (%) | | | | | |
| 20–29 | (0.0) | (0.0) | (0.0) | 1 (5.9) | 1 (1.4) |
| 30–39 | 4 (18.2) | 4 (22.2) | 3 (18.8) | 3 (17.7) | 14 (19.2) |
| 40–49 | 4 (18.2) | 6 (33.3) | 7 (43.8) | 8 (47.1) | 25 (34.3) |
| 50–65 | 13 (59.1) | 7 (38.9) | 6 (37.5) | 5 (29.4) | 31 (42.5) |
| >65 | 1 (4.6) | 1 (5.6) | (0.0) | (0.0) | 2 (2.7) |
| **Sex, n** (%) | | | | | |
| Male | 8 (36.4) | 1 (5.6) | 4 (25.0) | 10 (58.8) | 23 (31.5) |
| Female | 14 (63.6) | 17 (94.4) | 12 (75.0) | 7 (41.2) | 50 (68.5) |
| **Race, n** (%) | | | | | |
| African American | 2 (10.0) | (0.0) | (0.0) | (0.0) | 2 (2.9) |
| Asian/Pacific Islander | 3 (15.0) | 2 (11.1) | 2 (13.3) | 1 (5.9) | 8 (11.4) |
| Caucasian | 13 (65.0) | 15 (83.3) | 11 (73.3) | 13 (76.5) | 52 (74.3) |
| Hispanic | 1 (5.0) | 1 (5.6) | 1 (6.7) | 3 (17.7) | 6 (8.6) |
| Native American/Alaskan | (0.0) | (0.0) | 1 (6.7) | (0.0) | 1 (1.4) |
| Mixed | 1 (5.0) | (0.0) | (0.0) | (0.0) | 1 (1.4) |
| | 27.1 | 26.2 | 26.4 | 25.2 | 26.3 |
| **BMI, mean kg/m$^2$ (95% CI)** | (24.3 – 29.9) | (22.8 – 29.5) | (24.1 – 28.6) | (23.5 – 26.8) | (24.9 – 27.6) |
| **BMI class, n** (%) | | | | | |
| Normal | 11 (50.0) | 10 (55.6) | 8 (50.0) | 10 (58.8) | 39 (53.4) |
| Overweight | 4 (18.2) | 4 (22.2) | 5 (31.3) | 5 (29.4) | 18 (24.7) |
| Obesity | 7 (31.8) | 4 (22.2) | 3 (18.8) | 2 (11.8) | 16 (21.9) |
| **Overweight/Obesity prior, n (%)** | 14 (63.6) | 8 (44.4) | 7 (43.8) | 7 (43.8) | 36 (50.0) |
| **Specialty, n** (%) | | | | | |
| Pediatrics | 12 (54.6) | 13 (72.2) | 12 (75.0) | 15 (88.2) | 52 (71.2) |
| Internal Medicine / Pediatrics | 10 (45.5) | 5 (27.8) | 4 (25.0) | 2(11.8) | 21 (28.8) |
| **Chronic diseases, n** (%) | | | | | |
| Asthma | 5 (22.7) | 4 (22.2) | 3 (18.8) | 6 (35.3) | 18 (24.7) |
| Type 2 Diabetes Mellitus | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) |
| Dyslipidemia | 2 (9.1) | 1 (5.6) | 1 (6.3) | 1 (5.9) | 5 (6.9) |
| Gastroesophageal reflux Disease | 2 (9.1) | 1 (5.6) | 5 (31.3) | 3 (17.7) | 11 (15.1) |
| Coronary Artery Disease | (0.0) | (0.0) | 1 (6.3) | (0.0) | 1 (1.4) |
| Hypertension | 1 (4.6) | 1 (5.6) | 2 (12.5) | 3 (17.7) | 7 (9.6) |
| Non-alcoholic fatty liver disease | (0.0) | (0.0) | 1 (6.3) | (0.0) | 1 (1.4) |
| Obstructive Sleep Apnea | (0.0) | (0.0) | 1 (6.3) | (0.0) | 1 (1.4) |
| Osteoarthritis | (0.0) | (0.0) | 1 (6.3) | 1 (5.9) | 2 (2.7) |
| Polycystic Ovarian Syndrome | (0.0) | (0.0) | 1 (6.3) | 1 (5.9) | 2 (2.7) |

