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A description of Physical Therapists' Knowledge in Basic Competence Examination of Musculoskeletal Conditions: an Italian National Cross-Sectional Survey

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SUMMARY

Background. According to the World Health Organization, musculoskeletal conditions (MSC) are a major contributor of disability worldwide. The prevalence and impact of MSC has created the need for more careful reflection on how all health professionals are trained about the appropriateness and cost-effectiveness of treatments for these complaints.

Aim. To evaluate basic musculoskeletal knowledge in a population of Italian students and physiotherapists.

Methods. Adaptation in Italian context and administration of 25-items quantitative cross-sectional paper-based survey was conducted. 460 physiotherapy students and graduates were involved in the survey. The survey focuses on the most common diagnoses seen in the musculoskeletal field and in the context of primary care. Data was analyzed by descriptive and inferential statistics.

Results. Four-hundred and sixty respondents completed this paper-based survey. Overall respondents' average score was 45.03/100 (pass rate of 7.8%). Physiotherapists with degrees (n=318) obtained an average score of 49.28/100 (SD +/- 18.08), with an overall pass rate of 10.7%. Physiotherapists with degrees and specialized in Manual Therapy obtained higher scores than non-specialized colleagues (62.40/100, SD +/- 16.63 and 39.83/100, SD +/- 15.90, respectively). Moreover, physiotherapists specialized in Manual Therapy obtained a significantly different sufficiency pass rate and did better than their non-specialized colleagues (28.3% *versus* 1.7%, $p < 0.01$) and even better than their colleagues specialized in Sports physiotherapy (average score 52.89/100, SD +/- 17.50, pass rate 11.1%). Physiotherapists with a Master of Science averaged a score of 61.37/100 (SD +/- 17.94) and a pass rate of 37.5%. Second year physiotherapy students scored 15.83/100 (SD +/- 10.57), while third year students scored 39.53/100 (SD +/- 14.26); however, students achieved a very low pass rate (0% and 1.7% respectively for the 2nd and the 3rd year students).

Discussion and conclusions. This study provokes deep reflection on the structure and contents of the physiotherapy degree course: the results of this survey could lead to a radical restructuring of the academic syllabus so as to allow this scientific discipline to reach its full potential.

KEY WORDS

Italian survey; musculoskeletal conditions; physiotherapy; professional competence; screening.

BACKGROUND

According to the World Health Organization, Musculoskeletal Conditions (MSC) are: a) a major contributor of disability worldwide, with lower back pain being the single leading cause of disability globally; b) highly prevalent throughout a person's lifespan, occurring at all decades over the course of adulthood; and c) a particular economic burden in developed countries, where more than half of chronic medical conditions in patients around the age of fifty are bone and joint disorders (1). The United States Bone and Joint Initiative (USBJI) noted that MSC strikes half of the adult population of the United States of America (USA), around 126 million individuals, far outstripping circulatory (31%) and respiratory (28%) diseases (2). Furthermore, recent economic analyses of spending estimates stratified by condition, age and sex group, and type of care in the USA (3), indicate that lower back and neck pain accounted for the third-highest amount, with estimated health care spending of $ 87.6 billion (4). Due to this, the prevalence and impact of MSC has created the need for a more careful reflection on how all health professionals are being taught about the appropriateness and cost-effectiveness of treatments for MSC.

As physiotherapists are health professionals associated with treating patients with MSC (5), it follows that each professional should demonstrate proficiency in MSC management. The medical profession requires a more critical review of the MSC content in training clinicians and students (6).

Surveys regarding basic screening skills relating to the musculoskeletal area began with the development and validation of the Basic Competency Examination in Musculoskeletal Medicine (BCEMM) in 1998 by Freedman and Bernstein, a 25-items open answer questionnaire which evaluated competences concerning the knowledge of MSC (6). The prevalence and costs of MSC increase and access to physiotherapy so physiotherapist have to provide guideline-consistent non-pharmacological care. However, so far, there are no published studies that have investigated the levels of musculoskeletal knowledge of Italian physiotherapists. For such reason, the main aim of this study is to evaluate the musculoskeletal basic knowledge in a population of Italian students and physiotherapists by means of a cross-cultural adaptation and administration of the BCEMM; the secondary aim of this survey is to compare the results of Italian respondents with American ones.

MATERIALS AND METHODS

A quantitative paper-based cross-sectional survey was used to evaluate knowledge in the management of MSC. The survey was administered to Italian students and physiotherapists following the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) guidelines (7) and STrengthening the Reporting of OBservational Studies in Epidemiology (STROBE) (8) between June and December 2016.

This survey was approved by Ethical Committee of ASL Lecce (Italy) (report number 36, of the 13th of May 2016).

