

# Economic Burden and Cost-effectiveness of Physical Therapy Programs for Osteoporotic Patients: A Systematic Review

Dionysios Theodosis-Palimeris, Fotini Gialama, Chrysoula Argyrou, Ioannis K. Triantafyllopoulos, Efstathios Chronopoulos

*Laboratory for the Research of Musculoskeletal Disorders  
Medical School, National and Kapodestrian University of Athens, Greece*

## ABSTRACT

**BACKGROUND:** The continuous increase in the average world's population age has revealed osteoporosis as a serious public health concern, which ensues a great economic burden to both patients and society. Despite the fact that many studies have evaluated the economic costs associated with therapeutic interventions for osteoporosis, the cost of physical therapy has not been thoroughly studied yet.

**OBJECTIVE:** To review the existent data regarding the economic burden of physical therapy programs for osteoporotic patients and evaluate their cost-effectiveness.

**METHODS:** The articles were systematically sought from the electronic databases of PubMed and the Cochrane Library, using predetermined keywords and their combinations with no limit on publication date. Eligible studies were selected based on a set of inclusion and exclusion criteria, limiting articles to those published in English language.

**RESULTS:** A total of six studies were included, all of which evaluated the economic burden of physical therapy. The search strategy concerning the cost-effectiveness of physical therapy programs yielded no results.

**DISCUSSION:** The cost of physical therapy programs seems to vary significantly among the studies. However, there is limited evidence available regarding the cost of physical therapy and none regarding its cost-effectiveness and thus further research is needed in both areas.

**KEY WORDS:** osteoporosis; physical therapy; exercise; economic burden; cost-effectiveness

### Background

Osteoporosis is a metabolic disorder characterized by low bone density and defects in bone microar-

chitecture which leads to bone fragility and increased risk of bone fractures [1]. It is an important issue of public health, as it affects a great number

CORRESPONDING  
AUTHOR,  
GUARANTOR

**Ioannis K. Triantafyllopoulos**, MD, M.Sci., Ph.D, FEBOT.  
6, Dimitros str. 15124, Maroussi, Athens, Greece  
E-mail: sportdoc@otenet.gr

of people around the world and particularly postmenopausal women [2]. The clinical significance of osteoporosis lies in fractures that occur as a result of the increased bone fragility [3]. The definition of osteoporotic bone fracture refers to the fracture following a low energy accident and it is associated with low bone mineral density (BMD). Osteoporotic fractures usually involve hip, vertebral column and wrist [3-5]. It is estimated that there are globally about 9 million osteoporotic fractures yearly and that more than half of them occur in Europe and U.S.A. [6]

It has already been established that the osteoporotic fractures have both economic and social impact on the society [3,6]. The majority of the studies regarding the consequences of osteoporotic fractures concern hip fractures which are the most common type of fractures treated in hospital settings and they are therefore better recorded and analyzed [7]. Nonetheless, since these studies differ in terms of settings, treatments and pricing methods, it is difficult to make a direct comparison [8]. Osteoporotic fractures and especially hip fractures are a major cause of morbidity, mortality and incapacitation in older individuals [9,10].

Many interventions have been proposed to address osteoporosis regarding both prevention and treatment. These interventions include the radiological [11], pharmacological [12], surgical [13] and physiotherapeutic approaches [14]. However, the interdisciplinary approach in the prevention and treatment of osteoporosis is pivotal [15]. Physical therapists are an integral part of the interdisciplinary team in the treatment of osteoporotic patients and a thorough subjective and objective physiotherapeutic evaluation is considered of paramount importance. The evaluation tools needed in order to achieve a personalized rehabilitation program include the evaluation of the body posture and the range of motion of joints [16], muscle strength [16,17], balance [18,19], pain and functionality [20-22], as well as the aerobic capacity [23,24]. The physiotherapeutic rehabilitation programs vary depending on the physiotherapeutic evaluation and the level of functionality of the patient. These

programs usually include bone loading exercises and muscle strengthening [25-27], stretching and posture improving exercises [16], as well as pain relieving techniques [28].