| | Obesity training hours (Quartiles) | | | | |
|---|---|---|---|---|---|
| | 1st | 2nd | 3rd | 4th | Overall |
| | N=22 | N=18 | N=16 | N=17 | N=73 |
| Depression | 5 (22.7) | 2 (11.1) | 2 (12.5) | (0.0) | 9 (12.3) |
| None | 10 (45.5) | 9 (50.0) | 8 (50.0) | 8 (47.1) | 35 (48.0) |

BMI = Body Mass Index

**Table 2:**

Factors Associated with Obesity Training - Multivariable Analysis

| | Overall training quartile | | Lectures | | Online training | | Group discussions | | Hospital-based training | | Special topic courses | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **OR (95% CI)** | **P value** | **OR (95% CI)** | **P value** | **OR (95% CI)** | **P value** | **OR (95% CI)** | **P value** | **OR (95% CI)** | **P value** | **OR (95% CI)** | **P value** |
| **Male** | 2.81 (1.0 – 7.7) | ***0.05*** | 2.04 (0.8 – 5.4) | >0.1 | 3.01 (1.1 – 8.1) | ***0.03*** | 2.59 (1.0 – 6.7) | ***0.05*** | 0.58 (0.1 – 2.5) | >0.1 | 3.19 (1.2 – 8.5) | ***0.02*** |
| **Graduation year** | 1.05 (1.0 – 1.1) | ***0.03*** | 1.05 (1.0 – 1.1) | ***0.04*** | 1.01 (1.0 – 1.1) | >0.1 | 1.04 (1.0 – 1.1) | 0.08 | 1.14 (1.1 – 1.2) | ***0.001*** | 0.99 (0.9 – 1.0) | >0.1 |
| **Overweight/Obesity previously** | 0.63 (0.3 – 1.5) | >0.1 | 0.57 (0.2 – 1.4) | >0.1 | 1.11 (0.5 – 2.6) | >0.1 | 0.35 (0.1 – 0.8) | ***0.02*** | 1.54 (0.4 – 5.3) | >0.1 | 0.71 (0.3 – 1.7) | >0.1 |
| **Specialty** | | | | | | | | | | | | |
| Internal Medicine/Pediatrics | ref | --- | ref | --- | ref | --- | ref | --- | ref | --- | ref | --- |
| Pediatrics | 3.46 (1.3 – 9.4) | ***0.02*** | 1.72 (0.7 – 4.5) | >0.1 | 1.42 (0.6 – 3.6) | >0.1 | 2.39 (0.9 – 6.2) | 0.08 | 0.84 (0.2 – 3.0) | >0.1 | 3.10 (1.1 – 8.6) | ***0.03*** |

OR indicates odds ratio derived from ordered (aka ordinal) logistic regression model, which assumes proportional odds between each level of the dependent variable

Ref indicates a common reference point to which the other categories where compared to, for interpretation of results.

**Table 3:**

Clinical practice patterns, perceptions, and barriers of pediatric obesity management

