INTRODUCTION

Osteoporosis can be defined as a progressive systemic skeletal disease with physically and psychologically significant consequences, identified by a reduction in the bone mass and/or bone mineralized density (BMD), in addition to a change of bone microarchitecture which consequently can lead to increase the chance of bone fragility and fractures as the fragile bone may be fractured on minimal trauma where otherwise, normally a micro-fracture does not occur.[1-6] In other words, patients with osteoporosis seem to be asymptomatic due to painless progress of bone loss until the disease becomes clinically manifested and/or clearly observed as a result of trauma presenting as fracture.[1,7]

Osteoporosis is commonly noticed clinically during the fourth and fifth decades of life, it mostly occurs in females than males due to the possibility of hormonal changes, especially in postmenopausal females which can affect the quality of bone.[2,7-9] However, osteoporosis can also affect older men.[7-10]

As a result of significant impact and outcome of osteoporosis, it can be considered as a broad interesting disease related to the public health issue.[4-6,8]
The skeleton which is mainly affected by osteoporosis is metabolically active tissue subjected to constant alterations and adaptive processes named bone formation and bone resorption which are likely to be disturbed by osteoporosis as bone resorption may become more frequent than bone formation.\(^\text{[1,4,11,12]}\) Therefore, osteoporosis can also be considered as the most common metabolic bone disease which is characterized by low bone density.\(^\text{[1,4]}\)

There are different risk factors which may lead to the development of osteoporosis such as inadequate absorption of nutrients especially Calcium (Ca) and Phosphorus caused by intestinal disorders which can lead to Vitamin D deficiency that has an impact on bone density.\(^\text{[3,13‑15]}\)

Generally, osteoporosis can affect any skeletal site\(^\text{[3,8,16]}\) including Temporomandibular joint (TMJ) which is critical for mastication, occlusion and speaking.\(^\text{[17]}\)

Osteoporosis can occur in the bony components of the joint which are the articular fossa, articular eminence of the temporal bone and the condyle of the mandible that is most commonly affected by bone resorption.\(^\text{[18‑20]}\) Moreover, functional harmony of the masticatory system may be disturbed by the impact of general bone loss on the skeleton caused by osteoporosis, which then can result in increase the chance of occurrence of TMJ problems such as Temporomandibular disorders (TMD);\(^\text{[13,17,21]}\) therefore, patients suffer from pain, tenderness, clicking, weakness, shifting of the jaw to one side, protrusion of the mandible and occasional joint stiffness which can lead to limitation of mouth opening and adversely affects oral health.

TMJ is critical for jaw functional activity including mastication, occlusion and speech.\(^\text{[17]}\) Problems of TMJ mainly include TMDs which can be defined as a group of problems and complicated conditions influencing TMJ and associated musculature and structures.\(^\text{[17,22]}\)

TMDs can be categorised into Three types including myofascial pain disorders (myogenous), articular disorders (anterior disc displacement/ internal derangement) and degenerative disorders (progressive degeneration).\(^\text{[17,22‑24]}\)

Multiple diagnostic methods of TMJ disorders including TMDs were recognized. The most broadly used diagnostic method is research diagnostic criteria (RDC/TMD)\(^\text{[25,26]}\) which is used in this study because of its biopsychosocial approach for the diagnosis of TMJ disorders including TMDs.\(^\text{[27,28]}\)

Aims of the study
Examine and evaluate the presence and impact of TMJs disorders in patients with osteoporosis.

MATERIALS AND METHODS
A favorable ethical opinion was obtained for this study from the Iraqi Ministry of Health. Fifty-eight (58) patients with osteoporosis participated in this study after a brief verbal explanation of it was presented to them by the researchers who performed this study. This study was self-funded and it was reviewed by the scientific committee of the University of Babylon after obtaining consent form. Power calculation of the sample size (58 patients) of this study was done by using G-Power and based on data of two previous studies\(^\text{[29,30]}\) focusing on change in bone density of TMJs. The lower effect size (0.68) of study was used to calculate the sample size of this study at 80% power.

Each participated patient signed a consent form before starting participation in the study. An appointment was arranged for each participated patient to confirm the presence of TMJs disorders and case sheet was used for each patient. All patients with osteoporosis were recruited from the Outpatient Department of the Rheumatology clinic in Merjan Medical city/Babylon – Iraq between the period February-August 2019, and all of them were already diagnosed by Rheumatologists, physical and sport Rehabilitation physicians.

Dual Energy X-ray Absorptiometry shown in Image 1 performed for all patients to show the osteopenia and changes in bones density.

TMJs were examined by oral medicine specialties using (RDC/TMD) diagnostic method.\(^\text{[25,26]}\)

The standard criterion for the diagnosis of osteoporosis in postmenopausal women and older men is T-score of \(\leq -2.5\) at the lumbar spine, femur neck or total hip by bone mineral density testing.

![Image 1: Dual Energy X-ray absorptiometry machine](image1.png)
Inclusion criteria
Patients can converse in Arabic and have adequate understanding of the language to take part in the speaking, listening and reading required in the study; Patients are diagnosed with osteoporosis; Patients are ≥18 years of age; Patients can provide consent form to take part in the study.

Exclusion criteria
Patients are diagnosed with other bony changes not including osteoporosis; Patients have had an injury in the TMJs area; Patients have lacking in the ability to understand the study and provide consent form; Patients are <18 years of age.