As indicated by various studies, osteoporosis constitutes a great deal of the healthcare budget [29, 30]. The economic burden of the morbidity caused by osteoporotic fractures includes both the direct cost of hospitalization and follow-up and also the indirect cost caused by the impact of fractures on the activities of daily living, including the sick-leave days [6]. The expenses and the consequences on people's health related to osteoporotic fractures can be classified according to: (1) the outpatient care, which includes the number of hospital, physiotherapy, occupational therapy and home care visits and the number of radiological and biochemical blood tests, (2) the number and duration of hospitalization, (3) the social services, (4) the care provided by non-trained personnel like relatives, (5) the transportation of patients, (6) the pharmacological therapy, (7) the indirect expenses such as sick leaves and (8) the quality of life of the patients [8].

The limited resources available for healthcare budget require efficient usage and allocation. The economic evaluation can lead the decision making process in resource allocation to be more efficient in the context of an appointed budget [31]. It represents a methodological tool often used in medicine in order to assist healthcare decision making on resources allocation [32]. There are four kinds of economical evaluation that can be used: the Cost Minimization Analysis (CMA), the Cost Effectiveness Analysis (CEA), the Cost Benefit Analysis (CBA) and the Cost Utility Analysis (CUA) [33-36].

The above data further solidify the fact that the contribution of physical therapy in the prevention of osteoporosis and rehabilitation is crucial and should, therefore, be studied along with the fact that both the preventive measures and treatment of osteoporosis are considered rather expensive. The purpose of this study is to evaluate the cost of physical therapy programs in osteoporotic patients as well as their cost-effectiveness.

