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Original Article

Knowledge and practice of stretching by university students

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Abstract:
Flexibility is a somewhat complicated concept to define due to the large number of terms and components it encompasses and there are many stretching techniques we can use. However, the knowledge that university students of Physical Education have, according to previous studies, is often very scarce. The purpose of this study was to obtain information about flexibility and the practical application of stretching techniques possessed by students at the Latvian Academy of Sports Education in Riga, Latvia. A sample of 159 volunteer students participated in the present study, (male n = 83; female n = 76) from four courses and the first year of Master's degree in Physical Education (age 21.51 ± 2.40 years). The students completed the survey consisting of 14 questions related to their knowledge of stretching techniques and part of the training session in which they perform stretching. The knowledge and use of stretching techniques was low for both university and Master´s students, but the third-year students had more knowledge (1.87 ± 0.672 vs. 0.84 ± 0.569). Most of the participants do not usually have dedicated stretching sessions and if they do, they are rare (0.20 ± 0.659). Most participants tend to stretch during both warm-up and cool-down. The knowledge of university students about flexibility and stretching is insufficient. In conclusion, we agree that the use of stretching by university students during their training sessions is low. It would be advisable to implement intervention programmes and sessions dedicated solely to the development of this physical quality at the school and/or university.
Key Words:- **Development of flexibility, static-passive technique, bouncing technique, range of motion, practical application flexibility.**

Introduction

Flexibility is a component associated with physical fitness in relation to health (Micheo, Baerga & Miranda, 2012), and is defined as the ability to be able to execute movements with a large joint range of motion (Merino-Marban et al., 2011). It is improved by performing stretching exercises, a very popular exercise modality generally used for health, recreation, and performance purposes (Babault et al., 2021).

Flexibility is an important component of health-related physical fitness and sport performance (Brito et al., 2013). Therefore, exercises that improve flexibility are usually included in the routines of athletes, in the prescriptions for sedentary people, people over 65 years old or with any pathology related to mobility, so that they can improve their health and quality of life (Brito et al., 2013). Flexibility is assessed in most of the health-related fitness batteries (Marques et al., 2021).

In relation to the pathologies and problems caused by the lack of stretching, Urrutia (2020) points out that stretching, within the field of physiotherapy today, is a common therapy and is used to increase flexibility (Decoster, 2005; Gunn, 2018), to prevent and cure contractures (Harvey, 2017) or to manage different pathologies (Page, 2012). Thus, cramps, contractures or muscle stiffness appear quite frequently in people and increase in the elderly, in people who have done some physical exercise and in pregnant women (Thompson, 2007). In addition, they can lead to various pathologies related to muscle injuries that are effectively treated during recovery periods thanks to stretching (Rodas et al. 2009).

Flexibility can be improved through different stretching techniques such as static-passive stretching in trained men (Dias et al. 2017), dynamic stretching technique in healthy men (Barbosa et al. 2018), proprioceptive neuromuscular facilitation (PNF) technique in older adults between 65 and 85 years old (Silva et al. 2017) and bouncing technique in adolescent girls (Becerra-Fernández et al., 2016) and in different populations. On the other hand, stretching is a very common practice in both physical-sports and clinical settings, whose main purpose is to maintain or improve range of motion (Ayala, Sainz and Cejudo, 2012), since the lack of stretching ends up causing muscle shortening (Becerra-Fernández et al., 2017) and can limit the ability to carry out daily activities (Bushman, 2017).

Not all stretching is performed in the same way or pursues the same objective. Depending on the context (clinical, warm-up, cool-down, specific sessions), the application of one technique or another will be

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more appropriate to achieve the proposed objectives (Ayala, Sainz & Cejudo, 2012). The static-passive technique used during warm-up may decrease performance in subsequent strength tasks related to the soleus (Trajano et al., 2020). However, when a dynamic technique is used in the warm-up, performance increases in speed exercises (Zmijewski et al., 2020) and explosive strength exercises (Merino-Marban et al., 2021). And performing the same static-passive stretches during the cool-down seems to be more effective in improving flexibility than performing them during the warm-up (Mayorga-Vega et al., 2014). Therefore, it is of vital importance that doctors, coaches, physical trainers, and other members in the field of physical-sports activity know the characteristics, advantages, and disadvantages of each of the different stretching techniques (Ayala, Sainz & Cejudo, 2012). Therefore, the proper use of stretching techniques and exercises is a key element when performing physical activity (Passarella et al., 2020).

