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Comparison of utilization rate of CT scans of the abdomen and pelvis in patients with elevated BMI compared to patients with normal BMI presenting to the ER with gastrointestinal symptoms

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ABSTRACT

Purpose: The purpose of this study was to determine if patients with elevated BMI were more likely to get Abdominopelvic CT imaging compared to patients with normal BMI presenting with similar Gastrointestinal (GI) symptoms to the Emergency Room (ER).
Methods: The study included 611 adults presenting to the ER with GI symptoms during the study period, of which 291 patients underwent CT imaging. ER triage notes and electronic records were used to identify patients' demographic data, symptoms, body weight and height. BMI was used as a measure of obesity. Reports of the CT scans were reviewed and categorized into normal cases, cases with non-acute incidental findings and cases with acute significant findings by the reviewers. A chi-square test was used to compare the two groups.
Results: Of the 611 patients, 231 (37.8%) had a normal BMI (<25 kg/m^2), and 380 (62.2%) had an elevated BMI (>25 kg/m^2). Of the 231 patients with normal BMI, 98 (42.4%) received CT imaging. Of the 380 patients with elevated BMI, 193 (50.8%) underwent CT imaging, ($p = 0.045$). The percentage of acute significant CT findings was similar in both groups (45.9% vs. 45.6%), ($p > 0.05$). The elevated BMI group had a higher percentage of normal exams compared to the normal BMI group (44.0% vs. 10.2%), ($p < 0.0001$). The percentage of non-acute incidental findings was higher in the normal BMI group compared to the elevated BMI group (43.8% vs. 10.3%), ($p < 0.0001$).
Conclusion: According to our study results, there is a positive correlation between increased BMI and a higher utilization rate of abdominal CT imaging, ($p = 0.045$).

Introduction

The prevalence of obesity continues to increase, reaching epidemic proportions. Obesity has a significant impact on morbidity and devastating implications for overall public health.[1] In the USA, obesity rates have more than doubled – from 14% to 32% in less than 50 years.[7] It is estimated that more than half (64.5%) of the US adults (aged 20 and older) are overweight (defined as BMI $\geq$ 25 kg/m^2), and nearly a quarter are clinically obese (BMI $\geq$ 30 kg/m^2).[1] Increased Body Mass Index (BMI) is associated with an increase in all-cause mortality and in diseases related to this increasing mortality rate, such as Diabetes Mellitus, Coronary Artery Disease, Hypertension, Heart Failure, Hyperlipidemia and cancer, including gastrointestinal (GI) cancers (gastric adenocarcinoma, esophageal, gallbladder, liver, pancreatic, and colorectal cancers).[2] Higher BMI is also related to increased risk of developing gallstones, nonalcoholic fatty liver disease, and abdominal compartment syndrome.[3]

According to our research, studies relating GI symptoms and obesity are limited. Previous studies demonstrated that patients with elevated BMI experience GI symptoms more often than those with a normal BMI.[4,5,7,10–12] There have been several recent population-based studies from the United States, New Zealand, Australia, Europe, and Iran that have provided new information about the prevalence of GI symptoms among various BMI categories.[4,8,9] Overall, significant associations between GI symptoms and increased BMI were found for gastroesophageal reflux, upper abdominal pain, diarrhea, bloating, chest pain, heartburn, vomiting, retching and incomplete evacuation.[4,10,11]

Obesity-related health care costs have also increased. Americans who are obese now make up a quarter of the population and are

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responsible for a 40 billion-dollar rise in annual medical spending. On average, an obese person spends more than $ 1400.00 for his/her medical care annually, almost 42% more than that spent by a non-obese person.[6,13]

Although there have been numerous studies relating GI symptoms to increased BMI, to our knowledge, no studies to date have analyzed the utilization rate of Abdominopelvic CT imaging in patients with elevated BMI. As the utilization of diagnostic imaging in recent years continues to increase,[17] the aim of this retrospective study was to explore if patients with elevated BMI were more likely to undergo the Abdominopelvic CT imaging compared to patients with normal BMI presenting to the ER with GI symptoms. Higher imaging rates in the overweight population may potentially expose these patients to higher radiation doses, increasing the risk of developing cancer as well as increasing health care costs.

Methods

Study selection/design. We conducted a retrospective population-based study at a large community-based tertiary care teaching hospital. This study was approved by the local institutional review board and was HIPPA compliant. An ER electronic searchable database listing all presenting patients with their self-reported symptoms was used to identify patients with GI/abdominal symptoms. The abdominal symptoms included were: upper and lower abdominal pain, nausea, vomiting, constipation, and diarrhea. The study sample included 611 adult patients (aged 18 and older) who presented to the ER with abdominal symptoms during two, 1 month periods (September–October, 2012 and May–June, 2013) for a total of two months of data collection. The two month data collection period was selected to ensure sufficient data was captured for statistical analysis. Two non-consecutive months were selected in order to obtain patient samples from different times of the year. The increased time spread between the sample sets would decrease potential seasonal effects and provide a better representation of the patient population presenting to the ER.