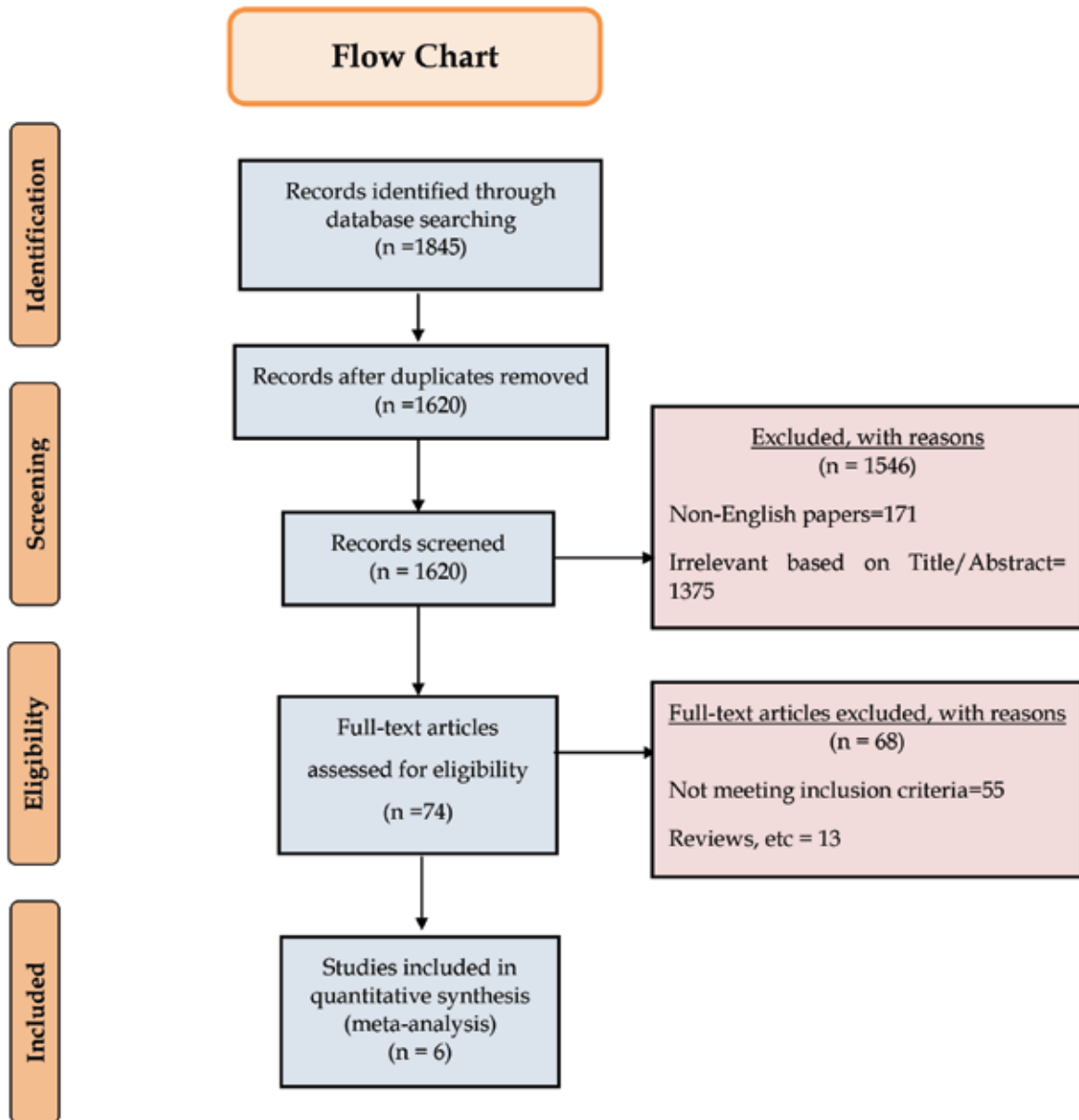


Fig. 1. Flow chart of the Systematic Review of the economic cost of physical therapy programs of osteoporotic patients

## A. Cost analysis of physical therapy programs for osteoporotic patients

### 1. Methods

For the purposes of this study we performed two systematic reviews. The first was designed to investigate the financial burden of physiotherapeutic interventions for osteoporosis and the latter to study the cost-effectiveness of the physiotherapeutic pro-

grams for osteoporotic patients. This systematic review was conducted according to the principles of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [37, 38].

#### 1.1 Search strategy

In order to identify all studies of cost analysis the collection of data was based on the search of scientific articles in electronic databases «MEDLINE/

TABLE 1. Studies that investigate the economic burden of the morbidity related to osteoporosis

Author (year)	Country	Sample (N)	Cost Duration	Perspective	Costing year (Currency)	Cost		Total Cost
						D	I	
Phillips et al. (1988) [39]	USA	>45 year old (Women)	NA	3rd party payer	1986 (US Dollars, \$)	√	NA	5,2\$
Rabenda et al. (2006) [40]	Belgium	N: 329 (Men & Women)	6 months	3rd party payer & Societal	2004 (Euro, €)	√	√	80,9 € (patient/month)
Haussler et al. (2007) [41]	Germany	>50 year old (Men & Women) N <sub>men</sub> : 1.321.672 N <sub>women</sub> : 6.482.086 N <sub>total</sub> : 7.803.758	NA	3rd party payer & Provider	2003 (Euro, €)	√	NA	5,4€
Dimai et al. (2012) [42]	Austria	N <sub>men</sub> : 51.721 N <sub>women</sub> : 68.190 N <sub>total</sub> : 119.911	1 year	Societal	2008 (Euro, €)	√	√	685,6 €
Eekman et al. (2014) [43]	Netherlands	N: 116 >50 year old (Women)	1 year	Societal	2008 (Euro, €)	√	√	79.154€
Qu et al. (2014) [44]	China	N: 938 (Men & Women)	1 year	Societal & Provider	2007 (Chinese Yuan, ¥)	√	√	19.730¥ (Average Annual Cost)

NA: not available, D: direct, I: indirect

PubMed» and «Cochrane Database», without limitation on publication date. The research included all the possible combinations of the following groups of terms: (a) financial terms: Cost, economic burden, cost of illness, burden of illness and (b) terms related to the medical condition (osteoporosis): Osteoporosis, osteopenia, osteoporotic fracture.

### 1.2 Inclusion criteria

1.2.1 The studies were chosen according to their Title/Abstract if cost, economic burden, cost of illness, burden of illness, were studied and if the cost of physical therapy programs of osteoporotic patients was mentioned.