Furthermore, according to the studies of Mayorga-Vega, et al. (2011) and Oshita, et al. (2017), the knowledge about flexibility techniques and the practical application of these techniques is not sufficient in university students and in the general population and knowledge of stretching should be improved when experts are present.

For all of the aforementioned reasons the question and the approach of the present study was born: do future PE teachers have sufficient knowledge about stretching and its practical application? This study aims to determine the knowledge of Physical Education (PE) students (Latvian Academy of Sports Education, Riga) about stretching techniques, how they are applied, which stretches they perform in their training sessions and to analyze whether this knowledge improves over the years of the study.

Material & methods

An observational, cross-sectional, descriptive study was conducted on a sample of 159 volunteer university students from the Latvian Academy of Sports Education in Riga.

Participants

A sample of 159 volunteer university students (83 males and 76 females), corresponding to the four university courses and the first year of the Master's degree at the Academy of Sports Education, located in an urban area of the city of Riga (Latvia), participated in the present study. From the total number of participants, those belonging to the second and fourth year and the first year of the Master's degree were eliminated as the sample was not representative of the second and fourth year and the first year of the Master's degree. Therefore, the sample finally consisted of 148 university students (78 males and 70 females) from the first and third years of the Academy of Sports Education (Table 1).

The protocol of the present study was first approved by the Ethics Committee of the Latvian Academy of Sports Education. Afterwards, the university students were fully informed about all the characteristics of the study and were required to sign an informed consent document. The study protocol respected the current agreement of the Declaration of Helsinki (AMM, 2013) on ethical principles for research involving human subjects.

Procedure/Test protocol

Students completed an ad hoc questionnaire designed with the intention of obtaining information on the knowledge and practical application of stretching techniques. This questionnaire was the same as the one used in a similar study conducted in a Spanish university population (Mayorga-Vega et al., 2011). The questionnaire consisted of 14 questions, including questions about the techniques students knew, the type of techniques they used and at what point in the session they applied them.

Measure/Instruments

The questionnaire started with general questions (name, gender and age). After which they were asked about PA habits, stretching habits and knowledge about stretching through the following questions (the questionnaire was translated into Latvian by the 2nd author of the study):

1- Are you federated in any sport?
2- How many hours of Physical Activity do you performance per week?
3- What is the maximum number of training hours that you do in a weekday?
4- What is the maximum number of training hours that you do in a day at the weekend?
5- What sports do you do?
6- What sports do you spend more time doing/training?
7- How many minutes do you spend stretching in a single training session?
8- In which part of the training session do you stretch?
9- Do you dedicate any training session exclusively to stretching?
10- How much time do you allow between training sessions and stretching?
11- What stretching techniques do you know?
12- Which stretching techniques do you use when you are training?
13- Which stretching techniques do you use when you are warming up for training?
14- Which stretching techniques do you use when you are cooling down after training?

Data collection and analysis / Statistical analysis

An analysis of descriptive statistics, frequency tables and Pearson's chi-square tests was performed to describe key trends in the data collected and to observe the behavior of the sample. The different statistics were performed with the statistical software SPSS Version 25.0 for Windows (IBM® SPSS® Statistics).

Results

A descriptive analysis of the data was carried out. Table 1 shows the general characteristics of the participants.

Table 1. General characteristics of the participants

	1st Year	3rd Year	Total
Participants	53	95	148
Age	20.98 ± 3.42	21.48 ± .955	21.30 ± 2.19
Men / Women	20 / 33	58 / 37	78 / 70
Federated / Non federated	16 / 37	27 / 68	43 / 105

Table 2 shows the differences in PA habits, time spent stretching, stretching techniques known and used in practice by the first and third-year students. It is worth highlighting the few minutes dedicated to stretching in each session (2.80 ± 1.267), and the relative absence of sessions dedicated to stretching per week (0.20 ± 0.659). Moreover, third-year students know more stretching techniques than first- year students (1.87 ± 0.672 vs. 0.84 ± 0.569).