| | Obesity training hours (Quartiles) | | | | |
|---|---|---|---|---|---|
| | 1st | 2nd | 3rd | 4th | Overall |
| | N=22 | N=18 | N=16 | N=17 | N=73 |
| I feel it is too difficult for children, adolescents, and young adults to change their behavior (n, %) | | | | | |
| Strongly disagree/ Disagree | 11 (50.0) | 11 (61.1) | 10 (62.5) | 10 (13.7) | 42 (57.5) |
| Neutral | 4 (18.2) | 3 (16.7) | 1 (6.3) | 1 (5.9) | 9 (12.3) |
| Strongly agree/ Agree | 7 (31.8) | 4 (22.2) | 5 (31.3) | 6 (35.3) | 22 (30.1) |
| Frequency of overweight or obesity to the EMR (n, %) | | | | | |
| <50% of the time | 4 (18.2) | 1 (5.6) | 1 (6.3) | | 6 (8.2) |
| 50–75% of the time | 3 (13.6) | 6 (33.3) | 1 (6.3) | 1 (5.9) | 11 (15.1) |
| >75% of the time | 15 (68.2) | 11 (61.1) | 14 (87.5) | 16 (94.1) | 56 (76.7) |
| I think patients are generally not interested in improving their weight status. (n, %) | | | | | |
| Strongly disagree/ Disagree | 17 (77.3) | 16 (88.9) | 11 (68.8) | 9 (52.9) | 53 (72.6) |
| Neutral | 1 (4.6) | 1 (5.6) | 2 (12.5) | 4 (23.5) | 8 (11.0) |
| Strongly agree/ Agree | 4 (18.2) | 1 (5.6) | 3 (18.8) | 4 (23.5) | 12 (16.4) |
| I would treat obesity more regularly if there was reimbursement set aside for that purpose (n, %) | | | | | |
| Strongly disagree/ Disagree | 8 (36.4) | 5 (27.8) | 10 (62.5) | 11 (64.7) | 34 (46.6) |
| Neutral | 9 (40.9) | 11 (61.1) | 4 (25.0) | 3 (17.7) | 27 (37.0) |
| Strongly agree/ Agree | 5 (22.7) | 2 (11.1) | 2 (12.5) | 3 (17.7) | 12 (16.4) |
| Trust of weight loss advice from physicians with overweight/obesity (n, %) | | | | | |
| More likely to trust | 3 (13.6) | 1 (5.6) | 2 (12.5) | 1 (5.9) | 7 (9.6) |
| Equally likely to trust | 7 (31.8) | 10 (55.6) | 8 (50.0) | 3 (17.7) | 28 (38.4) |
| Less likely to trust | 12 (54.6) | 7 (38.9) | 6 (37.5) | 13 (76.5) | 38 (52.1) |
| I feel there is a lack of adequate referral services for diet, physical activity, and weight management (n, %) | | | | | |
| Strongly disagree/ Disagree | 0 | 2 (11.1) | 1 (6.3) | 2 (11.8) | 5 (6.9) |
| Neutral | 0 | 0 | 0 | 1 (5.9) | 1 (5.9) |
| Strongly agree/ Agree | 22 (100) | 16 (88.9) | 15 (93.8) | 14 (82.4) | 67 (82.4) |
| I think there are long wait times for referrals to obesity medicine specialists (n, %) | | | | | |
| Strongly disagree/ Disagree | 2 (9.1) | 0 | 2 (12.5) | 3 (17.7) | 7 (9.6) |
| Neutral | 9 (40.9) | 5 (27.8) | 2 (12.5) | 5 (29.4) | 21 (28.8) |
| Strongly agree/ Agree | 11 (50.0) | 13 (72.2) | 12 (75.0) | 9 (52.9) | 45 (61.6) |
| I feel there is a lack of effective tools and information to give to pediatric patients regarding obesity (n, %) | | | | | |
| Strongly disagree/ Disagree | 0 | 1 (5.6) | 2 (12.5) | 3 (17.7) | 6 (8.2) |
| Neutral | 3 (13.6) | 3 (16.7) | 4 (25.0) | 6 (35.3) | 16 (21.9) |
| Strongly agree/ Agree | 19 (86.4) | 14 (77.8) | 10 (62.5) | 8 (47.1) | 51 (69.9) |
| I feel there is a lack of effective treatment options in children, adolescents, and young adults with obesity (n, %) | | | | | |