RESULTS
A total of 172 patients with osteoporosis were recruited and were verbally approached to determine if they had an interest to participate in the study by their clinical staff. Of these, 91 (53%) declined participation in the study. The remaining 81 patients (47%) were interested in participating and discussed the study with the clinical researchers. An appointment was arranged for each patient who had an interest to participate in the study after signed a consent form. Of the participated patients (n = 81), 61 (75%) were diagnosed with TMJs disorders by the clinical researchers and the remaining 20 (25%) were considered ineligible because they did not have TMJs disorders and then excluded from the study. As a result of no one of them participated patients asked to withdraw from the study after signing the consent form, the data of the last three patients (4%) diagnosed with TMJ disorders were not included in the results of the study. Therefore, the data of 58 (72%) osteoporotic patients diagnosed with TMJs disorders were only included in the results because the sample size of this study is 58 patients. The number of female patients participated in this study was Forty Six 46 out of 58 osteoporotic patients, while the number of male patients was 12. Therefore, the majority of patients participated in the study were females (79%) as shown in Figure 1.

The age of patients ranged from 48 to 66 years (Mean 54.3). The Fifty-eight (58) patients participated in this study were with the following TMJs disorders:

Twenty-seven (27) (47%) out of 58 patients with TMJ clicking as anterior disk displacements.

Seventeen (17) (29%) out of 58 patients with spasm in muscles of mastication.

1. Fourteen (14) (24%) out of 58 patients with subluxation and dislocation.

Figure 1: Patients’ gender distribution

Descriptive statistics were used in this study as the study based on the percentage of TMJ disorders occurrence in patients with osteoporosis. These results are also showed by the following Figure 2:

DISCUSSION
In this study, female patients were more than male patients. The majority of females is consistent with the data of previous studies.[2,3,7,9] The cause of differences in gender-related to osteoporosis may be due to biological effects of changes in female reproductive hormones (estrogen) especially in postmenopausal females as hormonal changes can adversely affect bone density and strongly determine the rate of bone resorption.[2,3,7,9] On the other hand, osteoporosis can also occur in older males.[3,7,9]

In addition to that, female patients had more symptoms of chronic TMDs than those of male patients due to the probability of increase hormonal changes (especially estrogen) and emotional stress in middle age female patients than male patients.[17,31‑33]

The mean age of patients participated in this study was about 54 years. This is in contrast with the findings of[3‑5,7‑9,13,16,18,19,25,29,31‑36] who found that osteoporosis clinical manifestation can be seen in patients during fourth and fifth decades of their life.

Regarding osteoporosis and TMJ problems, Kim et al. on 2016[37] revealed that any changes related to organs in the human body such as pathological events connected with the health status of other human organs or structures. One of the health compromised or complications in these patients are bones pathological changes and associated structures (orthogenic or myogenic), one of the main bone dysfunction and muscles fatigue or spasms in patients with
osteoporosis are TMDs and myofacial pain dysfunction syndrome.\textsuperscript{[37]}

Moreover, TMDs can be classified into three types which are myofacial pain disorders, articular disorders and degenerative disorders.\textsuperscript{[17,22-24]} Myofacial pain is considered as the most common type of TMDs, but is not frequently seen in the articular changes of TMJ.\textsuperscript{[17]} Abnormal disc position (disc displacement with or without reduction) can be seen in articular disorders.\textsuperscript{[17,22]} Secondary osteoarthritis and progressive degeneration can occur as a result of chronic articular disorders.\textsuperscript{[17,24]}

The hypothesis related to bony changes including TMJ area is due to reduction in proliferating capacities or abilities of osteoblasts of all bones in the human body and condylar bone is one of them.\textsuperscript{[38,39]}

The fibrocartilage in TMJ located above the condylar bone of the mandible, this bone is susceptible to inflammatory damage due to systemic disease that makes bony changes like arthritic features,\textsuperscript{[10,36]} compromised health of patients with osteoporosis like psychological and emotional stressful conditions occurred due to this disease then lead to degenerative features of mandibular condyles.

Furthermore, the development of general bone loss in the skeleton can be provoked by the presence of poor habits and medical conditions/disorders which may lead to disturbance in the masticatory system and therefore can increase the chance of occurrence of TMDs.\textsuperscript{[1,321]}

In addition to that, deficiency of vitamin D and Ca associated with osteoporosis and reduction of bone mass density (BMD) can cause abnormalities and degenerative changes of condylar bones.\textsuperscript{[36]} However, prevention of osteoporosis can be established by using Vitamin D supplements with regular exercise for maintaining the health condition of the bone.\textsuperscript{[7,34]}

Although there is a significant relationship between osteoporosis and TMJ problems, the osteoporosis prevalence seems not to be of importance regarding clinical and/or radiographic findings of osteoarthritis with degenerative changes in TMJs.\textsuperscript{[34,35]}

Ultimately, this study is subject to limitation which includes a dearth in the literature about TMJs disorders and osteoporosis. Another limitation is the predominance of female patients with osteoporosis and TMJs disorders than male patients which might be due to the over recruitment of female patients.

CONCLUSIONS

Osteoporosis can have a significant impact on the oral and dental health of the patient through increasing the chance of occurrence of TMJ problems, especially the TMDs which are likely the main causes of jaw functional limitation through the presence of pain, tenderness, muscular fatigue, clicking and stiffness of the jaw.

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Conflicts of interest
There are no conflicts of interest.

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