Participants and setting

This survey was administered to 2nd and 3rd year Italian students of Physiotherapy and to Italian physiotherapy graduates.

The Italian Association of Physiotherapists (AIFI) promoted the survey and sent a mail to its regional offices in order to invite participants to the study. A further reminder was sent three months after the first contact in case of missing response. Furthermore, AIFI requested the collaboration of the coordinators of three-year degree courses and Masters' degree courses of specialization in Manual Therapy and in Sport Rehabilitation. Masters' degree course of specialization in Manual Therapy is an advanced specialization training that represents the academic post-graduate program in Manual Therapy in Italy, based on the standards established by the International Federation of Orthopaedic Manipulative Physical Therapists (9). The post-graduate study courses (Specialized Masters) in Sports Physiotherapy aim to develop advanced skills referring to the standards dictated by the International Federation of Sports Physiotherapy (IFSPT) official WCPT subgroup, for the recognition of the title of Italian Sports Physical therapist (10).

The following groups were included within the target population; a) physiotherapists (three years "standard" University course) that answered to the AIFI recall and participated to the on-topic meeting for administration of the survey, b) physiotherapist students that were registered on the University Graduation Courses that comply to participate in the survey, c) physiotherapists specialized in Manual Therapy (OMPts) and Sport Rehabilitation that agreed to complete the survey and d) physiotherapists with Master of Science (three years of basic graduation plus two years of "advanced" University course) (11). All participants completed the informative consent form before taking part in the survey. In order to allow comparisons between competences based on the current Italian University system, samples were divided according to different educational levels of the respondents: students in their second and third year, physiotherapists (graduates, three years), physiotherapists with first level graduation plus Specialization in Manual Therapy or Sport Rehabilitation (specializations courses had an average of 16 months), physiotherapists with first level graduation plus Master of Science (two years after basic 3-years Physiotherapy degree).

Questionnaire development and pre-testing

The questionnaire administered was the Italian Version of the BCEMM. To improve the consistency of the content and face validity, the authors of this paper made a trans-cultural adaptation process following Beaton's Guidelines, 2000 (12) (detailed steps for cultural adaptation of the BCEMM into Italian are showed in **Appendix 1**).

Questionnaire implementation

Questions of BCEMM were based around the most common diagnoses seen in the musculoskeletal field and in the context of primary care (6). Pathologies which require immediate referral to a specialist or pathologies not requiring physiotherapist expertise, or pathologies that require emergency room treatment were also included (6). The whole administered questionnaire was reported in **Appendix 2**.

The socio-demographic variables were implemented from Friedman's study questionnaire and were investigated by 6 open questions (*e.g.*, age, graduation year) and 5 closed multiple-choice questions (*e.g.*, gender, educational qualification).

For clinical questions, authors in this paper and experts form the Expert Committee decided not to improve, modify or make any changes to the questions because they judged them to be complete and exhaustive as far as the content of the questionnaire was concerned. This also makes it possible for the authors to compare BCEMM-I with preceding administrations of the questionnaire (6, 13-15).

Questionnaire administration

The different regional Committees contacted by AIFI, organized some local meetings in which the survey was administered. Firstly, the authors explained the aims of the study. The participants expressed their willingness to participate in the voluntary study signing the consent forms. The forms with the demographic questions were handed out. When all the demographic questions forms were completed and handed in, the main questionnaire was then handed out and the participants were given 30 minutes to complete it. In the past administrations of the questionnaire (6, 13-15), no time limit for completion was ever decided. However, the authors of this study opted for a 30 minutes time limit due to administrative reasons (*i.e.* availability of co-workers to administer the questionnaire).

The questionnaire was completed under supervision (1 supervisor for about 10 respondents).

Data collection procedure

The survey was paper based, so every time that the questionnaire was administrated to a group of respondents, all the documentation was put into an envelope by a referring collaborator, sealed and signed, and then delivered to the first author of this study (GG). After the demographic information had been collected, the contents of the test and all the study data was archived in the AIFI National Headquarters, stored in a safe to guarantee the privacy of the participants' data as declared to the Ethics committee.

ANALYSIS

The privacy of the subjects was maintained by using study ID numbers assigned by a secretary who was unaware of the study. ID numbers were obtained from the chronological number of the survey's completion. In addition, unidentified demographic data was obtained, including details regarding the participant's training background, their qualifications (*i.e.* students, three years degree, Specializations in Manual Therapy or Sport Rehabilitation, Master of Science) and work experience as free-lance professionals or as employees.