| | Obesity training hours (Quartiles) | | | | |
|---|---|---|---|---|---|
| | **1st** | **2nd** | **3rd** | **4th** | **Overall** |
| | **N=22** | **N=18** | **N=16** | **N=17** | **N=73** |
| Strongly disagree/ Disagree | 3 (13.6) | 3 (16.7) | 1 (6.3) | 7 (41.2) | 14 (19.2) |
| Neutral | 4(18.2) | 1 (5.6) | 2 (12.5) | 3 (17.7) | 10 (13.7) |
| Strongly agree/ Agree | 15 (68.2) | 14 (77.8) | 13 (81.3) | 7 (41.2) | 49 (67.1) |
| I feel bariatric surgery is a safe option for treating obesity in children, adolescents, and young adults (n, %) | | | | | |
| Strongly disagree/ Disagree | 4 (18.2) | 2 (11.1) | 4 (25.0) | 4 (25.5) | 14 (19.2) |
| Neutral | 11 (50.) | 6 (33.3) | 7 (43.8) | 5 (29.4) | 29 (39.7) |
| Strongly agree/ Agree | 7 (31.8) | 10 (55.6) | 5 (31.3) | 8 (47.1) | 30(41.1) |
| I feel bariatric surgery is a useful tool for treating obesity in children, adolescents, and young adults (n, %) | | | | | |
| Strongly disagree/ Disagree | 3 (13.6) | 1 (5.6) | 1 (6.3) | 3 (17.7) | 8 (11.0) |
| Neutral | 8 (36.4) | 9 (50.0) | 6 (37.5) | 5 (29.4) | 28 (38.4) |
| Strongly agree/ Agree | 11 (50.0) | 8 (44.4) | 9 (56.3) | 9 (52.9) | 37 (50.7) |

**Table 4:**

Clinical practice patterns, perceptions and barriers of obesity management - Multivariable Ordered Logistic Regression

| Question | How often do you add overweight or obesity to the EHR? (More often) | | I would treat obesity more regularly if there was reimbursement set aside for that purpose. (Agreement) | | I feel there is a lack of effective tools and information to give to pediatric patients regarding obesity. (Disagreement) | | I feel there is a lack of effective treatment options in children, adolescents, and young adults with obesity. (Disagreement) | | I feel it is too difficult for children, adolescents, and young adults to change their behavior. (Disagreement) | | I think patients are generally not interested in improving their weight status. (Disagreement) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OR (95% CI) | P value | OR (95% CI) | P value | OR (95% CI) | P value | OR (95% CI) | P value | OR (95% CI) | P value | OR (95% CI) | P value |
| **Training hours (quartile)** | | | | | | | | | | | | |
| 1st | ref | --- | ref | --- | ref | --- | ref | --- | ref | --- | ref | --- |
| 2nd | 0.76 (0.2 – 3.0) | >0.1 | 0.90 (0.3 – 2.8) | >0.1 | 0.93 (0.3 – 3.1) | >0.1 | 0.82 (0.2 – 2.7) | >0.1 | 1.89 (0.6 – 6.0) | >0.1 | 2.53 (0.6 – 10.0) | >0.1 |
| 3rd | 2.83 (0.4 – 18.6) | >0.1 | 0.45 (0.1 – 1.5) | >0.1 | 2.18 (0.6 – 7.9) | >0.1 | 0.64 (0.2 – 2.2) | >0.1 | 2.03 (0.6 – 7.1) | >0.1 | 1.39 (0.3 – 5.8) | >0.1 |
| 4th | 5.46 (0.5 – 57.0) | >0.1 | 0.26 (0.1 – 1.0) | ***0.05*** | 4.93 (1.4 – 17.9) | ***0.02*** | 4.16 (1.1 – 15.3) | ***0.03*** | 1.63 (0.4 – 6.1) | >0.1 | 0.73 (0.2 – 2.9) | >0.1 |
| **BMI class** | | | | | | | | | | | | |
| Normal | ref | --- | ref | --- | ref | --- | ref | --- | ref | --- | ref | --- |
| Overweight | 0.87 (0.1 – 6.0) | >0.1 | 0.35 (0.1 – 1.3) | >0.1 | 0.85 (0.2 – 3.3) | >0.1 | 0.98 (0.2 – 3.9) | >0.1 | 2.56 (0.6 – 10.3) | >0.1 | 0.57 (0.1 – 2.6) | >0.1 |
| Obesity | 0.93 (0.2 – 5.4) | >0.1 | 0.40 (0.1 – 1.8) | >0.1 | 1.00 (0.2 – 4.3) | >0.1 | 3.00 (0.7 – 12.2) | >0.1 | 1.21 (0.3 – 5.2) | >0.1 | 0.28 (0.1 – 1.5) | >0.1 |
| **Overweight/ Obesity prior** | 0.51 (0.1 – 2.7) | >0.1 | 1.82 (0.5 – 6.4) | >0.1 | 0.95 (0.3 – 3.4) | >0.1 | 0.50 (0.1 – 1.7) | >0.1 | 1.95 (0.5 – 6.9) | >0.1 | 2.89 (0.7 – 12.4) | >0.1 |
| **Specialty** | | | | | | | | | | | | |
| Internal Medicine/ Pediatrics | ref | --- | ref | --- | ref | --- | ref | --- | ref | --- | ref | --- |
| Pediatrics | 4.88 (1.4 – 16.5) | ***0.01*** | 1.95 (0.7 – 5.2) | >0.1 | 0.84 (0.3 – 2.3) | >0.1 | 0.62 (0.2 – 1.7) | >0.1 | 0.33 (0.1 – 0.9) | ***0.03*** | 0.21 (0.1 – 0.7) | ***0.01*** |