1.2.2 All studies included in the review had to be published as full articles in English. As a result, studies that were not written in English, or did not mention the exact cost in numbers regarding

the physiotherapeutic interventions or did not use Cost-effectiveness, Cost-Benefit, Cost-Minimization and Cost-Utility methods were excluded from the review.

### 1.3. Study selection

The selection process consisted of 3 stages. In the first stage the results from the electronic search were imported in the Endnote X6 Library (Thomson Reuters, CA, USA). In the initial literature search 1845 studies were identified for evaluation. In the second stage, after removing duplicates, 1620 studies remained for evaluation. In the final stage 171 non-English papers were excluded and further 1375 due to irrelevance based on title, abstract and key words, 74 full papers remained. 68 studies were further excluded as they did not meet inclusion criteria or were reviews, summaries and clinical trials. Finally, 6 studies were selected to be evaluated for

the present systematic review. Details regarding the strategy of literature search are depicted in the flow chart of the systematic review as suggested by the PRISMA (Fig. 1).

## 2. Results of the systematic review regarding the cost of physical therapy programs for osteoporotic patients

### 2.1. Summary of selected studies

Literature review yielded 6 studies that evaluated the economic cost of osteoporotic patients, including the cost of physical therapy. These studies performed in United States of America (U.S.A) [39], Belgium [40], Germany [41], Austria [42], Netherlands [43] and China [44], published between 1988 and 2014. These studies investigated the economic burden of the society (societal perspective), the insurance companies (third party payer perspective) and the National Health Insurance system (health insurance system perspective). The majority of them addressed both the direct and indirect cost of osteoporosis [40, 42-44] and only two studies examined the direct cost alone [39, 41]. Furthermore, the time frame for the cost evaluation was either one year after the fracture [42, 44], 6 months after the fracture [40] or was not mentioned at all [39, 41]. Details about the characteristics of each study are presented in Table 1.

### 2.2. Cost of physical therapy in the treatment of osteoporosis

The cost of physical therapy programs for osteoporotic patients is rather variable among the different studies. More specifically, in the study of Eekman et al. (2014) [43], physical therapy holds the second place in the direct expenses for the treatment of osteoporotic patients accounting for 16,3% of the overall direct cost. It was also found to be the third most expensive treatment in the study of Dimai et al. (2012) [42], where it accounted for 10% of the direct cost. Moreover, in the studies of Rabenda et al. (2006) [40] and Haussler et al. (2007) [41] physical therapy is highlighted as the 6<sup>th</sup> most costly intervention of the direct cost with 4,9% and 3,1% re-

**TABLE 2.** Cost of physical therapy programs for osteoporotic patients and their classification according to % of the overall direct cost in each study

Physical Therapy		
Author (year)	% Direct cost	Expenditure classification
Phillips et al. (1988) [39]	0.2%	7th
Rabenda et al. (2006) [40]	4.9%	6th
Haussler et al. (2007) [41]	3.1%	6th
Dimai et al. (2012) [42]	10%	3rd
Eekman et al. (2014) [43]	16.3%	2nd
Qu et al. (2014) [44]	0.1%	10th

**TABLE 3.** Cost of physical therapy programs for osteoporotic patients and their classification according to % of the overall direct cost in each study

Drug Use		
Author (year)	% Direct cost	Expenditure classification
Phillips et al. (1988) [39]	0.4%	6th
Rabenda et al. (2006) [40]	26.9%	2nd
Haussler et al. (2007) [41]	14.6%	3rd
Dimai et al. (2012) [42]	4.6%	6th
Eekman et al. (2014) [43]	0.3%	8th
Qu et al. (2014) [44]	21.7%	2nd

spectively. Furthermore, it seems that in the U.S.A. in 1988 physical therapy for osteoporotic patients was classified as the 7<sup>th</sup> (out of 8) most expensive direct cost treatment by holding the 0,2% of the total direct cost [39]. More recently, in the study that was performed in China by Qu et al. (2014) [44], physical therapy was found to be the least expensive treatment, consuming only 0,1% of the overall direct cost, which classifies it in the last (10<sup>th</sup>) category of the direct expenses for osteoporosis (Table 2).

