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In 2014 a new Editor in chief for the Italian Journal of Physiotherapy

M. BACCINI [1], R. GATTI [2]

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Nearly three years have passed since the first issue of the Italian Journal of Physiotherapy (IJP) was published and we are very pleased for having won our bet: the journal is still alive, it is regularly issued, the peer-reviewing process of submitted articles is well established, and the quality of published papers is decorous. Moreover, the indexing of the journal in the CINAHL and PEDro databases has been achieved. We are satisfied, taking that the bet could have appeared a rash decision, considering the objective difficulty of creating a new scientific journal together with the small size of the newborn Italian Society of Physiotherapy (SIF) that chose to found it.

In agreement with the SIF board, Roberto Gatti, who has just become the new S.I.F. president, decided to leave his role of IJP editor in chief with the first issue of 2014. This decision is mainly based on two reasons: first, from an organizational point of view the management of the new role requires to spread the responsibility of the SIF activities among the collaborators, in order to create a competitive and motivate team of people. As second, the position of SIF president does not leave the time for correctly following the development of the IJP. This follows straightforward, if we think that all the SIF board members, included the President, are physiotherapists very committed to their vocational activity. For the role of IJP Editor in chief, Roberto Gatti proposed to the SIF board Marco Baccini, at present one of the three Associate editors of the IJP. In acknowledgement of his scientific and professional skills, Marco's new role has been well accepted by all the SIF board. Aside from IJP associate board, Marco Baccini was one of the physiotherapists involved in the design and foundation of the SIF, and he was member of the SIF board since its foundation until 2013.

What projects do we have about the Italian Journal of Physiotherapy? Though all the members of the Journal Board have definitely done their part, we must realize that we have a long way to go yet in order to consolidate the journal and to attain its indexing in other important international databases.

We think that the Italian Journal of Physiotherapy has the potential to create a niche for itself in Europe. Based to 2005 data which can be retrieved in the European Region website of the World Confederation for Physical Therapy,[1] the number of certified physiotherapists in Europe is over 350,000. Only in a minority of European countries, however, a physiotherapy journal is currently being published in the English language and in several countries no physiotherapy journal is being published at all, or at least no reference journal of the local physiotherapists association exists. Overall, we can estimate that over 230,000 physiotherapists work in these countries and, therefore, do not have direct or easy access to a scientific journal published in the English language. Roughly, these countries belong to the area of Southern Europe or East Europe, with some important exception (*e.g.*, Germany).

It appears that the Italian Journal of Physiotherapy is beginning to catch the attention of researchers working in these countries. Indeed, a particularly positive aspect of the journal is that the last issues include an increasing number of articles from non-Italian authors. The IJP, therefore, could aim to become gradually the reference journal of physiotherapy associations, scientific societies and/or universities in countries of South and East Europe. The way will be long and likely will require to change the journal's name in the future, but we think that we should start directing our efforts towards this ambitious objective.

[Available at: Number of Physiotherapists - http://physio-europe.org]

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ORIGINAL ARTICLE

Work-related thumb pain in physiotherapists: prevalence, risk factors and prevention, an observational study

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ABSTRACT

Background. Former studies proved that work-related thumb pain in physiotherapy is a common problem, yet most of these studies investigated a population in Australia. The purpose of this study was to determine factors which are highly correlated with thumb pain in physiotherapists working in the Belgian province Vlaams-Brabant.

Methods. This was a cross-sectional, observational design. A self-administered questionnaire was sent to physiotherapists, associations, nursing homes, rehabilitation centres and hospitals. Exclusion criteria were: working outside Vlaams-Brabant, rheumatic disease or previous surgery to the forearm or wrist. One hundred fifty seven physiotherapists participated. Associations between thumb pain and the variables were indicated with Chi Square analyses.

Results. Forty-four percent had thumb pain once in their career. But remarkably, 91% were never given any preventative advice. An average score of 3 on a NRS of 10 was given for their pain. Friction and massage were techniques which primarily caused thumb pain. Paradoxically gender, age, years of experience, average amount of worked hours in one week and area of practice had no influence on the development of thumb pain. Rest was a popular treatment (58%) along with exercises (33%), bracing (33%) or medication (29%).

Conclusion. Friction and massage provoked thumb pain. A prevalence of 44% is very high and this impairment should not be ignored. The change in execution of techniques is a consequence of thumb problems. The optimum therapy for work-related thumb pain was rest, considering the satisfaction about this treatment. *(It J Physiotherapy 2013;3:145-53)*

KEY WORDS: Thumb - Wounds and injuries - Physical therapy - Risk factors.

Work-related thumb pain is a common problem in physiotherapy.[1-10] In a study by Cromie J *et al.*[2] concerning work-related problems in general, it was shown that thumb pain was the fourth most frequent work-related disorder with a prevalence of 11%. Reglar P *et al.*[9] even found a prevalence of 57% in their study where they compared a group of physiotherapists with a control group.

After reviewing former studies by using an existing check list for case control [7] and cross-sectional designs,[8] in the end six studies, which investigated work-related thumb pain in physiotherapy, were considered to be reliable.[4, 6, 9, 11-13] Most of these studies investigated a population in Australia. Only one study from Reglar P *et al.*[9] examined a European population. So far there is no recent study about work-related thumb pain in a Belgian population.

These former studies showed that 23% of the physiotherapists with thumb pain left their jobs as a result of their work-related condition. Hence we cannot ignore this problem. Moreover, it was demonstrated that 63% of those with a work-related disorder changed their habits and started to use other techniques to treat patients.[1]

Thirty two percent of those with work-related complaints took sick leave, but only 10% of them reported their condition as a work related accident.[3] These are alarming figures and show that work-related disorders in physiotherapy are prevalent and that they have more impact than was expected.

Therefore prevention of thumb pain is important and it would be recommended that it takes place in the education of physiotherapists. Determining the ideal thumb position for execution of massage, frictions or manipulations, which could avoid thumb pain, would be a step in the right direction.

In this study work-related thumb pain in physiotherapy is defined as 'the pain that occurs during the execution of techniques which a physiotherapist should use in function of his profession. This pain could be present at the level of the metacarpophalangeal joint (MCP), the interphalangeal joint (IP), the thumb base or at a combination of those. The physiotherapist must blame this pain on his work, and no distinction is made between pain occurring at the time of or after ending this activity.

The aim of this study was to determine the factors with a high correlation to thumb pain in physiotherapists working in the Belgian province of Vlaams-Brabant. We also wanted to investigate the consequences of work-related thumb pain. Additionally we estimated the prevalence of work-related thumb pain in physiotherapy. Moreover, we wanted to determine the best therapy according to physiotherapists to treat their work-related thumb pain.

Materials and methods

Study design

This study used a cross-sectional observational design. A self-administered questionnaire, based on previous research,[4, 6, 9, 11-13] was mailed to the physiotherapists whose e-mail address were available on the online directory and the site www.kinesitherapeuten.zoekeensop.be. The same questionnaire was sent to seven associations (such as the professional association of Flemisch Physiotherapists Axxon) who forwarded the questionnaire to their members working in Vlaams-Brabant. Also 16 nursing homes, seven rehabilitation centers and three hospitals of Vlaams-Brabant were contacted. Ethical approval was granted by the Medical Ethics Committee of the University of Brussels (B.U.N. 143201111471).

Participants

Participants were excluded if they were retired, if they were working outside Vlaams-Brabant, if they had a rheumatic disease or if they had previous surgery to the forearm or the wrist. In total 21 participants were excluded. Ten of them were excluded because they had a rheumatic disease, seven had previously undergone surgery and four lived but did not work in Vlaams-Brabant. In other words, we were looking for active physiotherapists working in a private practice, hospital, nursing home or rehabilitation centre. A sample size of 157 was considered acceptable. According to the desired power of 0.80 and significance level of α=0.05 160 participants would have been optimal. The sample size of the present study is comparable to previous studies in this area, this sample size is acceptable too.[6, 9, 11-13]

Outcome measures

The questionnaire contained only multiple choice questions, however in some cases the participants were invited to add extra information to the answer if necessary (Appendix 1).

Demographic information, number of working hours, work domain and hand position during the execution of manual techniques were questioned. The hand position which the therapists are using was investigated with pictures of possibly used techniques, based on the three hand position categories which Snodgrass SJ *et al.*[11] considered in their study. The physiotherapists had to choose the one position mostly corresponding to their own technique.

If thumb pain was present, the participants were directed to answer additional questions about the location of the pain (at which joint the pain was present), the severity, the causes and consequences and the treatments they had al-

ready tried together with their satisfaction about these treatments.

Statistical analysis

All the data was analysed descriptively. The obtained data were processed in SPSS Statistics 17.0. To indicate an association between thumb pain and the variables, Chi square analyses were performed.

Results

Demographics

The characteristics of the subjects (N.=157) are summarized in Table I. Most of the participants have less than ten years of experience in physical therapy (40%) and slightly more of them are women (54%). Forty-seven percent of the participants are working as a manual therapist and 40% of them are working more than 45 hours a week on average.