The chief investigator (GG) trained 4 of the judges (FB, MP, AS, FBo) on how to award points to the participants. The judges and the principle investigator are all physiotherapists specialized in MSC and work as university lecturers in Post-graduated Master for Rehabilitation in Musculoskeletal fields. Therefore, the judges conducted a blind correction of the questionnaires for the calculation of the overall score, following the procedures described by Freedman and Bernstein (6): a) a maximum point of 1 was awarded for each question; b) zero points for unanswered question; c) the validation process used a partial credit-weighted system to award a mark to partially correct answers; d) spelling mistakes were not to be taken into account; e) the overall score was obtained by adding up the scores for each individual question and the result was then multiplied by 4 to obtain the score as a percentage (6). The entire process was supervised by the chief investigator. The results of the questionnaires and the demographic data were recorded on an excel file that was sent by e-mail to a statistician (MM), who performed a blind statistical analysis.

Participants whose score was above the previously established threshold of 73.1% would be deemed successful in passing the test (6).

Frequency distribution for categorical variables and measures of central tendency with standard deviation for continuous variables were calculated using STATA for Windows 11.0.1

(Calcago, IL). T-test for independent samples and Kruskal Wallis test were both used to compare the knowledge among the different levels of education (*i.e.* students, graduates of three years courses, respondents specialized in Manual therapy, respondents specialized in Sport Rehabilitation, respondents with Master of Science). Alternative analysis of variance (ANOVA) is used to compare the means between more than two groups. The difference in pass rates among the sub groups of physiotherapists divided by level of education was tested using Pearson's chi-squared test. The significance level was established beforehand as being < 0.05.

RESULTS

All participants (n=460, 278 males and 182 females) Mean sample age was 27.7 years, SD +/- 7.3; this parameter was calculated on 447/460 subjects as 13 participants did not declare their age. All respondents completed the informed consent form before taking part. No student or graduate physiotherapist reported having any knowledge of the content of the questionnaire used in the study. Mean scores on the questionnaire and pass rates are reported in **table I** and **table II**, respectively. Average time for completing survey was 18 minutes.

One hundred and forty-two students of Physiotherapy (118 of the third year, 24 of the second year) completed the survey. The average age of the Physiotherapy students participating was 23.31 (SD +/- 2.98 for students from third year) and 21.75 (SD +/- 3.12 for students from second year). All of the student respondents completed the questionnaire under supervision.

Three-hundred and eighteen physiotherapists who were qualified to practice their profession in Italy, completed the survey, 79/460 of them (17.17%) worked as employees, the remaining worked in private practice (n=381/460, 82.83%). The average age of the participating physiotherapists graduated was 29.7 (SD +/- 7.6). One hundred and thirty-one of the graduated physiotherapists (28.48% of

Table I. Field of work, provenience and mean score of respondents.

		N	Mean (Std Dev)	p-value for comparison of means
Sample		460	45.03 (18.66)	
Gender	Male	278	45.86 (19.27)	0.24
	Female	182	43.77 (17.66)	
High School	Scientific high school	349	44.61 (19.20)	0.51
	Classical high school	46	48.65 (17.20)	
	Professional school	13	50.08 (21.96)	
	Magistral institute	11	44.36 (21.54)	
	Others	41	43.15 (12.89)	
University degree	Degree	318	49.28 (18.08)	<0.001
	Student 2 year	24	15.83 (10.57)	
	Student 3 year	118	39.53 (14.26)	
Master of Science	No	444	44.44 (18.43)	<0.001
	Yes	16	61.37 (17.94)	
Master Manual Therapy	No	354	39.83 (15.89)	<0.001
	Yes	106	62.40 (16.63)	
Master Sport Physical Therapy	No	451	44.88 (18.66)	0.202
	Yes	9	52.89 (17.50)	
Sample provenance	North	177	53.05 (17.26)	<0.001
	Center	184	39.50 (18.43)	
	South	98	41.13 (16.48)	
Work	Self employed	381	44.88 (19.20)	0.709
	Employee	79	45.75 (15.87)	

Table II. Pass rates of respondents.

		N	Pass rate	Chi squared test for indipendence
Sample		460	0.078	
Gender	Male	278	0.086	0.43
	Female	182	0.066	
High school	Scientific high school	349	0.083	0.08
	Classical high school	46	0.087	
	Professional school	13	0.077	
	Magistral institute	11	0.091	
	Others	41	0.024	
University degree	Degree	318	0.107	0.003
	Student 2 year	24	0	
	Student 3 year	118	0.017	
Master of Science	No	444	0.067	<0.01
	Yes	16	0.375	
Master Manual Tharapy	No	354	0.017	<0.01
	Yes	106	0.283	
Master Sport Physical Therapy	No	451	0.077	0.711
	Yes	9	0.111	
Sample Provenence	North	177	0.147	<0.01
	Center	184	0.027	
	South	98	0.051	
	Estero	1	0	
work	Self-employed	381	0.076	
	Employee	79	0.088	0.707

the whole sampling recruited) were certified as specialized: in particular 106 respondents (23.04%) were University post-graduated specialized in Manual Therapy, 9 respondents (1.96%) were specialized in University post-graduated training in Sports Physiotherapy and 16 respondents (3.48%) had a Master of Science for Health-professions training graduation.