Table 2. Physical Activity and Stretching Habits

	1º	3º	Mean
Hours of PA/week	5.77 ± 1.694	5.04 ± 1.617	5.30 ± 1.677
Weekly PA sessions	4.79 ± 2.134	4.32 ± 2.398	4.49 ± 2.311
Min. of stretching/session	3.13 ± 1.428	2.61 ± 1.133	2.80 ± 1.267
Stretching sessions	0.28 ± 0.794	0.16 ± 0.571	0.20 ± 0.659
Min. between exercise and stretching	86.91 ± 74.734	66.20 ± 87.445	73.61 ± 83.454
Num. of known techniques	0.84 ± 0.569	1.87 ± 0.672	1.54 ± 0.777
Num of techniques they can explain	0.45 ± 0.932	0.76 ± 0.986	0.65 ± 0.975
Num. of techniques in warming up	0.89 ± 0.506	1.06 ± 0.501	1.00 ± 0.508
Num. of techniques in main part	0.94 ± 0.569	1.28 ± 0.630	1.16 ± 0.629
Num. of techniques in cooling down	0.87 ± 0.440	1.07 ± 0.550	1.00 ± 0.522

Table 3 shows at which stage of the session participants stretch.

Table 3. Frequencies of stretching phases of the session

	First year Frecuency	Valid porcentage	Third Year Frecuency	Valid Porcentage
0	1	1.9 %	1	1.1 %
1	15	28.3 %	17	17.9 %
2	0	0 %	0	0 %
1 y 2	1	1.9 %	0	0 %
3	8	15.1 %	23	24.2 %
1 y 3	27	51 %	54	56.9 %
1, 2 y 3	1	1.9 %	0	0 %
Total	53	100 %	95	100 %

0= Non phase; 1= Warm up; 2= Main part; 3=Cool down.

In Table 4, we can observe the frequency of the weekly training sessions in which they perform some kind of stretching. Most of the participants perform some stretching in at least two sessions per week.

Table 4. Frequencies of weekly sessions with some stretching

Num of sessions	First year Frecuency	Valid percentage	Third year Frecuency	Valid percentage
0	1	1.9 %	0	0 %
1	9	17.0 %	9	9.5 %
2	43	81.1 %	86	90.5 %
Total	53	100 %	95	100 %

Table 5 shows the frequency of exclusive stretching sessions. Most of the participants do not perform exclusive stretching sessions.

Table 5. Frequencies of weekly exclusive stretching sessions

Num of sessions	First year Frecuency	Valid percentage	Third year Frecuency	Valid percentage
0	45	84.9 %	85	89.5 %
1	4	7.5 %	8	8.4 %
2	2	3.8 %	0	0 %
3	1	1.9 %	1	1.1 %
4	1	1.9 %	1	1.1 %
Total	53	100 %	95	100 %

Lastly, Figures 1 and 2 show the number of minutes (%) of participants in the first and third year, respectively, that elapse between a training session and the subsequent stretching.

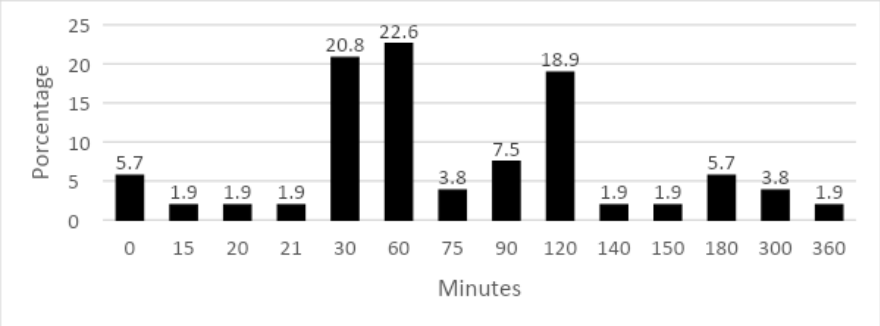

Figure 1: Minutes between training and post-stretching (1st year)