Thumb pain

Twenty-seven of the 157 responding physiotherapists (17%) reported that they currently had thumb pain. Moreover 69 (44%) subjects stated that they had thumb pain at one time in their career. Remarkably, 91% of the participants never received any preventative advice about work-related thumb pain during their aca-

TABLE I.—*Characteristics of the subjects (N.=157).*

	All responder Number (%)	Painful thumb Number (%)
Total	157	69
Gender		
Female	85 (54.1)	38 (55.1)
Male	72 (45.9)	31 (44.9)
Age (yr)		
<40	92 (58.6)	41 (59.4)
41-60	56 (35.7)	24 (34.8)
>60	9 (5.7)	4 (5.8)
Years worked as a physiotherapist		
<10	62 (39.5)	28 (40.6)
11-20	38 (24.2)	16 (23.2)
21-30	27 (17.2)	10 (14.5)
>30	30 (19.1)	15 (21.7)
Worked hours a week		
<25	13 (8.3)	5 (7.2)
26-45	82 (52.2)	39 (56.5)
>45	62 (39.5)	25 (36.2)
Current area of practice		
Pediatrics	10 (6.4)	2 (2.9)
Geriatrics	21 (13.4)	7 (10.1)
Manual physiotherapy	74 (47.1)	35 (50.7)
Neurology	9 (5.7)	6 (8.7)
Sport physiotherapy	32 (20.4)	17 (24.6)
Psychomotoricity	5 (3.2)	1 (1.4)
Gynecology/Postnatal physiotherapy	4 (2.5)	1 (1.4)
Other	2 (1.3)	0 (0)
Handposition		
Position A	58 (36.9)	21 (30.4)
Position B	48 (30.6)	25 (36.2)
Position C	17 (10.8)	5 (7.2)
Other	34 (21.7)	18 (26.2)
Prevention advise		
Yes	14 (8.9)	5 (7.2)
No	143 (91.1)	64 (92.8)

TABLE II.—*Influence of thumb pain on working habits.*

	χ^2	P (significant)
Choice of work technique	4.188	=0.041
Hours of working	61.232	<0.001
Numbers of patients treated	61.232	<0.001
Career	65.058	<0.001
Technical execution of treatment	6.391	=0.011

demic curriculum. All the physiotherapists who had ever experienced thumb pain, gave a median of 3 on a Numerical Rating Scale of 10 (NRS). In order to eliminate the recall bias, we have also calculated the NRS-score of the physiotherapists with current thumb pain, which was also 3 on a scale of 10.

Factors that were not significantly related to thumb pain were: gender, age, years of experience working as a physiotherapist, average amount of worked hours in one week and area of practice (*e.g.*, paediatrics, manual therapy). The execution of massage, triggerpoint-therapy and mobilisations on patients were not significant factors provoking thumb pain. Remarkably, there is a trend to significance in sport physiotherapy where 77% of the subjects indicates massage as a cause of work-related thumb pain (χ^2=2.980, P=0.084).

A significant association was found between thumb pain and manipulations (χ^2=29.348, P<0.001) although the respondents did not consider this factor as the cause of their thumb pain. Two third of the respondents who claim that manipulative techniques provoke thumb pain are men.

The therapists could mention extra techniques, which they believe to provoke thumb pain in the questionnaire. Eighteen out of 69 physiotherapists with thumb pain made use of this opportunity. Fifty-six percent of them indicated frictions as a cause of their thumb pain. Therefore frictions are also a cause of work-related thumb pain.

The results (Table II) demonstrate that physiotherapists with thumb pain did not change their working habits: *e.g.*, the choice of work technique or hours they were working. The same results were found for the numbers of patients treated and career (*e.g.*, quitting their job, change of the area of practice). Yet the technical execution of the treatment changed as a result of thumb pain. In this study only one physiotherapist indicated that thumb pain had influence on his career. When the physiotherapist had thumb pain, it was significantly (χ^2=53.319, P<0.001) more frequent at the metacarpophalangeal joint (35%) and the carpometacarpeal joint (23%) than the interphalangeal joint (6%), this is summarized in Table III. There was a significant difference in localisation of the pain between the groups with less than 10 years of work experience and those with more than 30 years of work experience. Both groups experienced mostly pain on one joint, respectively 50% and 64%. However, the group with less experience had more pain on two joints (46%) compared to the older group where most physiotherapists had pain on three joints (21%). As expected, the dominant hand was more affected (46%) than the non-dominant hand (10%) (χ^2=16.783, P<0.001). Here it can be noticed that there was a trend towards significance with more pain on both thumbs in manual physiotherapists (χ^2=5.2, P=0.074).

All therapists, with and without thumb pain, were questioned about the hand position they used (Figure 1). They had to answer which posi-

TABLE III.—*Presentation of pain.*

	Number (%)
Painful joints	
CMC	16 (23.2)
MCP	24 (34.83)
IP	4 (5.8)
MP & CMC	6 (8.8)
IP & CMC	1 (1.4)
IP & MP	12 (17.4)
IP, MP & CMC	5 (7.2)
Missing data	1 (1.4)
Painful thumb	
Dominant hand	32 (46.4)
Non-dominant hand	7 (10.1)
Both hands	30 (43.5)

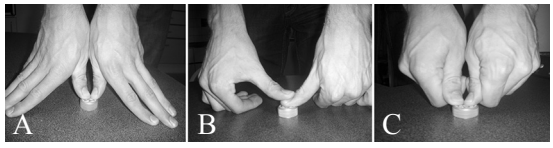

Figure 1.

tion most closely corresponded with their usual hand position. Most therapists (37%) did not support the thumb with their index finger while the MCP joints were touching each other and while the thumbs were not overlapping (Figure 1A). Although there was no significant relationship between the hand position and the presence or absence of thumb pain, there was a tendency towards a difference between the hand positions and the age groups (χ^2=10.958, P=0.090).

In the youngest group "Position B" was the most commonly used technique (38%) in contrast to the therapists aged between 41 an 60 years who particularly used "Position A" and to the therapists older than 60 years who elected "Position C" (33%). In position B, the thumbs are not supported by the index fingers and the thumbs are overlapping in contrast to position C, in which the thumbs are supported and not overlapping. When analyzing the relationships between the used technique and the location of the pain (χ^2=21.720, P=0.416), it becomes clear that "Position A" causes more pain on the CMC joint (33.3%), the MP joint is more painfully in "Position B" (44%) and in "Position C" (40%). The IP joint does not hurt when physiotherapists use "Position C", this may be due to the fact that supporting the thumbs relieves the IP joint.

Treatment

Eighteen of the responding physiotherapists (26%) tried taping and 39% of them were satisfied with the result of this taping. Twelve participants (17%) chose a splint or brace as treatment for their thumb pain and 42% of them were satisfied with that treatment.

The most divergent opinion was on the effectiveness of splinting or bracing, 17% of the physiotherapists were dissatisfied and 8% very satisfied.

Medication (29%), exercises (33%) and rest (58%) turned out to be common treatments. Of these, rest was indicated as the most effective treatment since 23% of the therapists were very satisfied, 40% satisfied and only 5% were not satisfied at all. More than one answer was allowed. These results are summarized in Table IV.

Comparing the group with more than 30 years of work experience, to the group with less than 10 years of experience, we found that the older group (73%) significantly used more medication as a treatment than the group with less experience (27%) (P<0.001). Remarkably we found that one physiotherapist in five of those with thumb pain, never had any treatment for thumb pain.

Discussion

This study demonstrated that 40% of the physiotherapists had thumb pain at the moment they were answering the questionnaire. Similar results were reported in previous research where 41% had current thumb problems and 65% reported having a problem with their thumbs at some point in their life.[6]

The median score of participants with thumb pain was 3 on a scale of 10 for this pain. This is comparable with other researches where values of 30.2/100 [11] and 4.2/10 [13] were reported. We did not include the concept of pain in this

TABLE IV.—*Treatment and satisfaction.*

Numbers (%)	Dissatisfied	Neutral	Satisfied	Very satisfied	Total	% of total with thumb pain
Taping	1 (5.6)	10 (55.6)	7 (38.9)	0	18	26%
Medication	1 (5.0)	8 (40.0)	10 (50)	1 (5.0)	20	29%
Exercises	1 (4.3)	13 (56.5)	7 (30.4)	2 (8.7)	23	33%
Splint or brace	2 (16.7)	4 (33.3)	5 (41.7)	1 (8.3)	12	17%
Rest	2 (5.0)	13 (32.5)	16 (40.0)	9 (22.5)	40	58%
Medical intervention	1 (12.5)	5 (62.5)	1 (12.5)	1 (12.5)	8	12%

study, therefore it is not clear whether the physiotherapists complained about pain, stiffness or fatigue of the thumb.

We did not find a significant relationship between thumb pain and gender and this result is consistent with the study of Wajon A *et al.*[12] Nevertheless some studies did find that gender was a risk factor for developing thumb pain.[2, 6] The finding that thumb pain was not related to age and area of practice is in contrast with the results in the study of McMahon M *et al.*[6] These authors [6] also indicated an association between thumb pain and massage or trigger-point therapy as a cause of the thumb problems which is in contrast to the results of the present study. We did find that frictions provoke thumb pain. Friction was not an answer option in this survey. Therefore we would expect that more physiotherapists would have indicated friction as a cause of thumb pain had this possibility been stated explicitly. Manipulations however did not provoke thumb pain. This study showed a significant relation between manipulation and thumb pain but the physiotherapists indicated that manipulations were not the cause of their thumb pain. Former research focused more on manual techniques in general.[6, 10] In the present study it could not be determined how many hours the physiotherapists needed to perform the manual techniques to develop thumb pain.