### 2.3. Other sources of direct cost related to osteoporosis

In the aforementioned studies the most expensive

**TABLE 4.** Cost (% of total direct cost) of special equipment, patient transportation and nutrition for osteoporotic patients

Author (year)	Special Equipment , Transportation & Nutrition					
	Phillips et al. (1988) [39]	Rabenda et al. (2006) [40]	Haussler et al. (2007) [41]	Dimai et al. (2012) [42]	Eekman et al. (2014) [43]	Qu et al. (2014) [44]
<b>Description</b>						
Special Equipment (% Direct Cost)	✗	✗	√ (1,4%)	✗	✗	√ (1,1%)
Transportation (% Direct Cost)	✗	✗	✗	✗	✗	√ (2,5%)
Nutrition (% Direct Cost)	√ <sub>a</sub> (51,5%)	✗	✗	✗	✗	√ (0,9%)

*a*: included in hospital care, √: Available, ✗: Not Available

direct intervention was proved to be the in-hospital care, consuming over 50% of the total direct cost, except for the study of Rabenda et al. (2006) in which it constituted only the 5.9% of the total direct cost for the treatment of osteoporotic patients [40].

The nursing care services were found to be the second most costly direct intervention in many studies [39, 41, 42], accounting for 39,5% [39], 20% [42], and 16,5% [41] of the total direct cost. In the rest of the studies these expenses are not mentioned separately, which leads to the conclusion that they are included in the cost of the in-hospital care [40, 43, 44].

Medical visits, both outpatient and at home visits, are classified as the third most expensive direct intervention in the study of Philipps et al. (1988) [39]. On the other hand, the economic burden studies conducted in Austria [42], Netherlands [43] and China [44] include only the visits in the outpatient clinic and classify them as the 5<sup>th</sup>, 7<sup>th</sup> and 8<sup>th</sup> most costly intervention in the treatment of osteoporotic patients [42-44]. It is important to note that medical visits, either in the clinic or at home, are not included in the cost estimation for the treatment of osteoporotic patients in the studies of Haussler et al. (2007) [41] and Rabenda et al. (2006) [40].

On the contrary, biochemical blood tests and the

use of radiologic modalities were found to be the most expensive of all according to the study that conducted by Rabenda et al. (2006) [40], consuming about 3,4% of the total direct cost. In relevant studies performed in China [44], U.S.A. [39], Austria [42], and Netherlands [43], these expenses hold the 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> position of the economic cost for osteoporosis [39, 42-44]. Finally, in the study of Haussler et al. (2007) [41], these expenses are not mentioned at all.

The cost of pharmacological treatment of osteoporotic patients has been investigated by all the studies included in the systematic review for the economic burden of morbidity associated with osteoporosis (Table 3).

The surgical procedures in the treatment of osteoporosis are included in the in-hospital expenses in the majority of the studies. The study of Phillipps et al. (1988) [39] is the only one to evaluate the cost of surgical procedures and they found that they occupy the 4<sup>th</sup> position as they consume only the 1.7% of the total direct cost.

The special equipment (crunches, walkers, braces etc.), the transportation of patients and nutrition seem to be the expenses with the fewest cost references in the studies that were exported for the sys-