Both students and graduate physiotherapists coming from the North of Italy (n=177/460) obtained significantly higher scores compared to their counterparts from South (n=98/460) and Central (n=185/460) Italy (t-test and Kruskal-Wallys test p-value < 0.01). Furthermore, overall pass rates were 14.7%, 5.1% and 2.7% respectively, and chi-square test of independence between sufficiency at the test and area of origin results p < 0.01. Employment status (private practice or employed) had no significant statistical effect on scores (p=0.71).

Physiotherapists possessing a degree (n=318/460) obtained an average score of 49.40/100 (SD +/- 18.07), with an overall pass rate of 10.7%, while Physiotherapy third year and second year students obtained a score of 39.53/100 (SD +/- 14.26) and 15.83/100 (SD +/- 10.57) respectively. The mean score of graduated therapists is significantly different from the mean score of undergraduate ones (t-test has a p-value < 0.01, confirmed with Kruskal-Wallys).

Physiotherapy students obtained an overall pass rate of 1.7% and 0% respectively for third and second year (chi-square test of independence between graduation and sufficiency at the test results p < 0.01). Physiotherapists specialized in Manual Therapy (n=106/460) obtained an average score of 62.40/100 (SD +/- 16.63) and a significative different sufficiency pass rate than their non-specialized colleagues (28.3% *versus* 1.7% respectively, p < 0.01). The mean score between respondents with specialization in Manual Therapy is significantly different (p < 0.001) from the mean of respondents without specialization. Physiotherapists specialized in Sports Physiotherapy obtained a pass rate of 11.1% and collected a mean score of 52.89/100 (SD +/- 17.50). T-test for the mean score between respondents with Sport Physiotherapy specialization and without showed

no significant result (p=0.202). There were not significant differences in the overall pass rate between professionals in possession of Sport Physiotherapy specialization and those without (p=0.71).
Physiotherapists with Master of Science (n=16/460) obtained a mean score of 61.37/100 (SD +/- 17.94) and had a significantly different overall pass rate compared to colleagues without Master of Science (37.5% *versus* 6.7% respectively, $p < 0.01$). Furthermore, T-test for the mean score between respondents with Master of Science and respondents without showed a significant difference ($p < 0.001$)
The overall scores of the Italian physiotherapy students and Italian physiotherapists are reported in **figure 1** (blue columns). Furthermore, in **figure 1**, the results of this study were compared to those of the American physiotherapists and health professionals reported in the study of Child *et al.* (13) and with the medical categories questioned in the earlier work of Matzkin (14) (red columns).

DISCUSSION

The main aim of this survey is to assess the competence of Italian physiotherapists and physiotherapy students in MSC by the administration of the BCEMM. In addition to this, the survey also aims to compare the results from Italian samples with those from the American one.
In 2005, the BCEMM questionnaire was used to test American physiotherapists and verify the adequacy of their basic and specialist training concerning their evaluation and management of MSC (13). Physiotherapist graduates who had not specialized through specific postgraduate programs demonstrated sufficient knowledge passing the exam with a mean score of 74/100, just one point above the level considered to be satisfactory (73.1/100), and above any other category of medical speciality apart from orthopaedic surgeons who attained the highest score of all, 94/100 (13).
American physiotherapists specialized in Musculoskeletal physiotherapy or Sport physiotherapy registered the test score of 81/100, making a notable gain in the direction of the orthopaedists and widening the gap between them and all the other medical specialists questioned (13). American students' average scores were above 60/100 but did not reach the minimum estimated to be satisfactory. However, American students attained a higher level of preparation than that of the components of all the other medical specialties questioned (13).
Indeed, the scores of Italian physiotherapy students are far below the sufficiency threshold, below those of their Amer-