Cromie J *et al.*[2] demonstrated that 60% of the therapists who spent 21-25 hours a week performing manipulation or mobilisation techniques had thumb discomfort. Thumb pain also did not have influence on the work-technique, the number of hours worked each week, the number of treated patients and the course of the career. Yet Reglar P *et al.*[9] reported that thumb problems were the cause of changing the way physiotherapists perform a task. In this study, only one therapist acknowledged that his thumb problems had consequences for his career. Cromie J *et al.*[2] found that one out of six physical therapists left the profession or changed setting due to work-related musculoskeletal disorders. Thumb problems also had an influence on the performance of certain techniques. Using other than the most efficient technique may cause a longer rehabilitation time for the patient. This unnecessary longer rehabilitation is associated with higher costs for the patient and society. When physiotherapists had thumb pain this concerned mostly the thumb of the dominant hand. Similar results were demonstrated in the study of McMahon M *et al.*[6] but Wajon A *et al.*[12] did not find an association between thumb pain and hand dominance. The pain was located at the MCP joint (35%) or CMC joint (23%). These results are almost equal to the results of a former study where 47% of the thumbs were painful at the MCP joint and 37% at the trapeziometacarpal joint. In this study, the trapeziometacarpal joint was not considered as a joint of the thumb, therefore this was not a possible answer in the questionnaire. The fact that the CMC joint is a painful joint could be due to the increased mobility at the CMC joint. No difference in mobility at the MCP or IP joint was demonstrated, thus this statement needs further research.[11] Snodgrass SJ *et al.*[11] already did research about the influence of the used hand position and force during mobilising. Based on the results of this study we also investigated the hand position of the physiotherapists. In the former study [11] there was no significant difference between the Pain and Non-Pain group for hand position. Since the correlation in the present study was not statistically significant, we drew the same conclusion. Yet we found an age difference since younger physiotherapists did not support the thumbs with the index fingers and the thumbs were overlapping, while older physiotherapists support their thumbs and did not overlap their thumbs. As younger physiotherapists had more thumb pain, we can assume that overlapping or not supporting the thumbs causes more thumb pain. However this could be explained by the experience of older physiotherapists displaying a learning process. The results also indicate that supporting the thumbs exonerate the IP joint, this could be used as a therapy when the IP joint is painful. A recent study of King P *et al.*[5] concluded that the older workers reported pain in the hands more often than the younger workers. The study also demonstrated that "older workers were no more likely to seek treatments of their symptoms". We did not examine this in our study. A study

of Rozenfeld V. *et al.*[10] showed that 41.7% visited a fellow therapist or that they treated themselves when they had thumb pain. In the study of Wajon A *et al.*[12] this was only 6%. In the same study 29% tried a splint or tape as a treatment. In the present study only 17% tried a splint or brace. Twenty-six percent tried taping, which is almost equal (32%) to the findings in a study of McMahon M *et al.*[6] In that study, only 15% sought a solution in medication, in our study this was 29%. The results may not be comparable because it is not known if, in the former studies, the possibility for more answer options existed. A recent study of Walsh T *et al.*[14] concluded that taping had an effect on the perception of stability of the thumb. Also a decrease in deviation from extension in one of more joints of the thumb were attained. Using a tape did not had an effect on the force produced during mobilisation. A comment about the former studies: they did not investigate the satisfaction levels with different treatments which is important for the interpretation. It cannot be assumed that when many people have tried a treatment then it automatically becomes the best treatment. We have taken into account this issue in the current study.

Limitations of the study

A limitation of this study is that we did not investigate how long the physiotherapists had to rest in order to treat their thumb pain. This could vary for example from one week up to three months and it is important in order to assess the efficiency of this treatment.

The fact that 91% of the participants never got prevention advice about thumb pain shows that this is an underestimated disorder. In the future, prevention advice should be included in the education of future therapists. Simultaneously, attention can also be given to other work-related disorders in physiotherapists, for example low back pain, upper back pain and neck pain. These have already been the topics of former studies [1, 2, 3, 5, 10] and also have a high prevalence in physiotherapy.

The preventive measures that could be concluded from this study are rather limited. However some guidelines could be deduced. As the dominant hand shows more often thumb pain, it is advisable to relieve this thumb by, for example, using both thumbs for frictions and massages. This study showed that younger physiotherapist had more thumb pain and used a different technique then their older colleagues. Therefore, their work technique is inadvisable and it would be better to support the thumbs with the index fingers and not to overlap the thumbs.

A sample size of 157 was acceptable. Although exact figures did not exist because the questionnaire was sent indirectly to the physiotherapists, the low response rate was disappointing. Even so the proportional distribution between male and female in the Pain group (38 females and 31 males) is similar to that in the Non-Pain group (47 females and 41 males). The fact that both groups are almost equal, excludes gender-related selection-bias since the questionnaire was also completed by physiotherapists without thumb pain. Using a questionnaire was a good method to collect data of a large group in a short period.

A disadvantage of the use of multiple choice questions is that, although the possibility existed in some questions, the physiotherapists were not stimulated to think about other response options.

Also self-reported data could contain inaccuracies due to recall bias. A longitudinal design starting with young physiotherapists could partly resolve this problem.

Conclusions

Physiotherapists working in Vlaams-Brabant demonstrated work-related thumb pain as shown for other physiotherapy populations. Especially when they performed frictions or massages. Work-related thumb problems in physiotherapy had a prevalence of 44%, which is very high. This underestimated impairment should not be ignored and good treatment is necessary to help these physiotherapists. The main adaptation to thumb problems is change in execution of techniques. When we had to describe the optimum therapy, taking into consideration the

number of therapists who tried the treatment and the satisfaction about the treatment, rest would be the best therapy. Secondly medication showed to be a good therapy and also taping or bracing was efficient in some therapists.

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APPENDIX 1

Survey on work-related thumb pain among physiotherapists in Vlaams-Brabant

1. In which province do you work?

— Vlaams-Brabant
— West-Vlaanderen
— Antwerpen
— Limburg
— Other:……..

2. What is your gender?

— Female
— Male

3. How many years of work-experience do you have?

— 0-5 years
— 6-10 years
— 11-15 years
— 16-20 years
— 21-25 years
— 26-30 years
— >30 years

4. Within what age group do you belong?

— < 30 years
— 31-40 years
— 41-50 years
— 51-60 years
— >60 years

5. How many hours in a week do you work as a physiotherapist?

— <15 hours
— 16-25 hours
— 26-35 hours
— 36-45 hours
— >45 hours

6. Within which field of physiotherapy are you most active? (Only 1 answer possible)

— Paediatrics
— Geriatrics
— Manual physiotherapy
— Neurology
— Sport physiotherapy
— Psychomotricity
— Gynecology/Postnatal physiotherapy
— Other:……

7. Which of the following comes closest to your hand position, used while treating your patients? (Only 1 answer possible)

A **B** **C**

— A: Thumbs not supported by index fingers, MCP joints are touching, thumbs are not overlapping

— B: Thumbs not supported by index fingers, MCP joints are not touching, thumbs are overlapping

— C: Thumbs supported by index fingers, MCP joints are touching, thumbs are not overlapping

— Other: ……..

8. Do you have a rheumatic disease?

— Yes
— No

9. Do you have in the past, surgery of the forearm or wrist?

— Yes
— No

10. Do you feel you have received adequate preventive information regarding work-related thumb pain?

— Yes
— No

11. Have you ever had thumb pain due to work-related activities?

— Yes
— No

TO BE COMPLETED ONLY IF YOU HAVE SUFFERED FROM THUMB PAIN

*12. Do you suffer **now** from work-related thumb pain?*

— Yes
— No

13. What score do you give yourself for thumb pain on a scale of 0 to 10 where 0 is no pain and 10 is extreme pain?

— Score= /10

14. Which thumb is hurting?

— The thumb of the dominant hand
— The thumb of the non-dominant hand
— Both thumbs

15. Which joint(s) is/are hurting?

— IP, MP and CMC joints
— IP and MP joints
— IP and CMC joints
— MP and CMC joints
— IP joint
— MP joint
— CMC joint

16. Symptoms are provoked or aggravated by…. (multiple answers possible)

— Massage
— Manipulations
— Trigger point therapy
— Mobilisations
— Other:……

17. What are the consequences of your thumb pain? (multiple answers possible)

— Changing of implementation of treatment techniques
— Changing in choice of treatment techniques
— Reduction in the working hours
— Reduction in the number of patients being treated
— Career change
— Other:……

18. Which treatment have you already tried?

— Taping
— Medication
— Stabilisation exercises
— Splint/brace
— Rest
— Medical intervention (Operation, Corticoïden injection,…)
— Other:…….

19. Are you satisfied with your already undertaken treatment(s)?

	Very satisfied	Satisfied	Neutral	Dissatisfied
Taping				
Medication				
Stabilisation excercices				
Splint/Brace				
Rest				
Medical intervention				

ORIGINAL ARTICLE

Reported fatigue in people after Guillain-Barré Syndrome: a retrospective national survey in the UK

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ABSTRACT

Aim. Despite continuing functional recovery over time, fatigue remains a persistent feature of post-acute Guillain-Barré Syndrome (GBS). The aim of this study was to determine the prevalence of fatigue in people after GBS and investigate its associations with other factors after GBS.

Methods. Validated questionnaires including the SF-36 and fatigue severity scale were sent to members of the GBS support group, a UK wide patient and carer organisation.

Results. A total of 884 questionnaires were returned (58% response rate). Respondents' answers demonstrated that those with severe fatigue following GBS had spent longer in hospital than those who were not severely fatigued (P=0.003). Poorer mental health was also associated with more severe fatigue. A strong predictor of prolonged fatigue was discharge from hospital in a wheelchair (OR=2.37, 95% CI 1.52 to 3.71, P<0.001) but the severity of fatigue appeared to be independent of recovery of mobility (Kendall's tau_b=0.03, P=0.2).

Conclusion. This survey is the largest study of fatigue in people after GBS. Its findings demonstrate that fatigue remains a persistent problem for many people after GBS. More severe fatigue was associated with decreased health related quality of life and increased levels of depression and anxiety in people after GBS. Whilst the severity of fatigue was significantly associated with poorer mobility on discharge, there was no association between the recovery of mobility after discharge and fatigue severity. This indicates that whilst other impairments and activity limitations improved over time, fatigue did not and implies that more severe fatigue is not simply an indicator of a more severe presentation of GBS. Whilst the reasons for persistent severe fatigue remain unclear, this study indicates that further investigations of mobility, mental health and fatigue are warranted so that targeted interventions can be put in place to manage this debilitating complication. *(It J Physiotherapy 2013;3:154-60)*

Key words: Guillain-Barré Syndrome - Rehabilitation - Fatigue - Mobility.

Guillain-Barré Syndrome (GBS) is an inflammatory peripheral neuropathy affecting 1-2 people per 100,000.[1] In addition to symptoms of weakness, sensory alterations and pain, increased persistent feelings of fatigue are reported to affect up to 80% of people after GBS and which may remain even when other symptoms have improved or disappeared.[2] The severity of experienced fatigue is more common in women and those over 50 but appears independent of both the subtype of GBS and antecedent infection.[3] Nonetheless, severe feelings of fatigue have a considerable impact upon psychosocial and physical functioning and contribute to persistent activity limitations.[4, 5] However, the factors precipitating severe fatigue in people after GBS are unclear.[6, 7] This study aimed to describe the prevalence of feelings of fatigue and identify pos-

sible contributors to the severity of the feelings by undertaking a survey of people after GBS who were members of the GBS Support Group (GBSSG) in the United Kingdom.