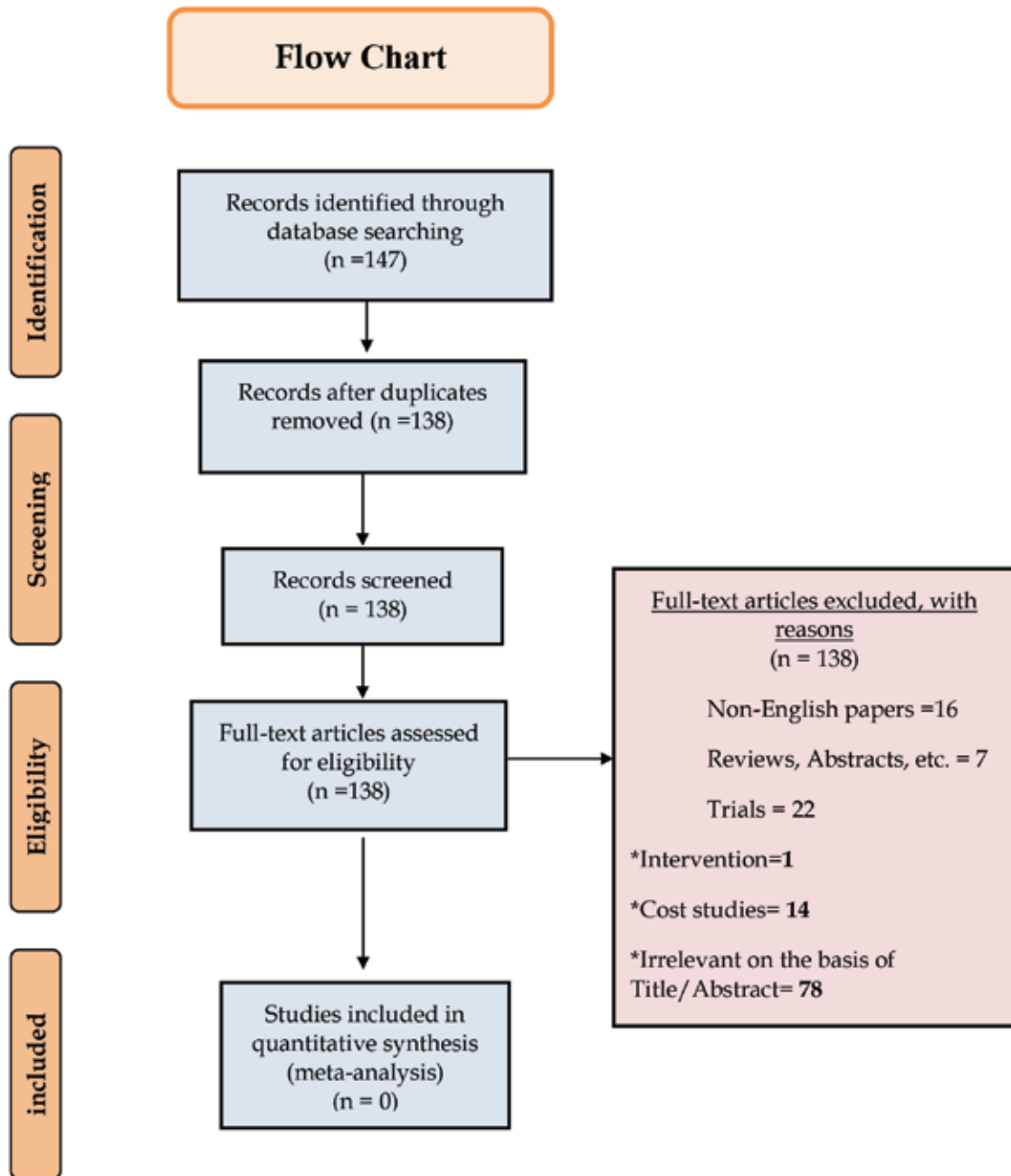


Fig. 2. Flow chart of the systematic review of cost-effectiveness of physical therapy programs for osteoporotic patients

tematic review. This is a rather surprising fact since, as highlighted by Prentice (2004) [45], nutrition plays a key role in the prevention and treatment of osteoporosis (Table 4).

Alternative medicine practices (homeopathic medicine, acupuncture, chiropractors and occupa-

tional therapy) are found to account for the least expenses of all the direct costs in the treatment of osteoporosis, as shown by the studies of Rabenda et al. (2006) [40] and Eekman et al. (2014) [43]. More specifically, the expenses for therapist visits in Belgium occupy the last position in the list of direct

expenses [40], while in Netherlands they are classified 6<sup>th</sup> out of 8 direct expenses for osteoporosis treatment [43], consuming the 0,6% and 1,6% of the overall direct cost respectively.