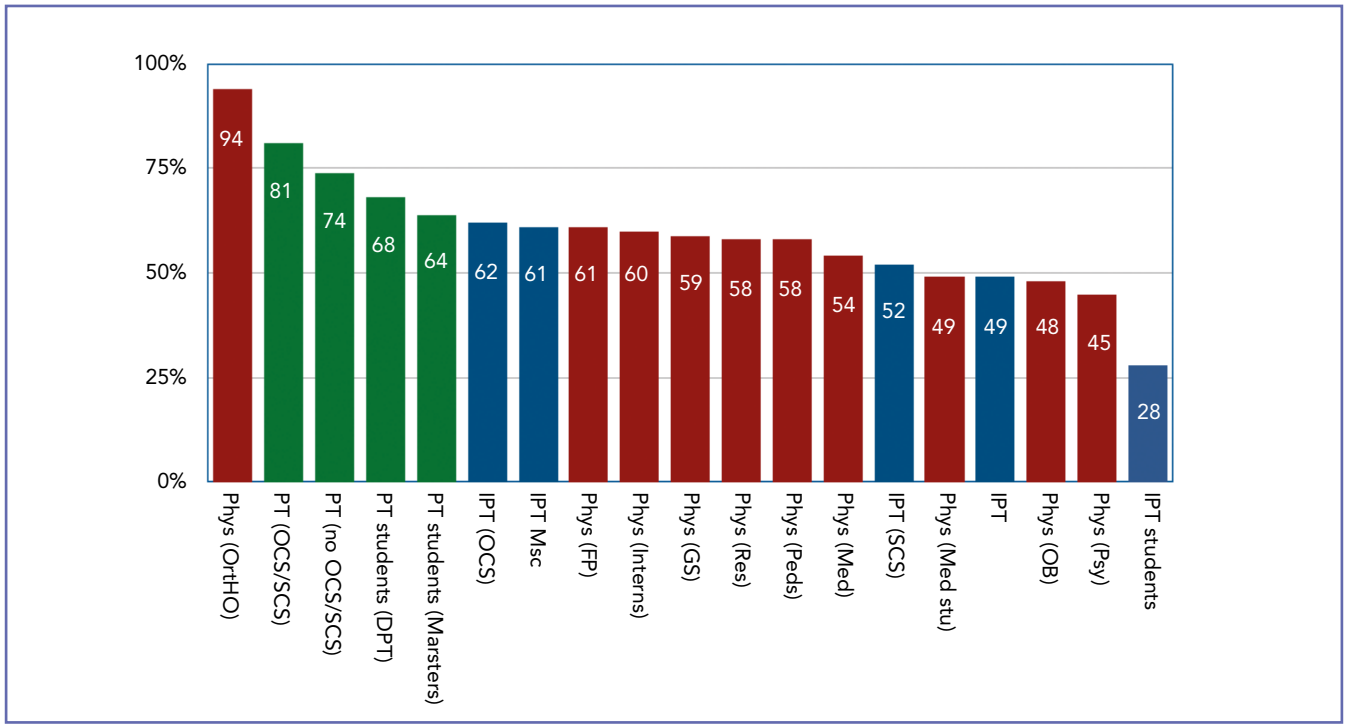

Figure 1. Overall score of musculoskeletal knowledge in Italian physiotherapy students, physiotherapists and specialized physiotherapists (blue columns) and comparison with previous studies by Child *et al.* (13) and by Matzkin (14) (red columns).

ican counterparts, and considerably lower also than those of American medical students. Such poor results might be justified by the differences in University programs in America and Italy and the greater importance attributed to manual issues (16). Therefore, knowledge of MSC and serious pathologies tends not to be analyzed in depth.

In fact, Italian physiotherapy students and physiotherapy graduates, especially the latter, not in possession of a post graduate specialization, showed poor knowledge of MSC that can be found in patients in direct access and this may consequently translate into a poor management of patients presenting these conditions. Only professionals specialized in Manual Therapy and professionals with a Master of Science collect a mean score greater than 60/100. Overall, Italian physiotherapy professionals result in having lower pass rates compared to American professionals.

One of the primary syllabus areas most emphasized in university physiotherapy programs around the world is the differential diagnosis of MSC, a necessary competence in the context of private clinical practice as well as in primary care (17). This data provides preliminary evidence that greater attention to the screening of the more common MSCs is present in physiotherapy programs in the United States but not in Italy. A threshold of 73.1 points has been established as satisfactory by directors of American schools of specialization and therefore as the minimum level of knowledge necessary to guarantee for someone's competence in MSC medicine (6). Italian three-year degree courses in physiotherapy appear to be far behind that threshold. This suggests, in the light of the growing availability of direct access treatment for patients with MSC in Italy, that a considerable quantity of content regarding these competences should be introduced into Italian physiotherapy University courses, especially in University courses from Center and South of Italy.

In fact, from our results, it seems that physiotherapists with a wider background in MSC screenings could have attained higher scores than those with only slight exposure to an orthopedic expertise and this is a consideration evidenced by the statistical significance expressed in the difference in scores obtained by Italian physiotherapists in different geographical regions: physiotherapists from the North had considerably higher scores than their colleagues from central and southern Italy. This can be explained because training programs in physiotherapy do not adopt standardized curricula in Italy and therefore exposure to didactic and clinical experience relative to the management of MSC differs.