Materials and methods

A questionnaire based survey design was utilised. Questionnaires (detailed below) were posted to 1535 members of the GBSSG in January 2007. Only those members with a confirmed diagnosis of GBS were asked to complete the questionnaires and a covering letter asked that those with chronic inflammatory demyelinating polyneuropathy (CIDP) or other forms of peripheral neuropathy should not answer the questionnaire as there was no way of screening out these members. The questionnaires asked for general information (age, gender, time since diagnosis, duration of inpatient stay, mobility on discharge), perceived physical condition (F-Score) [8] at worst and currently, current health related quality of life (Medical Outcomes Short form 36 questionnaire, SF36),[9] current mobility, anxiety and depression (Hospital Anxiety and Depression Scale, HADS) [10] and current feelings of fatigue (Fatigue Severity Scale, FSS).[11]

Once distributed, the investigators had no further direct contact with the volunteers but a notice was placed on the Group's website after six months encouraging suitable members to participate if they had not already so. Data were collected over a one year period.

Ethical approval was granted by the University of Manchester Ethics Committee.

Data analysis

Data were initially analysed to determine respondents with or without severe fatigue using the mean scores on the FSS; if respondents' mean score on the FSS was 5 or over they were considered to demonstrate severe feelings of fatigue.[12] Demographic and clinical characteristics were then analysed according to whether or not the respondent reported severe fatigue. Categorical variables were summarised using numbers and percentages and compared by group using Pearson's chi-square test. Ordinal and interval/ratio variables were summarised using medians and ranges and compared by group (severe fatigue or not severe fatigue) using Mann-Whitney tests. Level of mobility at discharge and at the time of the survey was determined from the F-score and ranked in terms of the degree to which respondents required support for ambulation: walking independently; using walking aids [stick(s), crutch(es) or frame]; self-propelled in a wheelchair; pushed in a wheelchair.

The association between variables and the FSS score was estimated using Kendall's tau_b correlation which avoids the introduction of a potential artefact when a continuous variable (*e.g.*, the FSS score) is dichotomised.[13]

The association between key predictor variables adjusted for age and gender and whether or not the respondent was currently severely fatigued was estimated using logistic regression; that between key variables and the FSS score was estimated using multiple linear regression. All analysis was undertaken using SPSS Release 15. Residuals from multiple regressions were skewed, so the analysis was repeated using a transformation of FSS scores. However, the same results were obtained and for ease of interpretation, the results for untransformed FSS score are presented here.

Results

The response rate was 58% (N.=884) over the 12 month data collection period. Of the 884 responses, 703 questionnaires were complete for the data of interest and were analysed (Table I).

Three hundred and ninety eight (56.6%) respondents reported severe feelings of fatigue (mean FSS ≥5.0). These respondents had significantly worse scores on all SF-36 subscales, HADS anxiety and depression and current F-score (P<0.001; Table II). Poorer SF36 subscale scores also correlated significantly with worsened FSS scores.

Respondents with severe fatigue had experienced a significantly longer inpatient stay (median 70 days v 49 days, P=0.003). However, adjusted for age, gender and mobility on discharge, duration of inpatient stay was not significantly

Table I.—*Demographic and mobility characteristics in severely fatigued and not severely fatigued respondents.*

Characteristic	Severely fatigued [1] (N.=398)	Not severely fatigued (N.=305)	Difference between severely fatigued and not severely fatigued	Association with FSS [2] score	
	Median (range)	Median (range)	P	Kendall's tau_b	P
Age (years)	66 (22 to 96)	65 (19 to 87)	0.350	0.03	0.224
Time since diagnosis (years)	6.3 (0.2 to 51.4)	7.2 (0.1 to 58.0)	0.361	-0.01	0.816
Duration of inpatient stay (days)	70 (2 to 820)	49 (2 to 1277)	**0.003**	0.08	**0.005**
	N (%)	N (%)			
Female	206 (51.8)	149 (48.4)	0.373	0.03	0.411
Mobility on discharge			**<0.001**		
Walking without aids	47 (12.0)	53 (17.5)	**0.040**	-0.10	**0.002**
Walking with aids	202 (51.7)	168 (55.6)	0.299	-0.01	0.677
Self-propelled/powered wheelchair	34 (8.7)	34 (11.3)	0.261	-0.01	0.646
Pushed in wheelchair	102 (26.1)	36 (11.9)	**<0.001**	0.14	**<0.001**
Other	6 (1.5)	11 (3.6)	0.075	-0.07	**0.022**

[1] FSS ≥5, [2] FSS: Fatigue Severity Scale.

Table II.—*Anxiety, depression and function in severely fatigued and not severely fatigued respondents.*

Characteristic	Severely fatigued [1] (n=398)	Not severely fatigued (n=305)	Difference between severely fatigued and not severely fatigued	Association with FSS[2] score	
	Median (range)	Median (range)	p	Kendall's tau_b	P
HADS [3] Anxiety	8 (0 to 21)	4 (0 to 18)	**<0.001**	0.24	**<0.001**
HADS Depression	7 (0 to 21)	2 (0 to 20)	**<0.001**	0.43	**<0.001**
F-score [4] at worst	5 (1 to 6)	5 (1 to 6)	0.247	0.02	0.596
Current F-score	3 (1 to 5)	2 (1 to 5)	**<0.001**	0.37	**<0.001**

[1] FSS ≥5, [2] FSS: Fatigue Severity Scale, [3] HADS: Hospital Anxiety and Depression Scale, [4] F-score: perceived physical condition.

associated with being severely fatigued (Odds Ratio, OR=1.00, 95% Confidence Interval, CI: 0.999 to 1.001, P=0.89) or the FSS score (B=0.00, 95% CI -0.001 to 0.001, P=0.76).

The F score at nadir was not significantly different for gender, age or the time since diagnosis. However, mobility at discharge from hospital was significantly poorer in respondents who reported severe fatigue (Table I) and severely fatigued respondents appeared more dependent at discharge. There was a significant improvement in mobility level from discharge to the point of the survey (P<0.001; N.=453 improved, N.=91 declined from discharge). Although there was a significant association between greater fatigue and poorer mobility on discharge (Table I), the change in the level of mobility from discharge to the respondents' current mobility was not significantly associated with their severity of fatigue (Kendall's tau_b=0.03, P=0.2).

The regression analyses (Table III) showed that being pushed in a wheelchair at discharge was the only mobility category significantly associated with being severely fatigued (OR=2.37, 95% CI 1.52 to 3.71, P<0.001) and it was positively and moderately associated with a higher FSS score (B=-0.55, 95% CI 0.21 to 0.89, P=0.001). Walking without aids at discharge was significantly associated with lower fatigue levels (FSS scores, B=-0.57, 95% CI -0.96 to -0.19, P=0.004).

Discussion

Feelings of fatigue are common in people after GBS.[14] This study is the largest survey of feelings of fatigue in people after GBS and provides im-

Table III.—*Adjusted associations between key predictors and being severely fatigued and Fatigue Severity Scale (FSS) score (N.=645).*

Predictor	Being severely fatigued [1] using logistic regression [2]			FSS score using linear regression [3]		
	Odds ratio	95% CI	P	B	95% CI	P
Age	1.01	0.99 to 1.02	0.384	0.01	-0.002 to 0.02	0.138
Female	1.23	0.90 to 1.70	0.197	0.14	-0.12 to 0.39	0.305
Duration of inpatient stay (days)	1.00	0.99 to 1.01	0.886	0.000	-0.001 to 0.001	0.755
Walking without aids at discharge	0.74	0.46 to 1.18	0.210	-0.57	-0.96 to -0.19	**0.004**
Self-propelled/powered wheelchair at discharge	0.86	0.48 to 1.55	0.620	0.09	-0.40 to 0.57	0.727
Pushed in wheelchair at discharge	2.37	1.52 to 3.71	**<0.001**	0.55	0.21 to 0.89	**0.001**
Other mobility at discharge	0.49	0.16 to 1.52	0.218	-0.74	-1.63 to 0.16	0.105

[1] FSS ≥5, [2] model χ^2=27.20; df: 7, P<0.001; Nagelkerke R^2=0.06, [3] ANOVA F=4.74, df=7 and 637, P<0.001; adjusted R^2=0.04.

portant indications of the nature and prevalence of fatigue many years after nadir.

The response rate of the survey was moderate (58%) and was similar to a postal survey of fatigue conducted in Norway (60% [7]). All members of the GBSSG were sent the survey but members with other conditions, such as CIDP, or members who were a relative of someone with GBS were asked not to complete the questionnaire, reducing the response rate. As such, the response rate of 58% should be considered as a conservative estimate. The proportion of those in the group with CIPD and other associated conditions is unknown as such the true rate of response is likely to have been much higher than 58%.

This study found that severe fatigue was present in over half of all respondents (57%; N.=398). This indicates that fatigue is a persistent symptom of GBS and agrees with the findings of others. However, levels in the current study were somewhat lower than a survey from the Netherlands (80% of 113 patients, 83 with GBS) [15] but higher than the proportion of patients reporting severe fatigue in a similar survey in a smaller sample in Norway (38% of 50 patients).[7] Two recent studies which examined the presence of severe fatigue many years after GBS reported slightly lower levels of severe fatigue (42% and 35% of 24 and 29 patients respectively), although their samples were much smaller than the current study which may account for this difference.[16]

Respondents were an average over six years after nadir which indicates that fatigue continues to be a significant problem for people many years after the onset of GBS. However, the relatively long time since nadir challenges the accuracy of the recall of symptoms. The results of this study are also limited as some respondents could have been more motivated to complete and return the questionnaire if they felt that they had not fully recovered, which may have inevitably biased the sample.