OR indicates odds ratio derived from ordered (aka ordinal) logistic regression model, which assumes proportional odds between each level of the dependent variable.

Ref indicates a common reference point to which the other categories where compared to, for interpretation of results.

**Table 5:**

Confidence in treatment of obesity - Multivariable Ordered Logistic Regression

| Question (Answer considered to be most correct) | I am generally successful in treating obesity in children, adolescents, and young adults. (Agreement) | | I feel I am well trained to provide nutrition counseling to children, adolescent, and young adult patients. (Confident) | | I feel I am well trained to provide exercise counseling to children, adolescents, and young adult patients. (Confident) | | I feel confident about utilization of weight loss medications as a treatment of obesity. (Confident) | | I feel confident when discussing potential eligibility for bariatric surgery with pediatric patients. (Confident) | | I feel confident about providing patient care before bariatric surgery. (Confident) | | I feel confident about providing patient care after bariatric surgery. (Confident) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **OR (95% CI)** | **P value** | **OR (95% CI)** | **P value** | **OR (95% CI)** | **P value** | **OR (95% CI)** | **P value** | **OR (95% CI)** | **P value** | **OR (95% CI)** | **P value** | **OR (95% CI)** | **P value** |
| **Training hours (quartile)** | | | | | | | | | | | | | | |
| 1st | ref | --- | ref | --- | ref | --- | ref | --- | ref | --- | ref | --- | ref | --- |
| 2nd | 1.38 (0.4 – 5.0) | >0.1 | 1.20 (0.4 – 4.1) | >0.1 | 1.03 (0.3 – 3.4) | >0.1 | 0.41 (0.1 – 2.4) | >0.1 | 1.36 (0.3 – 6.0) | >0.1 | 1.90 (0.5 – 7.9) | >0.1 | 0.96 (0.2 – 4.2) | >0.1 |
| 3rd | 0.75 (0.2 – 2.8) | >0.1 | 1.18 (0.3 – 4.3) | >0.1 | 1.43 (0.4 – 5.0) | >0.1 | 0.06 (0.0 – 1.0) | ***0.05*** | 1.86 (0.4 – 9.5) | >0.1 | 1.17 (0.2 – 5.5) | >0.1 | 1.37 (0.3 – 6.8) | >0.1 |
| 4th | 4.65 (1.2 – 18.1) | ***0.03*** | 5.32 (1.4 – 20.9) | ***0.02*** | 3.92 (1.0 – 14.8) | ***0.04*** | 0.64 (0.1 – 5.1) | >0.1 | 5.25 (1.2 – 23.5) | ***0.03*** | 7.06 (1.6 – 31.8) | ***0.01*** | 5.71 (1.2 – 26.9) | ***0.03*** |
| **BMI class** | | | | | | | | | | | | | | |
| Normal | ref | --- | ref | --- | ref | --- | ref | --- | ref | --- | ref | --- | ref | --- |
| Overweight | 0.70 (0.2 – 2.7) | >0.1 | 1.58 (0.4 – 6.1) | >0.1 | 1.70 (0.5 – 6.4) | >0.1 | 5.21 (0.5 – 53.3) | >0.1 | 1.04 (0.2 – 5.8) | >0.1 | 4.69 (1.0 – 22.9) | 0.06 | 6.15 (1.2 – 30.7) | ***0.03*** |
| Obesity | 0.90 (0.2 – 4.4) | >0.1 | 1.19 (0.3 – 5.0) | >0.1 | 0.42 (0.1 – 1.7) | >0.1 | 0.38 (0.0 – 4.4) | >0.1 | 1.40 (0.3 – 7.6) | >0.1 | 9.88 (1.7 – 56.7) | ***0.01*** | 3.18 (0.6 – 16.8) | >0.1 |
| **Overweight/ Obesity prior** | 1.32 (0.4 – 4.7) | >0.1 | 1.32 (0.4 – 4.7) | >0.1 | 1.88 (0.5 – 6.4) | >0.1 | 2.72 (0.3 – 22.0) | >0.1 | 1.03 (0.2 – 4.8) | >0.1 | 0.32 (0.1 – 1.4) | >0.1 | 0.57 (0.1 – 2.4) | >0.1 |
| **Specialty** | | | | | | | | | | | | | | |
| Internal Medicine/ Pediatrics | ref | --- | ref | --- | ref | --- | ref | --- | ref | --- | ref | --- | ref | --- |
| Pediatrics | 1.08 (0.4 – 3.1) | >0.1 | 2.53 (0.9 – 7.5) | 0.09 | 1.63 (0.6 – 4.7) | >0.1 | 0.03 (0.0 – 0.2) | ***<0.001*** | 0.26 (0.1 – 0.8) | ***0.02*** | 0.15 (0.0 – 0.5) | ***0.002*** | 0.05 (0.0 – 0.2) | ***<0.001*** |