#### 2.4. Sources of indirect cost

The indirect cost of osteoporosis was calculated by the morbidity economic burden in the majority of the studies. In these studies, the most expensive service of the indirect cost was found to be the paid working hours which consumes a percentage that ranges between 46,1% and 90,6% of the total indirect cost.

Finally, the present systematic review revealed that physical therapy of osteoporotic patients accounts for a great deal of the healthcare budget. Nevertheless, it is not evident whether this cost is associated with the optimal results in public health. The purpose of the second systematic review was to investigate the cost-effectiveness of the physical therapy programs for osteoporotic patients.

### B. Study of the cost-effectiveness of physical therapy programs for osteoporotic patients

#### 1. Methods

This systematic review was conducted according to the principles of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [37, 38].

##### 1.1. Search Strategy

In order to identify all the economic evaluation studies, the data collection was based on the search for scientific articles published in the electronic databases of «MEDLINE/PubMed» and «Cochrane Database», without limitation of publication date. The study included the use of all the possible combinations of the following three groups of terms (a): Disease terms: osteoporosis, osteopenia, osteoporotic fracture, (b): Intervention terms: physical therapy, physiotherapy, rehabilitation, exercise and (c): Economic terms: economic evaluation, cost effectiveness, cost utility, cost benefit, cost minimization, cost.

##### 1.2. Inclusion criteria

1.2.1. The studies selected to be included in the review were based on their Title/Abstract if they in-

cluded: cost-effectiveness (CEA), cost-minimization (CMA), cost-utility (CUA), cost-benefit (CBA) analysis, focused on the economic evaluation of physical therapy programs for osteoporotic patients.

1.2.2. The studies included had to be published as full papers in English. As a result, studies that were not published in English, or were not relevant to physical therapy interventions for osteoporosis excluded from the review.

#### 1.3. Study selection

The selection process included three stages. In the first stage, the results from the electronic search were imported in the Endnote X6 Library (Thomson Reuters, CA, USA). In the initial literature search, 147 articles were identified for further evaluation. At the second stages, after removing duplicates, 138 studies remained to be evaluated. At the third stage, 16 more studies were excluded, as they were not written in English, 7 more were reviews, summaries, books etc, 22 were clinical trials, 1 interventional study, 14 economic studies and 78 were irrelevant on the basis of their title, abstract and key words. Finally, out of the 138 articles that were found and further evaluated, none met the inclusion criteria. Details regarding the strategy of literature search are depicted in the flow chart of the systematic review as suggested by the PRISMA (Fig.2).

#### 2. Results of the systematic review regarding the cost-effectiveness of the physical therapy programs for osteoporotic patients

According to the results of the present systematic review, none of the economical evaluation studies was able to evaluate physical therapy programs for the treatment of osteoporotic patients.

The study of Barker et al. (2014) [46], is the only one designed to perform economical evaluation (cost-utility) of physical therapy programs for osteoporotic patients with spinal fracture, however, only the protocol that is going to be followed has been announced so far.

### Discussion

Osteoporosis affects a great majority of the global




population. Fractures associated with osteoporosis have social and financial impact to both patients and society. The therapeutic interventions for osteoporosis vary greatly and physical therapy constitutes an integrated part of these interventions.

Physical therapy plays a key role in the prevention of osteoporosis and also in the rehabilitation process. Nevertheless, while the economic cost of osteoporosis has been investigated by several studies during the last decades, the cost of physical therapy programs has been examined in only six of them. The limited number of associated studies makes the extrapolation for safe conclusion very difficult. Another limitation of extracting safe conclusions is the different period that each study was conducted and the different currency used to calculate the cost. More specifically, as mentioned above, there is an inherent difficulty in comparing the cost of interventions between different countries, as they differ in both the resources used for the treatment of osteoporosis and the pricing used by each country. For future research, the currency equivalents should be taken into consideration in order to further facilitate the comparison between the various studies.