The findings demonstrated that respondents with severe fatigue had poorer health related quality of life. This finding is supported by others who have reported that greater fatigue was significantly associated with poorer functioning and quality of life in people with peripheral neuropathy.[6, 17] However, the severity of fatigue was not significantly associated with age or gender which contradicts the findings from one study of 100 people that found fatigue was significantly more severe in women and those over 50 years.[17]

As shown in Table II, scores of anxiety and depression were still within or just above normal levels in the current study [10] but respondents with more severe fatigue demonstrated higher levels of anxiety and depression when compared to those with little or no fatigue. This is a novel finding as others have reported few differences in anxiety and depression between people with and without severe fatigue after GBS.[7, 17] Furthermore, anti-depressant medication has shown little benefit on fatigue in people after GBS, suggesting that mood and fatigue are unconnected.[18] However, the current study could not determine if a greater severity of fatigue is symptomatic of poorer mood or if

increased anxiety and depression occurred secondary to greater feelings of fatigue. It is also possible that the tools used to measure mood had items which could also represent fatigue or the physical symptoms of GBS (*e.g.*, "I feel as if I am slowed down") which could have artificially increased scores and associations with the FSS. Future work could utilise tools that do not include physical symptoms of mood in order to reduce this potential limitation.

Mobility at discharge was strongly associated with current levels of fatigue, despite many respondents being many years after the onset of their illness. This initially suggested that worsened fatigue was an indicator of a more severe condition, and as the patient recovered, the severity of fatigue would also improve. However, whilst mobility had significantly improved since discharge (N.=453 improved, N.=91 declined, median mobility at discharge: 3.5, median mobility at time of survey: 1, P<0.001) implying significant recovery of impairments and activity limitations, the current levels of fatigue were not associated with this change. This finding indicates the severity of fatigue cannot be assumed to change alongside other symptoms after GBS and that severe fatigue may be present despite relatively good recovery of other impairments. However, others have argued that greater feelings of fatigue are simply another symptom of a worsened condition,[7] contradicting the findings of the current study. Rekand *et al.* (2009) also reported that people after GBS with severe fatigue had a two-fold risk of having significant muscle weakness, suggesting that greater fatigue was directly associated with a more severe presentation of GBS and/or incomplete recovery. Conversely, others have found that the level of fatigue was not linked to the severity of GBS at nadir or the course of recovery in 100 people at least one year after the onset of GBS.[17] Similarly, there were no associations between fatigue severity and nerve conduction velocity distributions in 13 "neurologically well recovered" participants one year after GBS and 2 people with CIDP, implying that the severity of fatigue was independent of neurological and other impairments.[19]

One potential explanation for this finding is that people who were most limited in their mobility at discharge are likely to have taken longer to become more mobile and increase their independence. In turn, this longer duration of recovery may have meant that, over time, some respondents became less motivated to return to their pre-morbid hobbies and occupations or no longer had access to rehabilitation services and support to enable them to return to activities such as sport. Indeed, people several years after the nadir of GBS are recognised to have difficulty returning to sports [20] and employment [21] despite substantial clinical recovery. In the current study, despite becoming ambulant over time and returning to some activities, some respondents could have undergone cardiovascular de-conditioning. A reduction in daily activities brought about by the physical sequelae of GBS and/or by feelings of severe fatigue could elicit considerable de-conditioning so that even simple activities are perceived as effortful, tiring and increase the severity of fatigue. Conversely, it is equally possible that severe feelings of fatigue reduced participation and activity in some respondents, which would also result in reduced cardiovascular fitness.[22] The link between fitness and fatigue is unclear but others have found significantly reduced feelings of fatigue in people several years after the nadir of GBS after their participation in an exercise programme, suggesting there is some association.[23-25] The finding of the present study suggests that poorer mobility at discharge increased the likelihood of developing more severe fatigue, despite recovery of mobility. This highlights that people who are discharged from hospital using a wheelchair after GBS could benefit from further targeted and possibly prolonged interventions. Further research is warranted to determine if a greater duration of, and/or more intensive rehabilitation, could decrease the severity of fatigue in people who are less mobile after GBS.

However, it is acknowledged that there are many reasons that influence the duration of inpatient stay, in addition to the level of physical functioning. Social, personal and psychological factors such as the desire for patients to return to their family and loved ones, social circumstances or simply pressure on hospital beds which pre-

cipitates discharge of patients for whom little more can be offered other than continued therapy (which can be conducted in the community) and natural recovery are all likely to influence discharge planning. However, it is clear that discharge is likely to precipitate a reduction in the amount of therapy offered to patients [26] which could slow functional recovery. Future work could seek to identify factors that influence the timing of hospital discharge for people after GBS and investigate the provision of rehabilitation services for this patient group.

Conclusions

This is the largest study of fatigue in people after GBS. Although tempered by the effect of recall and the self-selected sample, the findings show that people with more severe levels of fatigue have greater levels of anxiety and depression and poorer quality of life. They also show that severe fatigue several years after nadir may be associated with the level of mobility at discharge. However, whilst mobility significantly improved over time, the severity of fatigue was not associated with this improvement, suggesting that other factors may influence fatigue and that greater fatigue is not simply an indicator of a more severe disease course. Further work is now needed to investigate other factors that may contribute to severe fatigue including cardiovascular fitness and mental health and to devise targeted rehabilitation programmes to manage fatigue in people after GBS. However, the results of this study indicate that persistent fatigue is a problem for many people several years after nadir and suggest that longer follow up and monitoring of fatigue could be indicated particularly for those who have the greatest limitations in mobility on discharge from inpatient care.

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REVIEW

Virtual reality for improving balance in stroke patients: systematic review and meta-analysis

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ABSTRACT

Recovery of balance is one of the most important goals in rehabilitation of motor disability after stroke. The use of virtual reality (VR) in this field is inserted in the rehabilitation programs as an emerging approach that comes from technological development. The objective of this systematic review is to describe the effectiveness of VR for the recovery of balance in subjects who experienced a stroke, compared to conventional therapies. The research was performed in PubMed, Embase, PEDro, Cinahl and The Cochrane Library (last search July 2013). Randomized controlled trials (RCTs) that analyzed efficacy of VR for recovery of balance in stroke patients were retrieved. The validity of the included studies was assessed using the Cochrane Collaboration tool for evaluating risk of bias. Three RCTs were eligible. The total sample included 60 patients. The pooled treatment effect on equilibrium measured with the Berg balance scale was 1.61 points (95% 0.56 to 2.66; I2=54%) in patients at 12 months to stroke onset, and 5.17 points (95% interval confidence 3.86 to 6.48; I2=not applicable) for patients 24 months after stroke. VR-based exercises improve equilibrium after stroke in particular in chronic patients. Adequately powered randomized trials are needed before making conclusions that might influence clinical practice. *(It J Physiotherapy 2013;3:161-9)*

KEY WORDS: Stroke - Virtual reality exposure therapy - Postural balance.

Among stroke survivors 55% to 75% continue to experience motor deficits associated to reduced quality of life.[1, 2] Balance control is one of the most studied issues in stroke rehabilitation. The loss of balance in the majority of cases results in falls and consequently in severe injuries. In order to prevent this and to enable these subjects to participate to social and working activities, great efforts are directed towards recovery of functional and balance abilities,[3] especially in early stages from stroke onset.

The training has to be both task-oriented and with proper repetition intensity.[4] The latter showed to be effective in many aspects of neurorehabilitation.[5] Virtual reality (VR) is a relatively recent approach that may enable simulated practice of functional tasks at a higher dosage than traditional therapies.[6, 7]

VR programs attempt to simulate real-world activities which may provide more interesting tasks when compared to conventional therapies, often based only on the automatic repetition of specific movements.These ecourage higher dose of treatment [8, 9] and promote a better learning through an immediate feedback on a performed task previously modelled on patients abilities.[10] VR is generally referred to all techniques able to induce sensory experimentation of places and objects through the interaction between humans and informatic technologies.[11] It is defined as the "use of interactive simulations created with computer hardware and software to present

Table I.—*Characteristics of the participants.*

Study	Sample size			Age	Stroke Details				Main inclusion criteria
	Total	Virtual reality	Control	Mean (range)	Timing post stroke	% Female	% Ischemic	% Right side affected	
Cho 2012 *et al.*[26]	24	12	12	64 (48-81)	<12 months	36	60	81	Independent walk
Cho 2013 *et al.*[27]	14	7	7	64.8 (56-75)	<12 months	50	64	57	1 to 4 Brunnstrom lower extremity score
Kim 2009 *et al.*[28]	24	12	12	52 (36-69)	≥ 24 months	41	41	46	Independent walk

"Age" expressed in years; NR: not reported; %values rapresent proportion of patients on the total sample size.

users with opportunities to engage in environments that appear and feel similar to real-world objects and events".[12, 13] In fact, key features of all VR applications are the sense of "presence in", and "control over", the simulated environment.[14] The "presence in" is defined as the feeling of being in an environment even if one is not physically present while the "control over" is the resulting behaviour of interaction with the environment and objects.[15] These two aspects make VR different from other forms of visual imaging such as video and television.

Previous systematic reviews including both observational studies and randomised controlled trials reported a positive effect and a wide application of VR on upper limb function [16] and lower limb rehabilitation.[10] A Cochrane systematic review and meta-analysis [17] focusing on upper limb function concluded that VR is a promising new rehabilitation approach for stroke recovery. But it also stated that there was insufficient evidence to draw conclusions. More in detail there were no statistically significant effects for functions related to lower extremities such as gait speed.

This review adds information about the use of VR in clinical setting through the exploration of its effects for improving balance that is related to lower limb recovery.

Although there is a growing interest in this approach since the first studies were published and also a consistent number of interactive gaming consoles are available and used in rehabilitation units,[18-20] VR programs designed specifically for rehabilitation purposes are difficult to access and thus rare in clinical settings. The development of a body of evidence in favour of VR for patient's recovery and return to activities may help the diffusion of this therapy in clinical contexts.

The aim of this work was to systematically review published articles about the efficacy of VR technologies versus usual care in subjects presenting motor limitations following stroke and to determine its effectiveness for balance recovery.

Methods

Types of studies

Randomised controlled trials testing VR based exercise programs aiming to the rehabilitation of adult subjects with motor deficits impairing balance after stroke were included. Trials that evaluated any intensity and duration of VR that exceeded a single treatment session were considered. Studies that compared two different types of VR without an alternative group were not included.