Our sample size numerosity (n=460; 142 students; 318 physiotherapists) compares favorably to that of Childs and colleagues (13) (a priori sample size=174 students and 182 physiotherapists). According to the latest European Commission Estimates there are over 61000 Italian physiotherapists, whereas is America there are three times as many; however, our sample size was almost double the size of the sample of American physiotherapists while the number of sample size for students was the same.

Given the wide spectrum of degrees of experience of doctors and physiotherapists and specialties represented in previous studies (13), this data offers a convincing standard of reference for at least a preliminary discussion on the on-topic knowledge of Italian physiotherapists compared to American physiotherapists and doctors regarding the management of MSC since an identical test has been used and administered using similar procedures to those used in the previous studies (6, 13, 14).

Taken as a whole, the results of this survey proved that graduates and specialized physiotherapists in Italy tend to have lower levels of knowledge of the management of MSC than their American counterparts (13). However, Italian specialized physiotherapists (*i.e.* Master of Science and Manual Therapy specialized professionals) tend to have scores which overlap or are at least comparable to American medical students, doctors and all medical specialists, aside from orthopedists. A possible explanation may be due to the degree to which management of MSC is emphasized in Italian physiotherapy degree courses as opposed to postgraduate specialization courses, which would require independent investigation.

At the moment, in Italy, there is a total of 85 first level degree courses in physiotherapy, 16 Masters' degree programs, 5 postgraduate courses for Manual Therapy specialization and 1 for specialization in Sport Rehabilitation with international recognition. In the last 25 years the figure and the role on the physiotherapist in Italy has changed considerably. The decree law number 502 form 1992, in line with community policies and in an attempt to meet the challenges connected with the sustainability of the healthcare system, has reformed the role of the physiotherapist's professional profile, conferring competences and responsibilities to all health workers involved in the Italian health system. Since 1994, the physiotherapist's professional profile has undergone a profound transformation, and what was once regard as an auxiliary non-autonomous professional figure has now turned into an intellectual autonomous and thus competent and responsible professional.

Here lies the paradox as the profession was legitimized by law but not by its own evolutionary process based on the continuous acquisition of specific theoretical and practical competences during its practice. In the year 2000, the law number 251, instituted a five-year degree course dividing it into a 3-year clinical degree course, which allowed the holder of such degree to practice his profession, and a two-year

course aimed at providing a qualification in management, research and teaching (Second cycle degree - Master of Science). However the law did not edit, reform or improved the study programs or syllabus. In our Knowledge only some studies have assessed the core competencies among physiotherapist students, trying to formulate an uniform educational program (18).

Overall, data from this survey shows the importance of Italian university specialization courses in the MSC area for physiotherapists, and also reveals the necessity to improve basic university programs, particularly those related to MSC screening, assessment and treatment.

The physiotherapist is an health professional that can work both autonomously and/or in strict collaboration with others medical health professionals such as physiatrist, orthopaedic, neurologist (19).

To date, physiotherapists workplace in Italy can be divided in employee into National Health System with filtered-access patients (the patient came to the physiotherapist with a prescription by another clinician -medical doctor) or private practice with direct-access patients (the patient came to the physiotherapist without any previous assessment) (5). Therefore, is mandatory that Universities programmes must be implemented in reference to the processes of screening for referral in physiotherapy (20, 21). Italian physiotherapist need to upgrade the knowledge and the detection abilities for screening extra-physiotherapy expertise pathologies that need of a deeper investigations by another health professionist (22, 23). However physiotherapy screening clearly differ from medical diagnosis. Physiotherapists, in fact, could not medically diagnose patients but must be well-prepared to identify signs and symptoms outside the scope of physiotherapy practice and refer to a physiatrist or specialist as appropriate (*e.g.* ortopaedic, neurologist) (24). Because of this, and to prepare the graduated physiotherapist to properly assess the patient coming in direct access, Universities must improve their programmes about the knowledge on the extra professional pathologies, their existence and specific clinical features in order to incrementing the suspect and guide a proper referral (25).

Authors in this paper suggest to a) review the musculoskeletal curricula and assure that the content is relevant and up to date, b) ensure that standardized assessment of students are implemented to guarantee that competencies are achieved, and c) implement reassessment of musculoskeletal knowledge during students university lessons, based on the evidence available in the literature (20, 22).

Another point of discussion is that medical training and training programs in physiotherapy do not adopt standardized curricula, neither in Italy or in the United States and therefore the amount of teaching and clinical experience related to the management of patients with MSC differs. This consideration was highlighted by the statistical significance expressed in the different scores obtained by Italian physiotherapists in different geographical regions (26).