Demographic data, patients' symptoms, body weight and height were confirmed by the ER physician's notes and electronic medical records. The study used BMI as a measure of obesity. Patient's weight was directly measured at presentation to the ER. BMI was calculated utilizing the following formula: BMI = weight (kg)/the square of height (m^2). The following classification was applied[11]:

$$\text{Normal weight}: 18.5\left(\mathrm{kg}/\mathrm{m}^2\right) \le \text{BMI} < 25\left(\mathrm{kg}/\mathrm{m}^2\right)$$

$$\text{Overweight}: 25\left(\mathrm{kg}/\mathrm{m}^2\right) < \text{BMI}\left(\mathrm{kg}/\mathrm{m}^2\right) < 30\left(\mathrm{kg}/\mathrm{m}^2\right)$$

$$\text{Obese/morbidly obese}: \text{BMI}\left(\mathrm{kg}/\mathrm{m}^2\right) \ge 30\left(\mathrm{kg}/\mathrm{m}^2\right)$$

Based on BMI values, the study sample (n = 611) was subdivided into two groups: an elevated BMI group [including overweight [25(kg/m^2) < BMI < 30(kg/m^2)] and obese/morbidly obese patients [BMI ≥30 (kg/m^2)] and a normal BMI group [BMI<25(kg/m^2)].

Of the 611 patients with abdominal symptoms presenting to the ER, 291 patients underwent abdominal CT imaging. Based on their presentation, the patients received either a contrast enhanced abdominal CT or a non-contrast abdominal CT scan. No patient received both types of CT exams. The CT scans were reviewed using a McKesson Picture Archiving System [McKesson PACS, Vancouver, Canada]. Reports of the CT scans were categorized into normal cases, cases with non-acute incidental findings and cases with significant acute findings by the reviewer who is a board certified Radiologist with 10 years of work experience and a fellowship training in MRI. Incidental CT findings included non-acute entities without significant immediate impact on patient's care such as indeterminate hepatic lesions, indeterminate renal and adrenal lesions, uterine fibroids, ovarian cysts, non-obstructing renal stones, diverticulosis coli, hepatic steatosis, and cholelithiasis. Significant positive CT findings included acute conditions with significant immediate impact on patient management (e.g. hospital admission or surgery) such as small bowel obstruction, acute appendicitis, acute pancreatitis, acute colitis and enteritis, diverticulitis, intra-abdominal masses/neoplasm, abdominal abscess, perforated viscus, free intraperitoneal air, acute cholecystitis, erosive changes at gastric band and volvulus, (Table 3). Patient outcome (e.g. discharge, hospital admission, or surgery) was confirmed with electronic medical records. It should be noted that some of the patients with significant CT findings simultaneously had incidental findings, however we grouped them into the significant findings category due to acuity of the CT findings and anticipated outcome. A chi-square test was used to compare the two groups.

Results

Of the 611 patients with abdominal symptoms presenting to the ER during the study period, there were 231 (37.8%) patients with normal BMI [<25 (kg/m^2)] and 380 (62.2%) patients with elevated BMI [>25 (kg/m^2)]. Of the 380 patients with elevated BMI, there were 205 (53.8%) overweight patients [25 (kg/m^2) < BMI < 30 (kg/m^2)] and 175 (46.2%) obese/morbidly obese patients [BMI ≥30 (kg/m^2)].

The mean BMI in the normal BMI group was 21.8 kg/m^2 and the mean BMI in the elevated BMI group was 32.0 kg/m^2. The mean age of the normal BMI group was 45.0 yrs and the mean age of the elevated BMI group was 46.8 yrs, (Table 1).

Of the 231 non-obese patients, 98 (42.4%) underwent abdominal CT imaging; and of the 380 patients with elevated BMI, 193 (50.8%) underwent CT imaging, (p = 0.045).

There were more females (n = 402) presenting with abdominal symptoms compared to males (n = 209). However, there was a higher percentage of overweight/obese males 137 (65.5%) than females 243 (60.4%), and a larger percentage of males received CT imaging compared to females [109 (52.1%) vs. 183 (45.2%)], (p = 0.05).

Normal exams: The number of normal exams (no findings) was 10 (10.2%) in the normal BMI group and 85 (44.0%) in the elevated BMI group (p < 0.0001), (Table 2).

Table 1
Demographic table.

Demographics		
	Elevated BMI	Normal BMI
Total patients (n = 611)	380 (62.2%)	231 (37.8%)
Mean age (yrs.)	46.8	45.0
Mean BMI	32.0	21.8
Total males (n = 209)	65.5%	34.4%
Total females (n = 402)	60.4%	39.5%
Total CT (n = 291)	193 (50.8%)	98 (42.4%)

Table 2
Comparison of normal, incidental and significant CT findings in both groups.

	Elevated BMI	Normal BMI	P value
Normal findings	85 (44.0%)	10 (10.2%)	<0.0001
Incidental findings	20 (10.3%)	43 (43.8%)	<0.0001
Significant findings	88 (45.6%)	45 (45.9%)	>0.05
Total CT (n = 291)	193 (50.8%)	98 (42.4%)	0.045