Types of participants

Participants were adult subjects (over 18 years) with a clinical diagnosis of stroke (World Health Organization definition)[21] either ischaemic or haemorrhagic (confirmation of the clinical diagnosis using imaging was not compulsory).Trials including participants with underlying rheumatological, cardiovascular or congenital conditions affecting the lower limbs were excluded from the review. (Table I).

Table II.—Intervention details and reported outcomes.

		Cho 2012 *et al.*[26]	Cho 2013 *et al.*[27]	Kim 2009 *et al.*[28]
Intervention Details	VR training	VR on weight shift and step + CPT	VR walking + CPT	VR on weight shift and step +CPT
	Control therapy	CPT	Treadmill + CPT	CPT
	Treatment duration	0,5h/day, 3 times per week, 6 weeks	0,5h/day, 3 times per week, 6 weeks	0,5h/day, 4 times per week, 4 weeks
	VR support	Nintendo Wii	Video records	IREX-VR
Reported outcomes	Balance	BBS, TUG	BBS, TUG	BBS
	Velocity			10-m Walking Test
	Kinematics	Postural Sway - Platform Metitur Ltd.	Gait Parameters - GAITRite	Postural Sway Velocity - GAITRite
	Follow-up	End of treatment=6 weeks	End of treatment=6 weeks	End of treatment=4 weeks

CPT: conventional physical therapy, including strength exercises, occupational therapy, elecrical stimulation, equilibrium exercises; BBS: Berg Balance Scale; TUG: Time Up and Go.

Types of interventions

Studies included used VR interventions that met the definition of Weiss *et al.*:[12] "use of interactive simulations created with computer hardware and software to present users with opportunities to engage in environments that appear and feel similar to real-world objects and events". Randomized trials comparing VR-based intervention *versus* a different one were included. The VR-based intervention consisted either in a single type of exercise (*e.g.*, move in a virtually reproduced setting) or in a combination of different types of exercise including VR-based rehabilitation programs. The intervention could be provided alone to the intervention group, unsupervised with instructional handouts after initial training, or individually supervised or provided as part of a supervised group (Table II).

Types of outcome measures

The considered outcome measure is balance (it was assessed at the end of treatment using functional scales, *e.g.*, The Berg Balance Scale).[22]

Search methods for identification of studies

Computer based searches

The Cochrane Central Register of Controlled Trials (The Cochrane Library), PubMed (from 1950), Embase (from 1980), Cinahl (from 1982) and PEDro (from 1929) databases were searched on July 2013.

A modified sensitivity-maximizing version of the Cochrane Highly Sensitive Search Strategy for identifying randomised trials [23] was combined with the subject-specific search. The search strategy applied for PubMed is shown in Appendix 1 and it was adapted also for other databases.

Only papers written in English were included.

Other resources searching

Reference lists of included studies and other potentially relevant articles were manually checked for additional trials; however the hand search did not detect additional eligible trials.

Data collection and analysis

Selection of studies

Two review authors (LM and DC) independently assessed title, abstracts and full-text for the identification of potential relevant studies from the results of computer-based search. The full text was then assessed considering the inclusion criteria. Disagreements were solved by consensus.

Data extraction and management

For each included study, two review authors (LM and DC) independently extracted the data using a piloted standardised data collection form.

Assessment of risk of bias in included studies

The risk of bias of the included studies was independently assessed by two review authors (LM and DC) using the Cochrane Collaboration's "Risk of bias" tool.[24] The following topics were assessed: description of randomisation, allocation concealment, blinding (only of the outcome assessors) and completeness of outcome data.

Measures of treatment effect

When two or more studies presented their data derived from the same instrument of evaluation (with the same units of measurement), data were pooled as a mean difference (MD) with 95% confidence intervals. Change scores and their relative standard deviations were used for computing pooled effect sizes.

Dealing with missing data

Unreported measures of variability necessary for meta-analyses were estimated through the use of reported variances with an appropriate correction as suggested in the Cochrane handbook for conduction of systematic reviews.[24]

Assessment of heterogeneity

Heterogeneity was assessed by visual inspection of the forest plot and consideration of the I^2 statistic in conjunction with the χ^2 test.[24]

Data synthesis

As clinically heterogeneous trials were pooled, heterogeneity was assessed by visual inspection of the forest plot. The I^2 statistic level greater than 50% was considered as indicator of substantial heterogeneity [24] and consequently the random-effects model was used.

Subgroup analysis and investigation of heterogeneity

Subgroup analyses were performed to determine whether outcomes varied according to time since onset of stroke (less or more than one year) and to intensity of intervention (total time of treatment).

To investigate whether the results of subgroups were significantly different, the test for subgroup differences available in RevMan [25] was performed.

Results

A total of three studies were finally identified for inclusion in the review.[26-28] The database searches are detailed in Figure 1. Unpublished studies were not included. The search of electronic databases provided a total of 264 citations. Of these, 179 were discarded after duplicates removal and after reviewing titles and abstracts, as it appeared that these papers did not meet the criteria. The full text of 23 citations was examined in detail. It appeared that 20 studies did not meet the inclusion criteria as described, mainly because patients randomisation was not performed or because the interventions were not addressed to answer the main question of the review.[29-34] Three studies met the inclusion criteria and were included in the systematic review.

Characteristics of included studies

All included studies took place in Republic of Korea. There were not multicentre studies.

They included 60 participants (30 to VR-training and 30 receiving conventional physical therapy). The main inclusion criteria for the majority of studies were the ability to walk independently, at least 6 months after stroke for two studies [26, 27] and more than one year for one study,[28] (even if it included patients with a mean of two years after stroke onset) and absence of cognitive impairments or musculoskeletal disorders that could potentially interfere with experimental tests.

The VR interface used were the Gesture Tek's Interactive Rehabilitation and Exercise System,[28] Nintendo Wii Fit balance board [26] and a real-world video projection during walking.[27]

In all studies there were an experimental group that executed movements in VR condition and a control group that executed standard exercises. In particular in the study of Kim *et al.*[28] patients

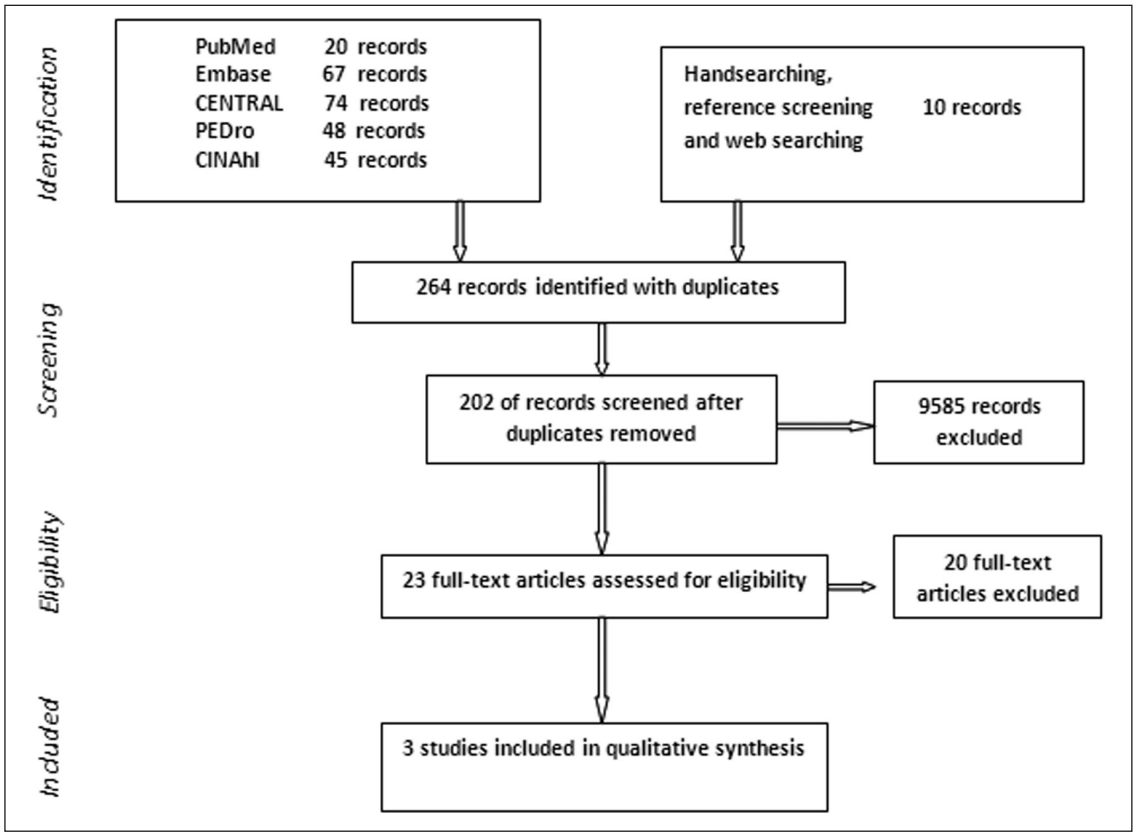

Figure 1.—Flow of trials for review inclusion.

Table III.—*Methodological quality of included studies.*

Study	Sequence Generation	Allocation concealment	Blinding of Assessors	Withdrawals	Reasons for Withdrawals	Analysis
Cho 2012 *et al.*[26]	LR	Unclear	Unclear	8%	Yes	P
Cho 2013 *et al.*[27]	LR	LR	LR	12%	Yes	P
Kim 2009 *et al.*[28]	LR	LR	LR	0%	-	P

LR: low risk; HR: high risk; Unclear: unclear risk of bias; P: analysis conducted per-protocol.

underwent conventional physical therapy for 40 minutes a day, 4 days a week for a total duration of treatment of 4 weeks. The experimental group received a 30 minutes of virtual reality in addition to conventional physical therapy.[28] Patients in the studies of Cho [26, 27] participated to the same standard rehabilitation program 5 times weekly for 6 weeks, where experimental groups underwent an additional 30 minutes of virtual reality balance training, 3 times weekly for 6 weeks [26] and 30 minutes of virtual reality walk training 3 times weekly for 6 weeks. Control group participated in treadmill gait training for 30 minutes a day, three times a week, for 6 weeks.[27]

All studies assessed balance through the Berg Balance Scale.[22] Other scales used were the Time Up and Go test [35] in studies of Cho *et al.*[26, 27] Patients in all studies were assessed at the end of treatment, no further follow-up measures were taken.