Papers who consider the role of the qualification in professional skills concluded that acquiring further specialization could update the knowledge and change the professional clinical practice in managing people with shoulder pain (27), could reduce prevalence of injury in amateur athletes (28) and give to the professional more qualification, improved manual skills and increased the confidence (29).

Strength and limits of the study

The fact that respondents to this survey come from a wide variety of degree courses and from all areas around the country increases the generalizability of its results.

One of the strengths of this survey is the blind correction of the questionnaires by the four judges and the blind statistical analysis: this way of managing a test promotes unbiased correction of the answers and helps to acquire trustworthy data.

In this study, the questionnaire was administered under supervision; this might exclude any type of contamination of the data by use of external sources: this aspect is a point of strength of this survey as it reinforces the assessing of the real knowledge of respondents. Furthermore this study obliged respondents to answer the questions they were given with time limit of 30 minutes: this aspect could also limit the possibility of the use of external sources (*i.e.* telematic assistance, smart phones, access to the internet, remote resources, books of notes or anything which could create an advantage over each participant's knowledge) and thus makes the collection of the real knowledge and data of the respondents much more reliable. A careful analysis however is necessary and requires that various limitations be taken into consideration.

In fact, in this study a generalization of the whole population of Italian physiotherapist is not possible due to:

a) the exiguous sample size recruited;

b) the respondents coming mostly from events organized by AIFI. Furthermore, in Italy, not all the physiotherapists are subscribed to AIFI.

In addition, the content of the test was mainly focused on the differential diagnosis of MSC commonly encountered in the context of primary care (for example, fractures and dislocations, low back pain, sciatica and arthritis) and emergency orthopedics which require immediate referral to an orthopedic surgeon or to the emergency room (for example compartment syndrome, dislocation of the hip, *etc.*) (13). This data, therefore, might not be generalizable to other theoretical or practical subjects specific to physiotherapy.

CONCLUSIONS

The authors of this paper hope that this study will trigger, within Italian academic and ministerial institutions, deep reflection on the structure and contents of the physiotherapy degree courses, which could lead to a radical restructuring of these academic paths so as to allow this scientific discipline to reach its full potential. A profession such as physiotherapy, which based on clinical science, needs high quality scientific research to guarantee effective treatments that can improve not only the state of health of patients, but also cost-effectiveness, which in turn could optimize the resources of the healthcare service.

Italian physiotherapists specialized in Manual Therapy and physiotherapists with a Master of Science scored higher than their colleagues with the basic graduation and the specialization in Sport Rehabilitation. Furthermore, their score was similar to that from the American physiotherapy student in Master and doctorate in Manual Therapy, American family practice and interns.

AUTHORS' CONTRIBUTIONS

GG: Conceptualization, Roles/Writing – original draft, Project administration; MP: Investigations, Project administration, Roles/Writing – original draft; AS: Investigations, Project administration, Roles/Writing – original draft; MT: Data curations, Project administration. FBo: Methodology, Supervision, Writing- Reviewing and Editing; FB: Methodology, Supervision, Writing- Reviewing and Editing; MM: Statistics, Reviewing and Editing; AD: Supervision, Validation, Writing- Reviewing and Editing

LIST OF ABBREVIATIONS

MSC= Musculoskeletal conditions.
USBJI= The United States Bone and Joint Initiative.
BCEMM= Basic Competency Examination in Musculoskeletal Medicine.
AIFI= Italian Physiotherapy Association.
OMPT= Orthoapedic Manipulative Physical Therapy.
IFOMPT= International Federation of Orthopaedic Physical Therapists.
MSc= Master of Science.

ACRONYMS

PHYS (ortho)= Physicians (orthopeadic); PT(OCS/SCS)= Physiotherapists (Orthopedic clinical specialists/ Sports clinical specialists); PT(NO ocs/scs)= Physiotherapists (no Orthopedic clinical specialists/ Sports clinical special); PT students= Physiotherapists students (doctorate in manual therapy); IPT(ocs)= Italian Physiotherapists (specialized in Manual Therapy); IPTMsc= Italian Physiotherapists (specalized Master of Science); PHYS(FP)= Physicians (Family practice); PHYS(interns)= Physicians (Interns);PHYS(gs)= Physicians (General surgery);PHYS(res)= Physicians (Resident); PHYS(ped)= Physicians (Paediatrics); PHYS(med)= Physicians (Internal medicine); IPT(scs)= Italian Physiotherapists (specialized in Sports Rehabilitation); PHYS(med stu)= Physicians (medical student); IPT= Italian physiotherapists; PHYS(ob)= Physicians (obstetrics-gynecology); PHYS(psy)= Physicians (psychiatry); IPT students= Italian physiotherapists students

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interests.