The studies of economical evaluation of therapeutic interventions in osteoporotic patients focus mainly on the surgical and pharmacological approaches, while there is no economical evaluation study for physical therapy. As a result, the deduction of conclusions regarding the optimal results

with the use of the least expenses in the physical therapy programs in osteoporosis is not feasible. What is more, the majority of the studies focus on the economic impact of osteoporotic fractures one year after the fracture, without evaluating the cost and quality of life of these patients after this time interval. It is also necessary to expand the study of the economic impact of osteoporosis to the time interval between osteoporosis diagnosis and the osteoporotic fracture incident, as well as after the first year from the fracture. In the present review, despite the fact that osteopenia was used as a keyword, there was no published study indentified to address the economic burden or the cost-effectiveness of interventions related to osteopenic patients.

### Conclusions

Overall, despite the inherent limitations of the existent data, it is crucial to highlight that osteoporotic fractures are expensive and as a result their prevention is pivotal. Towards this direction, it is evident that further research is needed in order to shed more light into the matter and to address to other questions that remain to be answered, as the evaluation of the cost-effectiveness of physical therapy programs for both osteoporotic and osteopenic patients. 

### Conflict of interest:

The authors declared no conflicts of interest.

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## ΠΕΡΙΛΗΨΗ

**ΣΚΟΠΟΣ:** Η οστεοπόρωση επιφέρει τεράστια οικονομική επιβάρυνση, τόσο στους ίδιους τους ασθενείς, όσο και στην κοινωνία. Τα οικονομικά φορτία νοσηρότητας, έχουν μελετηθεί για αρκετές από τις θεραπευτικές παρεμβάσεις της οστεοπόρωσης, ωστόσο καμία μελέτη δεν επικεντρώνεται στο κόστος της φυσικοθεραπείας. Στόχος της παρούσας μελέτης, είναι να αναδείξει το φορτίο οικονομικής νοσηρότητας (economic burden) προγραμμάτων φυσικοθεραπείας οστεοπορωτικών ασθενών και να εξετάσει τη σχέση κόστους-αποτελεσματικότητας αυτών.

**ΜΕΘΟΔΟΣ-ΑΠΟΤΕΛΕΣΜΑΤΑ:** Πραγματοποιήθηκαν δύο συστηματικές ανασκοπήσεις της διεθνούς αρθρογραφίας. Η πρώτη αφορούσε στο κόστος προγραμμάτων φυσικοθεραπευτικής παρέμβασης οστεοπορωτικών ασθενών ενώ η δεύτερη, οικονομικές αξιολογήσεις (σχέση κόστους-αποτελέσματος) των προγραμμάτων αυτών. Η αναζήτηση της αρθρογραφίας πραγματοποιήθηκε στις ηλεκτρονικές βάσεις δεδομένων «MEDLINE/PubMed» και «Cochrane Database», βασιζόμενη στις κατάλληλες «λέξεις κλειδιά» και τους συνδυασμούς τους. Οι μελέτες κόστους οι οποίες περιελάμβαναν το οικονομικό κόστος της φυσικοθεραπείας οστεοπορωτικών ασθενών, επιλέχθηκαν προς εξέταση για την παρούσα μελέτη και τελικά 6 συμπεριλήφθηκαν για επεξεργασία. Μελέτες οικονομικής αξιολόγησης δεν αναδείχθηκαν από την δεύτερη συστηματική ανασκόπηση.

**ΣΥΜΠΕΡΑΣΜΑΤΑ-ΣΥΖΗΤΗΣΗ:** Το κόστος προγραμμάτων φυσικοθεραπείας, φαίνεται να ποικίλλει ανάμεσα στις μελέτες. Επιτακτικό κρίνεται το αίτημα για περαιτέρω διερεύνηση του οικονομικού κόστους των παρεμβάσεων φυσικοθεραπείας οστεοπορωτικών ασθενών και η πραγματοποίηση μελετών κόστους-αποτελεσματικότητας αυτών.

**ΛΕΞΕΙΣ ΚΛΕΙΔΙΑ:** οστεοπόρωση, φυσικοθεραπεία, φορτίο οικονομικής νοσηρότητας, κόστος - αποτελεσματικότητα