Risk of bias within studies

On average the quality of trials was good. All studies reported description of randomisation

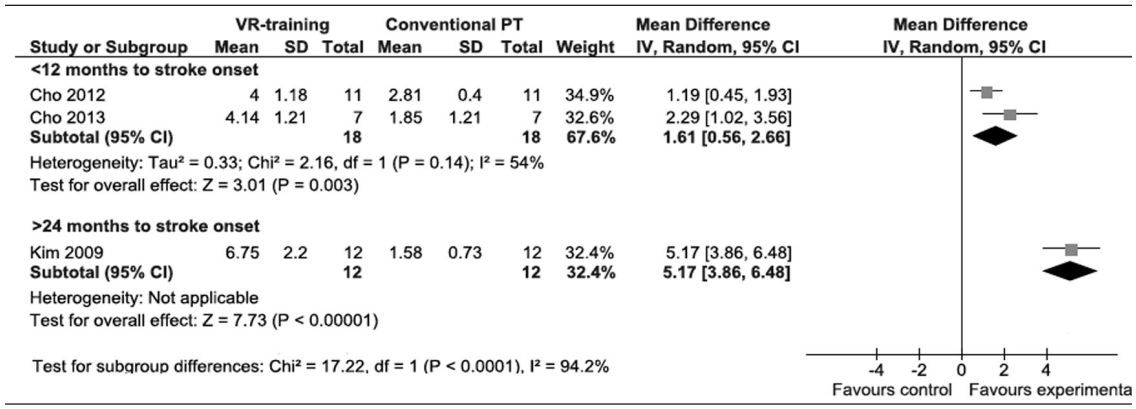

Figure 2.—Meta-analysis for balance.

processes [26-28] but one did not clearly attempt to blind the data collector for clinical measures.[26] Two studies [26,27] reported withdrawals providing reasons. All trials treated data with a per-protocol analysis (Table III).

Quantitative data synthesis

All studies reported a balance assessment comparison before training versus after training. In these three studies [26-28] the experimental groups improved Berg Balance Scale scores compared to the controls. Three trials with a total of 60 participants [26-28] measured postural control through the Berg Balance scale at the end of the treatment period. The use of VR-based exercises for patients after stroke did improve equilibrium. The pooled mean difference (random-effect model) for balance in patients at 12 months to stroke onset were was 1.61 points (95% CI 0.56 to 2.66; P<0.000001; level of heterogeneity I^2 54%) and for patients with 24 months after stroke was 5.17 points (95% CI 3.86 to 6.48; P<0.00001; level of heterogeneity I^2 not applicable) (Figure 2).

Non-statistically significant differences were detected among subgroups analysing the dosage of intervention for VR added to standard rehabilitation program (P=0.09).

Discussion

Our comprehensive search identified 3 RCTs including 60 participants overall. Most importantly, our meta-analysis suggests that VR after stroke improves balance abilities measured by the clinical instrument Berg balance scale and it may be a promising strategy to promote motor recovery after stroke. This is probably due to the provision of multisensory feedback (visual, auditory and in some cases tactile) and to the intensity of practice that is related to the effectiveness of the rehabilitative techniques.[36, 37] In fact the tasks designed in the VR programs permit a gradual increase of task difficulty level and can be adapted to the subject's motor capabilities.[38] VR devices have the potential to significantly extend our current understanding of movement and therapy and may substantially impact delivery of physiotherapy interventions.

However, it is important to focus on the aspects discussed above because of the substantial heterogeneity among the considered studies, such as the kind of devices used for creating virtual environments and time elapsed from stroke onset to the inclusion in studies. The use of VR seems to be more effective if used for training of chronic patients.

This could be due to the fact that chronic patients may be undertrained before the enrolment and they may have an unexploited potential for motor recovery.

However no study evaluated virtual reality within the first few months after stroke and also not all the patients would be eligible for this technology. Studies included patients who had mild to moderate impaired balance capacity (average Berg balance scale score 33/54), they were

able to walk independently and patients most severely affected were not assessed. This could reduce VR applicability in a clinical context. The limited number of studies is likely due to the recent availability of these novel technologies and this is another reason why the results of this review should be considered carefully.

This review is consistent with the results presented in other works [17, 39] stating that VR appears promising for the rehabilitative treatment of stroke patients. This work adds a quantitative analysis of the multifaceted aspect of stroke recovery through the pooling of outcomes measures of balance.

Due to the paucity of published studies and their relative reduced sample size it was not possible to perform a subgroup analysis for the identification of patient population that would benefit the VR treatment. The studies included in the review used different protocols of training, some were not specifically produced for rehabilitation, however the treatment estimated effect in the meta-analysis is in favour of treated patients with an informative contribute equally distributed among included studies (Figure 2). This fact encourages the use of these technologies in clinical settings but future studies could contribute to the identification of a more specific and efficient treatment protocol of training for these patients, tailored to specific balance problems (for example weight shifting or slow muscle activation).

The treatment effect obtained with the use of devices developed to play games would lead to a more compliant prosecution of therapy outside hospital bringing more benefit to patients especially during subacute or chronic stages after stroke.

All studies included in the meta-analysis were conducted in Korea, and the obtained results in this specific context and population may not be inferred for others because of cultural and behavioural features. A wider variety of population considered in studies included may give more solid estimation of VR effect.

The limitations of meta-analyses are well known.[40] In particular, the most important of this one is the clinical heterogeneity of the included trials explained through the use of a subgroup analysis that could reduce the generalizability of the overall effect estimation. Secondly, while our search strategy was comprehensive, it is possible that some studies were not identified in the search process, primarily for language limitation to written English papers. Lastly, sample size of the included studies is small and this could lead the review to a small study bias. Larger adequately powered randomized trials are needed before drawing conclusions that might influence clinical practice.

Conclusions

Systematic reviews and meta-analyses are essential tools for summarising evidence accurately and reliably. These help clinicians to keep up to date, to provide evidence for policy makers to judge risks, benefits, and harms of healthcare behaviours and interventions.

The results of this meta-analysis suggest that VR based exercises improve balance after stroke. A more comprehensive review of existing trials and large randomised controlled trials are needed to better define other clinical relevant outcomes and confirm these promising results.

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APPENDIX 1

1. "cerebrovascular disorders" [MeSH Terms] OR "Basal Ganglia Cerebrovascular Disease" [Mesh] OR "Brain Ischemia" [Mesh] OR "Carotid Artery Diseases" [Mesh] OR "Intracranial Arterial Diseases" [Mesh] OR "Intracranial Arteriovenous Malformations" [Mesh] OR "Intracranial Embolism and Thrombosis" [Mesh] OR "Intracranial Hemorrhages" [Mesh] OR "Stroke" [Mesh] OR "Brain Infarction" [Mesh]

2. "Brain Injury, Chronic" [Mesh] OR "Brain Injuries" [Mesh]
3. stroke* [TW] OR cva [TW] OR poststroke [TW] OR post-stroke [TW]
4. cerebrovasc* [TW] OR "cerebral vascular" [TW]
5. cerebral [TW] OR cerebellar [TW] brain* [TW] OR vertebrobasilar [TW]
6. infarct* [TW] OR ischemi* [TW] OR ischaemi* [TW] OR thrombo* [TW] OR emboli* [TW] OR apoplexy [TW]
7. #5 AND #6
8. cerebral [TW] OR brain [TW] OR subarachnoid [TW]
9. haemorrhage [TW] OR hemorrhage [TW] OR haematoma [TW] OR hematoma [TW] OR bleed* [TW]
10. #8 AND #9
11. "Hemiplegia" [Mesh] OR "Paresis" [Mesh]
12. hemipar* [TW] OR hemipleg* [TW] OR paresis [TW] OR paretic[TW] OR brain injur* [TW]
13. "Gait Disorders, Neurologic" [Mesh]
14. #1 OR #2 OR #3 OR #4 OR #7 OR #10 OR #11 OR #12 OR #13
15. "User-Computer Interface" [Mesh]
16. "Therapy, Computer-Assisted" [Mesh] OR "Computer Simulation" [Mesh] OR "Computer-Assisted Instruction" [Mesh] OR "Virtual Reality Exposure Therapy" [Mesh] OR "Robotics" [Mesh]
17. virtual realit* [TW] OR virtual-realit* [TW] OR VR [TW]
18. #15 OR #16 OR #17
19. "Motor Activity" [Mesh]
20. "Learning" [Mesh]
21. "Movement" [Mesh]
22. "Locomotion" [Mesh] OR "Walking" [Mesh]
23. "Gait" [Mesh]
24. "Posture" [Mesh]
25. "Postural balance" [Mesh]
26. "Leg" [Mesh]
27. "Weight-bearing" [Mesh]
28. #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27
29. movement [TW] OR gait [TW] OR locomotion [TW] OR walk* [TW]
30. equilibrium [TW] OR balance [TW] OR postur* [TW]
31. body sway [TW] OR stance [TW] OR weight-bearing [TW]
32. lower limb [TW]
33. sit [TW] OR sitting [TW] OR stand [TW] OR standing [TW] OR step [TW] OR stepping [TW] OR climb [TW] OR climbing [TW]
34. #29 OR #30 OR #31 OR #32 OR #33
35. #28 OR #34
36. #14 AND #18 AND #35
37. "Controlled Clinical Trial" [Publication Type] OR "Clinical Trial, Phase III" [Publication Type] OR "Clinical Trial, Phase II" [Publication Type] OR "Clinical Trial, Phase I" [Publication Type] OR "Multicenter Studies as Topic" [Mesh] OR "Randomized Controlled Trial" [Publication Type]
38. #36 AND #37

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Scientific publication productivity of Italian physiotherapists

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ABSTRACT

Aim. The purpose of this study was to analyse the scientific publication performances of Italian physiotherapists (PTs) in the last 20 years.