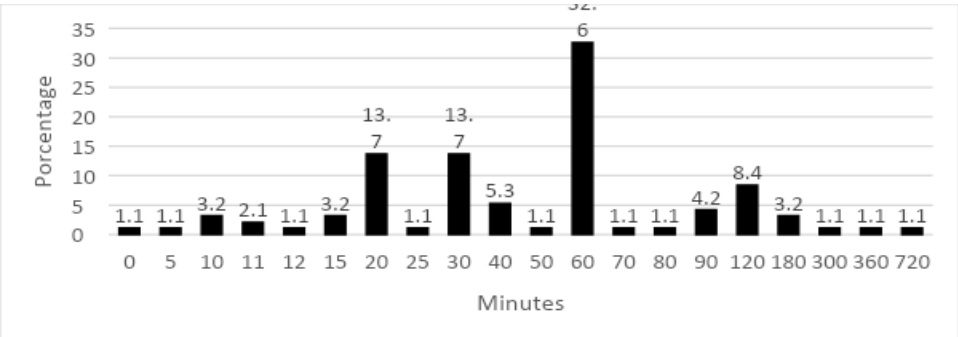

Figure 2: Minutes between training and post-stretching (3rd Year)

Dicussion

The aim of the present study was to investigate the knowledge about stretching techniques and their application in physical activity and sport among university students of the Latvian Academy of Sport Education, Riga. Our results revealed that PE and sports students are healthy and physically active but have a low level of knowledge about stretching techniques and their practical application. The time dedicated to stretching is insufficient and no sessions are dedicated exclusively to stretching.

Despite the total number of participants who enrolled in the study (148), it is striking that despite being students of Sports Education, only 43 are federated in some sport modality (Table 1).

The hours of PA they perform each week is 5.30h (Table 2). This result is in line with the recommendations of 150-300 minutes per week of PA for general health recommended by the OMS (2020). Regarding the minutes dedicated to stretching in each session, these are very low (mean 2.80 ± 1.267) which contrasts to studies indicating that the practice of stretching is widespread among professional and amateur athletes (Sainz de Baranda & Ayala, 2010). This is difficult to understand in future sport and Physical Education professionals. This result is related to the lack of sessions dedicated solely and exclusively to stretching (average of 0.20 sessions per week). According to Babault et al. (2021) stretching is important for pain reduction, recovery and improved quality of life among other benefits. Furthermore, according to Oshita et al. (2017), individuals without regular exercise habits may not have the correct knowledge of stretching and, therefore, receiving instructions on how to perform stretching is very important for this population.

In addition, the results obtained revealed that the third-year students know more techniques than the first-year students (Table 2). This is normal since the first-year students have just arrived at university and are in training, while the third-year students already have a more solid base than the rest of their classmates. Even so, the techniques known by the third-year students are scarce, as the average per student is less than 2 known

techniques. Why is this possible? It is possible that the third-year students, despite having studied and known the different techniques, as can be seen in the results in Table 2, the non-use of these techniques when setting up a stretching session or not usually doing them after engaging in sport means that this knowledge has been forgotten with the passage of time. These results are similar to the study by Mayorga-Vega et al. (2011), in which the survey of 217 Physical Education students revealed that 32.4% of students did not know any stretching technique.

Table 3 shows that 51% of first-year students and 56.9% of third-year students tend to stretch during both the warm-up and the cool-down. However, very few students stretch during the main part of the session. In addition, it should be noted that 28.3% of first-year students only stretch during the warm-up and 15.1% only during the cool-down. In third-year students, 17.9% stretch exclusively during the warm-up and 24.2% only during the cool-down. Different authors point out that stretching is most effective when the muscle temperature rises slightly to moderately (Gama et al., 2018; Garber et al., 2011). Therefore, introducing them at the end of the warm-up and/or in the cool-down would be more beneficial.