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APPENDIX 1

Translation and Italian cross-cultural adaptation of the BCEMM

Step 1: translation into Italian. Two mother tongue Italian translators developed two Italian versions of the BCEMM independently. One translator (GG) was a physiotherapist, with 16 years clinical experience and lecturer in physiotherapist's University courses for physiotherapists. The other translator was a professional translator with 5-years of, but with no medical background.

Step 2: synthesis. The two independent translations were compared and no discrepancies were noted. Both translators and an observer (FB) worked together on a final draft of the translation.

Step 3: backward translation. Working from that final draw, two English mother-tongue translators, without medical background, translated the questionnaire back into English.

Step 4: expert committee. The translators, a linguistic expert, an orthopaedic surgeon, and three physiotherapists (FBo, PM, AS) constituted a committee of experts. The linguistic expert was a MSc with 20 years of experience as an English teacher. The orthopaedic surgeon had 13 years of experience, and the physiotherapists on the Committee of Experts had clinical expertise in back and neck diseases and had attended training courses in pathology screening for physiotherapists. The committee analysed the translated document and developed the pre-final Italian version of BCEMM (BCEMM-I)

Step 5: pretesting. The BCEMM-I was administered to 50 subjects (26 physiotherapists, 15 physiotherapy students and 9 physiotherapists specialized in Manual Therapy and Sport Rehabilitation). Furthermore, a face-to-face interview between the respondents and the expert committee components was conducted to explore the possible difficulties encountered while filling in the questionnaire (*e.g.*, unclear or confusing questions, unknown or uncommon words and expressions) to ask about the experience in responding to the questions and to further clarify some of the answers given by the respondents.
In conclusion, the outcome of the pretesting stage was satisfactory and it was determined that no changes to the questionnaire were necessary. After that, the final BCEMM-I was developed.

APPENDIX 2

The BCEMM paper-based survey

Section A - demographic

1. Age (years)
2. Gender
   - Male
   - Female
3. High school attended
   - Classical high school
   - Scientific high school
   - Magistral Institute
   - Professional school
   - Others
4. University degree
   - Student 2° year
   - Student 3° year
   - Degree
5. Additional qualification
   - Master of Science
   - Master In Manual Therapy
   - Master in Sport physical therapy
6. Work
   - Employee
   - Self-employeed
7. Sample provenance
   - North
   - Center
   - South

Section B – Technical questions

1. What common problem must all newborns be examined for?
2. What is a compartment syndrome?
3. Acute septic arthritis of the knee may be differentiated from inflammatory arthritis by which laboratory test?
4. A patient dislocates his knee in a car accident. What structure(s) is/are at risk for injury and therefore must be evaluated?
5. A patient punches his companion in the face and sustains a fracture of the 5th metacarpal and a 3-mm break in the skin over the fracture. What is the correct treatment, and why?
6. A patient comes to the office complaining of low-back pain that wakes him up from sleep. What two diagnoses are you concerned about?

7. How is compartment syndrome treated?
8. A patient lands on his hand and is tender to palpation in the "snuff box" (the space between the thumb extensor and abductor tendons). Initial radiographs do not show a fracture. What diagnosis must be considered?
9. A 25-year-old male is involved in a motor vehicle accident. His left limb is in a position of flexion at the knee and hip, with internal rotation and adduction of the hip. What is the most likely diagnosis?
10. What nerve is compressed in carpal tunnel syndrome?
11. A patient has a disc herniation pressing on the 5th lumbar nerve root. How is motor function of the 5th lumbar nerve root tested?
12. How is motor function of the median nerve tested in the hand?
13. A 12-year-old boy severely twists his ankle. Radiographs show only soft-tissue swelling. He is tender at the distal aspect of the fibula. What are 2 possible diagnoses?
14. A patient presents with new-onset low back pain. Under what conditions are plain radiographs indicated? Please name 5 (example: history of trauma).
15. A patient has a displaced fracture near the fibular neck. What structure is at risk for injury?
16. A 20-year-old injured his knee while playing football. You see him on the same day, and he has a knee effusion. An aspiration shows frank blood. What are the three most common diagnoses?
17. What are the five most common sources of cancer metastatic to bone?
18. Name two differences between rheumatoid arthritis and osteoarthrosis
19. Which malignancy may be present in bone yet typically is not detected with a bone scan
20. What is the function of the normal anterior cruciate ligament at the knee?
21. What is the difference between osteoporosis and osteomalacia?
22. In elderly patients, displaced fractures of the femoral neck are typically treated with joint replacement, whereas fractures near the trochanter are treated with plates and screws. Why?
23. What muscle(s) is/are involved in lateral epicondylitis (tennis elbow)?
24. Rupture of the biceps at the elbow results in weakness of both elbow flexion and ?
25. What muscle(s) control(s) external rotation of the humerus with the arm at the side?