Methods. Articles written by Italian PTs and indexed in Scopus and PubMed from 1993 to 2012 were included. For each author, the total number of published papers indexed in Scopus and PubMed, total number of citations and the H-index for Scopus only were extracted. The authors were classified according to the region and the type of institution in which they worked.

Results. One-hundred and thirty-nine Italian PTs published 517 articles from 1993 to 2012. The number of authors was higher in northern and central regions (P<0.001). Authors working in research institutes have higher mean number of both articles and citations, when compared to those working in non-scientific institutes (mean values 8.89 vs. 4.16, P=0.002 and 71.14 vs. 33.95, P=0.008), as well as mean H-index (mean values 3.54 vs. 1.61, P<0.001), while no differences were found among regions. The number of articles increased over years (rho=0.987, P<0.001).

Discussion. Despite the potential presence of a selection bias for authors, results indicate an improvement of performances in scientific publication productivity of Italian PTs, with higher number of authors in northern and central regions and better performances in scientific institutions. *(It J Physiotherapy 2013;3:170-3)*

Key words: Bibliometrics - Authorship - Publications.

The consolidation of a profession depends on the work of its members to improve the available body of knowledge.[1] Peer-reviewed journals are generally the most important instrument in the dissemination of research results.[2]

According to the European Region of the World Confederation for Physical Therapy: "*A researcher in physiotherapy, as in any other field, is defined as a person with recognised academic qualifications such as a doctorate from a higher educational institute/university, and who is affiliated to a university or research institute that is conductive to research*".[3] Within this perspective, previous articles examined the publication productivity in academic physiotherapy programs, in the United States and Puerto Rico,[1] and Brazil.[4, 5]

In Italy, few physiotherapists (PTs) works as researchers in research institutes and even fewer in universities. Despite this, the monitoring activity of the Società Italiana di Fisioterapia (SIF) has highlighted an increasing number of articles indexed in PubMed that are published by PTs who are members of the Society.[6]

The purpose of this study was to analyse the scientific publication performances of Italian PTs in the last 20 years.

Materials and methods

Authors selection

The SIF database [6] was searched to identify members who were PTs and published articles

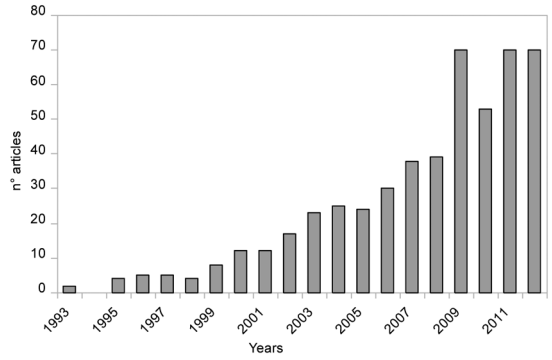

Figure 1.—Number of articles per year (source: Scopus and PubMed).

in international peer-reviewed journals indexed in PubMed. Then, all co-authors who were PTs were also included. In addition, Google Scholar and Scopus web search engine were searched using combinations of key words (physiotherapy, PT, Italy, rehabilitation) or appropriate sub fields (author search). Additional researches were conducted on professional networks (LinkedIn and ResearchGate) and searching physiotherapists who attended as invited lecturer or chairperson in national congresses on relevant fields. Further authors were identified through personal communications by Italian PTs interested in research.

Articles selection

All articles indexed in Scopus and PubMed from 1993 to 2012 were included.

For each author, the following variables were extracted: total number of published papers indexed in Scopus and PubMed, total number of citations and the H-index for Scopus only.

In addition, the authors were classified according to the region and the type of institution in which they were working: "Istituti di ricovero e cura a carattere scientifico" (IRCCS) and universities were classified as research institutes, while local health authorities, other hospitals or private practice activities were classified as non-scientific institutes.

Statistical analysis

The χ^2 test and the *t*-test were used to compare authors from different regions and types of

Figure 2.—Number of authors per region.

institution in which they were working, as well as to analyse gender differences. The correlation between time and number of published articles within the whole sample was estimated by using the Spearman's rho test. Data analyses were performed using the SPSS statistical package 13.0 for Windows. The level of statistical significance was set at 0.05.

Results

One-hundred and thirty-nine Italian PTs published 517 articles from 1993 to 2012. The number of articles increased over years (rho=0.987, P<0.001) (Figure 1). The number of authors was higher in northern and central regions (χ_2=146, P<0.001) (Figure 2) and authors were working more frequently in non-scientific institutes (N.=94, 67.1%). When the authors were considered in relation to the estimated population of physiotherapists by region,[7] the authors/PT population ratio was likewise higher in northern and central regions (in the order, Tuscany, Emilia-Romagna and Piedmont) (Table I). Authors working in research institutes had higher mean number of articles and higher mean

Table I.—*Authors/physiotherapists population ratio per region.*

Region	Authors (N.)	Estimated PTs population (N.)	Authors/PTs population ratio (%)
Lombardy	31	5844	0.5
Campania	0	3527	0.0
Lazio	8	4219	0.2
Sicily	1	2966	0.0
Veneto	17	3212	0.5
Piedmont	17	2862	0.6
Emilia-Romagna	23	3083	0.7
Apulia	2	2661	0.1
Tuscany	26	2588	1.0
Calabria	0	1236	0.0
Sardinia	0	1161	0.0
Liguria	4	1395	0.3
The Marches	4	953	0.4
Abruzzo	1	1010	0.1
Friuli-Venezia Giulia	4	952	0.4
Trentino-Alto Adige	0	900	0.0
Umbria	1	626	0.2
Basilicata	1	708	0.1
Molise	0	300	0.0
Aosta Valley	0	94	0.0

PTs: physiotherapists.

H-index, when compared to those working in non-scientific institutes (t=-3.865 and t=-3.711; P<0.001), as well as citations (t=-2.603; P=0.011) (Figure 3), while no differences were found among regions. No gender-related differences were found in terms of number of articles, mean H index and number of citations (Figure 4).

Discussion

This study examined the number of articles published by Italian PTs and indexed in Scopus and PubMed.

The choice of using both databases is based on their specific characteristics. Scopus indexes a larger number of journals than PubMed. However, an advantage of PubMed, not reproduced by Scopus, is that it is readily updated not only with printed literature but also with literature that is published online in an early version before printing by various journals. Moreover, Scopus includes articles published from 1966, but information regarding citation analysis is available only for articles published after 1996. PubMed is free and provides open access to all interested clinicians, researchers, and trainees and also to the public in general. Scopus is a database that belongs to commercial providers, requires an access fee and retrieves a greater proportion of non-English and review citations.[9] Finally Scopus provides the calculation of the H-index.

Results indicate an improvement of performances in scientific publication productivity of

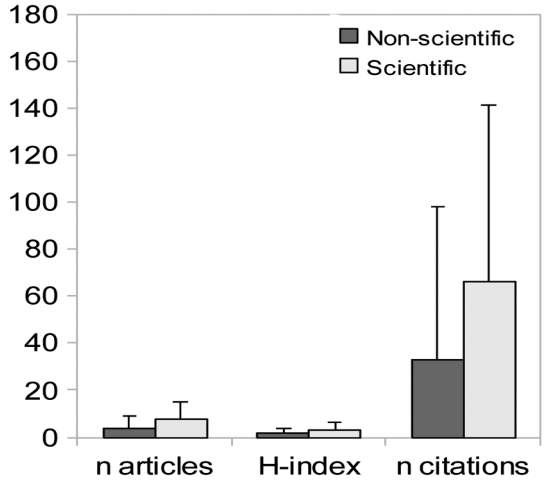

Figure 3.—Differences between types of institution for number of articles, H index and number of citations.

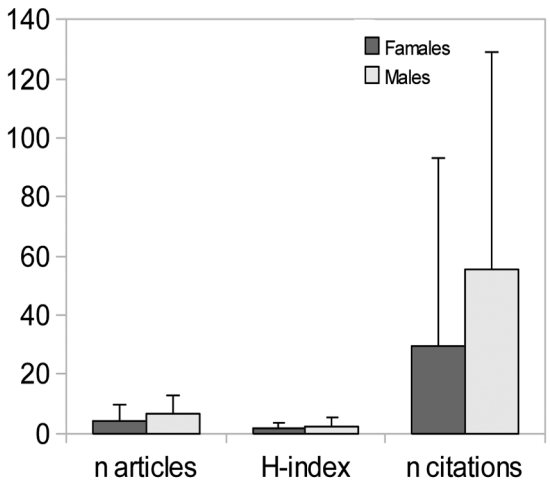

Figure 4.—Gender differences for number of articles, H index and number of citations.

Italian PTs. The reasons for this improvement are not referable to a larger involvement of PTs in research institutes or universities. In fact, authors working in scientific institutes were about one third of the total sample and nearly all of them worked in IRCCS, although they were employed more frequently as staff PTs and not as researchers. In addition, in Italy, at the moment of the data collection, only one PT was a member of a university. Previous studies conducted in other countries included only PTs involved in universities.[1, 4, 5, 10] For this reason, it is not possible to compare our results with previous literature in the physiotherapy field.

Differently from Kaufman *et al.*,[11] no gender difference was found in terms of bibliometric indicators. They examined a high number of independent factors to explain the reasons for the lower rate of articles per year for women than for men over the course of a academic career. However, since the sample selected in the study by Kaufman *et al.*[11] included only PTs involved in universities, the great part of these variables are not suitable for comparison with our sample.

The main limitation of the study is a high risk of bias in the authors' selection. Since no database provides options in searching for both profession and country, the search strategy may not have been really systematic. However, in this case, the number of authors, and then the number of articles, may just be underestimated.

In conclusion, despite the potential presence of a selection bias for authors, results indicate an improvement of performances in scientific publication productivity of Italian physiotherapists, with higher number of authors in northern and central regions and better performances in scientific institutions.

The scientific productivity of Italian PTs could further increase if they will employed in research institutes and universities as researchers and professors.

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