In relation to weekly sessions with some type of stretching (Table 4), most of the students in both courses perform, during at least 2 training sessions, the relevant stretching. However, observing Table 5, it can be seen that more than 80% of the students do not do any sessions exclusively dedicated to stretching. Thus, there seems to be a clear relationship between their knowledge of techniques the use of stretching during training sessions and the period of time they apply them. Thus, we should be aware of the importance of stretching, as different types of techniques are not only effective in improving performance, but also in reducing injuries and promoting sports rehabilitation (Page, 2012; Shrier, 2004; and Stone, 2006). Furthermore, the effect of stretching not only affects athletes, but also normal people in everyday life (Oshita et a. 2017).

Finally, in relation to the number of minutes of stretching between a training session and the relevant stretching, Graph 1 illustrates that most first-year students wait an average of at least 30 minutes before stretching (20.8% of the total), one hour for 22.6% of the students and 18.9% for those who wait at least two hours before stretching. Regarding the third-year students, 13.7% of the students decide to wait 20 and 30 minutes respectively to do the stretching exercises, but the majority (32.6%) decide to wait one hour to do them. If we take into account the time they dedicate to work on this physical quality, we can deduce that this population only dedicates time to stretching the large muscle groups as they stretch for a very short time on average, which will lead them to stretch for a few seconds each part of the musculature and they will not perform many repetitions during the stretching. Similarly, in the study by Mayorga et al. (2011), knowledge of the techniques and their practical application was scarce in the university population.

On this basis, the knowledge that future PE teachers should have should not be so low. As mentioned above, the benefits of stretching are many and maintaining muscle elasticity and extensibility will allow people to lead active and healthy lifestyles, reducing the likelihood of developing chronic conditions and diseases during adulthood (Vernaza et al. 2010). It is important to know the effects of the different stretching techniques. Thus, for example, according to Montalvo et al. (2023) the dynamic technique is more effective than the static technique on pain pressure threshold and muscular activation.

Furthermore, knowing that physical inactivity is one of the leading causes of death globally, using stretching, which is one of the simplest exercises to perform, would be an effective method to prevent physical inactivity (Oshita et al., 2017; Vernaza et al., 2010). This could be complemented by appropriate instruction by a supervisor to support exercisers and non-exercisers in performing stretching exercises (Babault et al., 2021; Oshita et al., 2017).

Practical application

It would be advisable to implement intervention programmes and sessions dedicated solely to the development of this physical quality at the school and/or university, in order to increase the knowledge and benefits of training this basic physical quality.

Conclusions

Despite being physical education students (Latvian Academy of Sports Education), the number of federated students in a sport was quite low (43 students out of 148).

The time students spent on stretching in each session was insufficient (2.80 ± 1.267 min.), although the time spent training (5.30 ± 1.677) is almost one hour per day during the week.

The number of known stretching techniques was lower in the first than in the third year (0.84 ± 0.569 vs. 1.87 ± 0.672).

Most of the students usually stretch during warm-up and cool-down, but also, there is a high percentage who only stretch during warm-up or cool-down. 89.5% of the students do not dedicate any session exclusively to stretching. The results obtained after completing the questionnaire show that physical education students have a low level of knowledge about stretching techniques and their practical application. It would be advisable to implement intervention programmes and sessions dedicated solely to the development of this physical quality at school and/or university, in order to increase knowledge in sports practice.

Conflicts of interest - The authors do not have any conflicts of interest to declare.

