STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(a) Low weight related to low bone mass in elderly patients with fractures: a case-control study
		(b) Background The number of patients with osteoporosis or low bone mass is increasing annually. Low weight is reportedly associated with low bone mass and is a strong predictor of osteoporosis. However, the relationship between weight and bone mass in elderly individuals is still not clear. Methods The study included 520 patients aged ≥65 years (178 men and 342 women). Age, sex, weight, and height were recorded. Femoral neck bone mineral density and T scores were determined using a dual-energy X-ray absorptiometry scanner. Blood calcium (Ca), phosphorus (P), albumin (ALB), alkaline phosphatase (ALP), aspartate aminotransferase (AST), alanine aminotransferase (ALT), triglyceride (TG), total cholesterol (TC), high-density lipoprotein (HDL) and low-density lipoprotein (LDL) levels were measured. Patients were classified by sex (male and female), age (65-79 years and ≥80 years), and T score (normal bone mineral density, osteopenia and osteoporosis). Results Age, sex, body mass index (BMI), and ALP and TG levels were independent risk factors for osteoporosis. For the 65-79- and ≥80-year-old groups, females presented lower T scores than males. Ca, P, ALB, ALP, TC, HDL and LDL levels were significantly different between men and women in the 65-79-year-old group. In addition, BMI and TG levels were significantly decreased in osteoporotic patients compared with patients with normal bone mass. TC levels declined in 65- to 79-year-old male and female osteoporosis patients. In the group of women aged ≥80 years, osteoporotic patients showed significantly increased ALP levels. Furthermore, we found positive correlations between BMI and TG levels in the male and female patient groups. However, we found no significant differences in ALB, Ca, P, HDL and LDL levels in osteoporotic patients compared to patients with normal bone mass. Conclusion Osteoporotic patients showed significantly decreased BMI and TG levels compared with those with normal bone mass. BMI showed positive correlations with TG levels in male and female patients. These results indicate correlations between BMI and bone mass and between lipid profiles and bone mass.
Introduction		
Background/rationale	2	The number of patients with osteoporosis or low bone mass is increasing annually. More than 33% of patients aged 50 years or older are affected by osteoporosis in

		China [1]. Osteoporosis is characterized by decreased bone mineral density (BMD) and damaged bone microarchitecture, leading to low bone mass and increased bone fragility, which increases the risk of fracture [2]. Many factors contribute to osteoporosis, including age, sex, lifestyle, and diseases [3]. Together with the T score, dual-energy X-ray absorptiometry (DXA) is considered a very important and widely used method for diagnosing osteoporosis [4]. Normally, osteoporosis is defined by the T score (normal bone density [≥ -1.0], osteopenia [-1.0 to -2.5], and osteoporosis [≤ -2.5]) according to the recommendations of the World Health Organization (WHO) [5, 6]. Recently, many studies have investigated risk factors for osteoporosis, including body mass index (BMI), serum lipid profiles, serum calcium (Ca) and phosphorus (P), serum albumin (ALB), alkaline phosphatase (ALP), serum alanine transaminase (ALT) and aspartate aminotransferase (AST) [7-11]. Previous studies have noted the association between obesity and osteoporosis and that obesity may be a protective factor for osteoporosis [12, 13]. Obese patients have higher mechanical loads on their bones, which is beneficial for bone mass [14, 15]. Moreover, weight loss is harmful to musculoskeletal health [16] and has been reported to be associated with bone loss, as well as a strong predictor of osteoporosis [17]. Older women who lost weight showed increased bone loss in the hip [18]. Another study reported that weight loss was related to hip-bone loss in older men and women [17]. These results indicated that elderly individuals with low weight had high risks of osteoporosis and fracture compared with those with high weight. Plasma lipid profiles have also been shown to change in response to weight [19]. The measurement of BMI is an easy method for determining an individual's weight category and is correlated with the percentage of body fat [20]. However, the relationship among BMI, BMD, and lipid profiles remains unclear.
Objectives	3	The aim of our study was to investigate the relationship between BMI and bone mass and the correlation between lipid profiles and bone mass and to explore the association between lipid and bone metabolism. In our study, we collected and analyzed clinical data from 520 patients aged ≥ 65 years.
Methods		
Study design	4	In this retrospective observational study, all patients aged ≥65 years admitted to the inpatient service at the Trauma Centre of Zhongda Hospital after experiencing a fracture from 2017 to 2020 were included. The fracture types included hip, vertebral, distal radius and proximal humerus fractures. All fracture patients were transferred to the emergency department. We excluded patients with cancer, thyroid disease, hypopituitarism, rheumatoid arthritis and chronic renal failure or renal dysfunction as well as patients who were receiving lipid-lowering, synthyroid or hormone-replacement therapies. All clinical data could be obtained for analysis in our study. Patients were classified by sex (male and female), age (65-79 years and ≥ 80 years), and T score (normal BMD (≥ − 1.0), osteopenia (− 1.0 to − 2.5), and osteoporosis (≤ − 2.5)).