OR indicates odds ratio derived from ordered (aka ordinal) logistic regression model, which assumes proportional odds between each level of the dependent variable.

Ref indicates a common reference point to which the other categories where compared to, for interpretation of results.

**Table 6:**

Physician knowledge of bariatric surgery

| | | Obesity training hours (Quartiles) | | | | |
|---|---|---|---|---|---|---|
| | | 1st | 2nd | 3rd | 4th | Overall |
| | | N=22 | N=18 | N=16 | N=17 | N=73 |
| **Which BMI would typically qualify a patient for bariatric surgery?** BMI (35+ with comorbidities) | Correct n, (%) | 20 (90.9) | 16 (88.9) | 15 (93.8) | 17 (100.0) | 68 (93.2) |
| | Incorrect n, (%) | 2 (9.1) | 2 (11.1) | 1 (6.3) | 0 | 5 (6.8) |
| **The average expected excess body weight loss from Roux-en-Y gastric bypass is:** 50–75% | Correct n, (%) | 16 (72.7) | 11 (61.1) | 8 (50.0) | 6 (35.3) | 41 (56.2) |
| | Incorrect n, (%) | 6 (27.3) | 7 (38.9) | 8 (50.0) | 11 (64.7) | 32 (43.8) |
| **The national 30-day mortality rate of patients who undergo Roux-en-Y bypass is:**<1% | Correct n, (%) | 17 (77.3) | 14 (77.8) | 11 (68.8) | 11 (64.7) | 53 (72.6) |
| | Incorrect n, (%) | 5 (22.7) | 4 (22.2) | 5 (31.3) | 6 (35.3) | 20 (27.4) |
| **Which is the most commonly performed metabolic and bariatric surgery Procedure in the United States**? Sleeve Gastrectomy | Correct n, (%) | 9 (40.9) | 7 (38.9) | 5 (31.3) | 3 (17.7) | 24 (32.9) |
| | Incorrect n, (%) | 13 (59.1) | 11 (61.1) | 11 (68.8) | 14 (83.4) | 49 (67.1) |
| **Patients who undergo bariatric surgery are expected to achieve their maximum weight loss within which time frame?** 12–18 months | Correct n, (%) | 7 (31.8) | 8 (44.4) | 7 (43.8) | 8 (47.1) | 30 (41.1) |
| | Incorrect n, (%) | 15 (68.2) | 10 (55.6) | 9 (56.3) | 9 (52.9) | 43 (58.9) |
| **Bariatric Surgery Knowledge percentage of correct answers:** | 3/5 correct n, (%) | 18 (81.8) | 12 (66.7) | 11 (68.8) | 8 (47.1) | 49 (67.1) |
| | % of correct answers | 62.7 | 62.2 | 57.5 | 52.9 | 59.2 |