References:

World Medical Assembly (WMA). (2013). WMA Declaration of Helsinki - Ethical Principles for Medical Research Involving Human Subjects. https://www.wma.net/es/policies-post/declaracion-de-helsinki-de-la-amm-principios-eticos-para-las-investigaciones-medicas-en-seres-humanos/ [In Spanish]

Ayala, F., Sainz de Baranda, P. and Cejudo, A. (2012). Flexibility training: stretching techniques. *Revista Andaluza de Medicina del Deporte, 5*(3),105-112. [In Spanish]

Babault, N.; Rodot, G., Champelovier, M.; Cometti, C. (2021) Survey on Stretching practices in Women and Men from Various Sports or Physical Activity Programs. *Int. J. Environ. Res. Public Health, 18,* 3928. https://doi.org/10.3390/ijerph18083928

Barbosa, G. M., Figueirêdo Dantas, G. A., Silva, B. R., Souza, T. O., & Brito Vieira, W. H. (2018). Static or dynamic stretching program does not change the acute responses of neuromuscular and functional performance in healthy subjects: a single-blind randomized controlled trial. Revista Brasileira de Ciências Do Esporte, 40(4), 418–426. doi:10.1016/j.rbce.2018.06.002

Becerra-Fernández, C. A., Merino-Marban, R., & Mayorga-Vega, D. (2016). Effect of a physical education-based dynamic stretching program on hamstring extensibility in female high-school students. *Kinesiology, 48*(2), 258–266. doi:10.26582/k.48.2.3

Becerra-Fernández, C.A., Mayorga-Vega, D y Merino-Marban, R. (2017). How do students' hamstring extensibility levels change through an academic year? A longitudinal study. *Educación Física y Ciencia, 19*(2), e029. https://doi.org/10.24215/23142561e029

Brito, L., Mendes, D. y Gil, C. (2013). Does Flexibility Influence the Ability to Sit and Rise from the Floor? *American Journal of Physical Medicine & Rehabilitation, 92*(3), 241-247.

Bushman, B., & American College of Sports Medicine. (2017). ACSM's Complete Guide to Fitness & Health, 2E. Human Kinetics.

Decoster, L. C., Cleland, J., y Altieri, C. (2005). The Effects of Hamstring Stretching on Range of Motion: A Systematic Literature Review. *Journal of Orthopaedic & Sports Physical Therapy, 35*(6), 377–387. doi:10.2519/jospt.2005.35.6.377

10. de Urrutia, I., González, Y., Calvete, A., and da Cuña, I. (2020). Effectiveness of stretching in musculoskeletal pathology: A systematic review. *Naturopathic Medicine, 14*(2), 107-116.

Dias, H., Paz, G., Maia, de F., Leite, T., Miranda, H. y Simão, R. (2017). Number of repetition after different rest intervals between static stretching and resistance training. *Revista Andaluza de Medicina Del Deporte, 10*(3)*,* 132-136.

Espinoza, G., Sánchez, B., Rojas, D., Gutiérrez, J. C., Cordero, K. and Blanco, L. (2021). Acute effect of static and dynamic stretching on performance and perception of effort in counter-resistance exercise. *MHSalud, 18*(1), 1-18. http://doi.org./10.15359/mhs.18-1.1 [In Spanish]

Estélio, H., Dantas, P., Soares, J. (2001) Flexibility in personal training. Castelo Branco University. Fit. & Perform, 1, 1-7. [In Spanish]

Gama, H. S., Yamanishi, J. N., Gallo, L. H., Valderramas, S. R., & Silveira Gomes, A. R. (2018). Stretching exercise: prescription and effects on musculoskeletal function in adults and elderly people. *CADERNOS BRASILEIROS DE TERAPIA OCUPACIONAL-BRAZILIAN JOURNAL OF OCCUPATIONAL THERAPY, 26*(1), 187-206.

Garber, C. E., Blissmer, B., Deschenes, M. R., Franklin, B. A., Lamonte, M. J., Lee, I. M., ... & Swain, D. P. (2011). American College of Sports Medicine position stand. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. *Medicine and science in sports and exercise, 43*(7), 1334-1359.

Gunn, L. J., Stewart, J. C., Morgan, B., Metts, S. T., Magnuson, J. M., Iglowski, N. J., Arnot, C. (2018). Instrument-assisted soft tissue mobilization and proprioceptive neuromuscular facilitation techniques improve hamstring flexibility better than static stretching alone: a randomized clinical trial. *Journal of Manual & Manipulative Therapy,* 1–9. doi:10.1080/10669817.2018.1475693

Harvey, L., Katalinic, O., Herbert, R., Moseley, A., Lannin, N., y Schurr, K. (2017). Stretch for the treatment and prevention of contracture: an abridged republication of a Cochrane Systematic Review. *Journal of Physiotherapy, 63*(2), *67–75. doi:10.1016/j.jphys.2017.02.014*

IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.