Setting	5	Age, sex, height, and weight were recorded from patient documents. BMI was calculated using weight and height (kg/m2). Femoral neck BMD and T scores were determined using a DXA scanner (Hologic Discovery Wi with software version 13.2). According to the WHO classification, the T score was used to define the BMD categories. Serum samples were collected immediately after the patients were admitted, and serum Ca, P, ALB, AST, ALT, ALP, triglyceride (TG), total cholesterol (TC), high-density lipoprotein (HDL) and low-density lipoprotein (LDL) levels were analyzed.
Participants	6	(*a*) In this retrospective observational study, all patients aged ≥65 years admitted to the inpatient service at the Trauma Centre of Zhongda Hospital after experiencing a fracture from 2017 to 2020 were included.
		(*b*) NA
Variables	7	BMI was calculated using weight and height (kg/m2). Femoral neck BMD and T scores were determined using a DXA scanner (Hologic Discovery Wi with software version 13.2). According to the WHO classification, the T score was used to define the BMD categories. Serum samples were collected immediately after the patients were admitted
Data sources/ measurement	8*	Age, sex, height, and weight were recorded from patient documents. Femoral neck BMD and T scores were determined using a DXA scanner (Hologic Discovery Wi with software version 13.2). According to the WHO classification, the T score was used to define the BMD categories. Serum samples were collected immediately after the patients were admitted
Bias	9	NA
Study size	10	The number of cases admitted to the Trauma Centre of Zhongda Hospital during the study period determined the sample size.
Quantitative variables	11	Patients were classified by sex (male and female), age (65-79 years and ≥ 80 years), and T score (normal BMD (≥ − 1.0), osteopenia (− 1.0 to − 2.5), and osteoporosis (≤ − 2.5)). Osteoporosis is characterized by decreased bone mineral density (BMD) and damaged bone microarchitecture, leading to low bone mass and increased bone fragility, which increases the risk of fracture [2]. Many factors contribute to osteoporosis, including age, sex, lifestyle, and diseases [3].
Statistical methods	12	(*a*) Data are presented as the mean ± standard deviation (SD). IBM SPSS statistics version 25 and GraphPad Prism version 8.4.0 software were used to analyze the data. After analyzing the normality using the Shapiro–Wilk test, data between two groups were evaluated by the t test and nonparametric test. For three groups, data were evaluated by one-way ANOVA. Multivariate analysis was performed by multiple linear regression. The Pearson correlation test was used to analyze the association between BMI and TG levels. *P<0.05, **P<0.01, ***P<0.001 and ****P<0.0001 indicated significant differences.
		(*b*) NA
		(*c*) NA
		(*d*) NA
		(*e*) NA

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Results		
Participants	13*	(a) In total, 520 patients aged ≥65 years were included in our study.
		(b) NA
		(c) NA
Descriptive data	14*	(a) A total of 178 male patients were enrolled, including 48 normal, 81 osteopenic and 49 osteoporotic patients. A total of 342 female patients were included in our study, including 36 normal, 103 osteopenic, and 203 osteoporotic patients (Table 1). Age, sex, BMI and ALP and TG concentrations were significantly different among the groups of normal, osteopenic and osteoporotic patients. Moreover, age, sex, BMI and ALP and TG concentrations were independent risk factors for osteoporosis (Table 1).
		(b) NA
		(c) NA
Outcome data	15*	NA
		A total of 178 male patients were enrolled, including 48 normal, 81 osteopenic and 49 osteoporotic patients.
		NA
Main results	16	(*a*) A total of 72 men and 154 women aged ≥ 80 years were examined in our study. The T score was significantly different in male patients compared to female patients. There were no significant differences in BMI or Ca, P, ALB, ALP, AST, ALT, TG, TC, HDL and LDL concentrations between male and female patients (Table 3).
		(*b*) NA
		(*c*) NA
Other analyses	17	Patients were divided into two groups according to age (65-79 years and ≥80 years). To analyze sex differences, a total of 106 men and 188 women were included in the 65- to 79-year age group (Table 2).
Discussion		
Key results	18	In our study, we analyzed the clinical data of 520 patients aged ≥65 years. We found that osteoporotic patients showed significantly decreased BMI and TG levels in comparison with patients with normal bone mass.
Limitations	19	This was a single-center retrospective study with a small sample size. Further multicenter and prospective studies with larger samples are needed to prove the association between TG metabolism and bone metabolism.
Interpretation	20	In conclusion, osteoporotic patients showed significantly decreased BMI and TG levels in comparison with patients with normal bone mass in our study. These results indicate an association between TG metabolism and bone metabolism and provide a new method for the treatment of osteoporosis.
Generalisability	21	NA
Other information		
Funding	22	There was no funding or support for this study.

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at

http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.