BMI: Body Mass Index

**Table 7:**

Obesity-related knowledge - Multivariable Ordered Logistic Regression

| | At least 3 out of 5 questions correct | |
|---|---|---|
| | **OR (95% CI)** | **P value** |
| **Training hours (quartile)** | | |
| 1st | ref | --- |
| 2nd | 1.06 (0.3 – 4.2) | >0.1 |
| 3rd | 0.63 (0.1 – 2.7) | >0.1 |
| 4th | 0.43 (0.1 – 1.9) | >0.1 |
| **BMI class** | | |
| Normal | ref | --- |
| Overweight | 3.00 (0.6 – 15.2) | >0.1 |
| Obesity | 1.75 (0.3 – 10.1) | >0.1 |
| **Overweight/Obesity previously** | 0.87 (0.2 – 4.0) | >0.1 |
| **Specialty** | | |
| Internal Medicine/Pediatrics | ref | --- |
| Pediatrics | 0.30 (0.1 – 1.0) | ***0.05*** |

OR indicates odds ratio derived from ordered (aka ordinal) logistic regression model, which assumes proportional odds between each level of the dependent variable.

Ref indicates a common reference point to which the other categories where compared to, for interpretation of results.

**Table 8:**

Personal habits - Multivariable Ordered Logistic Regression

| Question | Do you perform regular physical activity of at least 150 minutes of moderate intensity or 75 minutes of vigorous activity weekly? (More often) | | Do you consider yourself to have good nutritional habits? (More often) | | Do you use smartphone applications to help you manage your weight? (More often) | |
|---|---|---|---|---|---|---|
| | OR (95% CI) | P value | OR (95% CI) | P value | OR (95% CI) | P value |
| **Training hours (quartile)** | | | | | | |
| 1st | ref | --- | ref | --- | ref | --- |
| 2nd | 1.45 (0.4 – 5.1) | >0.1 | 2.21 (0.6 – 8.2) | >0.1 | 1.12 (0.3 – 4.8) | >0.1 |
| 3rd | 0.66 (0.2 – 2.3) | >0.1 | 0.36 (0.1 – 1.3) | >0.1 | 2.69 (0.7 – 10.9) | >0.1 |
| 4th | 1.12 (0.3 – 4.4) | >0.1 | 1.86 (0.5 – 7.0) | >0.1 | 1.52 (0.3 – 6.8) | >0.1 |
| **BMI class** | | | | | | |
| Normal | ref | --- | ref | --- | ref | --- |
| Overweight | 0.63 (0.1 – 2.8) | >0.1 | 0.59 (0.1 – 2.4) | >0.1 | 0.76 (0.2 – 3.4) | >0.1 |
| Obesity | 0.09 (0.0 – 0.5) | ***0.004*** | 0.17 (0.0 – 0.8) | ***0.03*** | 0.92 (0.2 – 4.4) | >0.1 |
| **Overweight/Obesity previously** | 2.69 (0.7 – 10.6) | >0.1 | 1.17 (0.3 – 4.3) | >0.1 | 6.03 (1.4 – 25.8) | ***0.02*** |
| **Specialty** | | | | | | |
| Internal Medicine/ Pediatrics | ref | --- | ref | --- | ref | --- |
| Pediatrics | 0.32 (0.1 – 0.9) | ***0.04*** | 1.02 (0.4 – 2.9) | >0.1 | 0.44 (0.1 – 1.4) | >0.1 |

OR indicates odds ratio derived from ordered (aka ordinal) logistic regression model, which assumes proportional odds between each level of the dependent variable

Ref indicates a common reference point to which the other categories where compared to, for interpretation of results.