López-Bedoya, J.; Vernetta-Santana, M.; Lizaur Girón, P.: Martínez-Patiño, M.J. and Ariza Vargas, L. (2019). Comparison of lexibility training techniques (FNP) with and without electrostimulation. *International Journal of Medicine and Physical Activity and Sport Sciences, 19*(74), 277-292. [In Spanish]

Mayorga-Vega, D.; Merino Marban, R.; Iglesias Navarrete, P.; Fernández Rodríguez, E. (2011). Knowledge about flexibility and its practical application among Physical Education Teacher Training students. *Trances, 3*(5), 661-686. [In Spanish]

Mayorga-Vega, D., Sánchez Rivas, E., Fernández Rodríguez, E. and Merino-Marbán, R. (2014). Effect of a stretching programme for the hamstring muscles in physical education classes in Primary Education. *Journal of Sport and Health Research. 6*(2), 159-168. [In Spanish]

McHugh, M. P., & Cosgrave, C. H. (2009). To stretch or not to stretch: the role of stretching in injury prevention and perfomance. *Scan J Med Sports, 20,* 169-181. https://doi.org/10.1111/j.1600-0838.2009.01058.x

Merino, R.; López, I.; Torres, G.; Fernández, E. (2011). Flexibility concepts and related terms. *Una revisión sistemática. Trances, 3*(1), 1-32. [In Spanish]

Merino-Marban, R., Fuentes-Martín V., Torres Bravo M et al. (2021). Acute effect of a static- and dynamic-based stretching warm-up on standing long jump performance in primary schoolchildren. *Biol Sport, 38*(3), 333–339.

Micheo, W., Baerga, L. y Miranda, G. (2012) Basic Principles Regarding Strength, Flexibility, and Stability Exercises. *American Academy of Physical Medicine and Rehabilitation, 4,* 805-811.

Montalvo, S., Conde, D., Sanchez, M., Martinez, P., Trevizo, R., & Ibarra-Mejia, G. (2023). Dynamic stretching improves muscle activation and pain pressure threshold but not isometric hand strength when compared to static stretching. *Journal of Physical Education and Sport, 23*(2), 293-300.

Organización Mundial de la Salud [OMS]. (2020). Physical Activity. https://www.who.int/es/news-room/fact-sheets/detail/physical-activity. [In Spanish]

Oshita, K., Matsuzaki, T., Hikita, A., Miyazaki, R., Hagiwara, G., Tashiro, T., Tsuno, T., Higuchi, Y., Funatsu, K. (2017). Association between the experience of supervised strength training and the knowledge of stretching. *Gazzeta Medica Italiana – Archivio per le scienze Mediche;* 176, pp. 1-12. Doi: 10.23736/S0393-3660.16.03422-7

Page P. (2012). Current Concepts in Muscle Stretching for Exercise and Rehabilitation. *Int J Sports Phys Ther, 7*(1), 109- 19.

Passarella, R., Nugroho, A. y Arsyad, F. (2020). Pull-down Fitness Technique Analysis using Motion Capture. *Journal of Physics: Conference Series, 1500,* 1-11. doi:10.1088/1742-6596/1500/1/012105

Rabita, G. y Delextrad, A. (2013). Stretching. En Hausswirts. C. y Mujika. I. *Recovery for performance in sport*, 191-201. Champaing: Human Kinetics.

Rodas, G., Pruna, R., Til, L., Martín, C. (2009). Clinical Practice Guideline on Muscle Injuries. Epidemiología, diagnóstico, tratamiento y prevención. *Apunts med esport, 164,* 179-203. [In Spanish]

Rubini, E., Costa, A., & Gomes, P. (2007). The effects of stretching on strength performance. *Sports Med, 37*(3), 213-222. https://doi.org/10.2165/00007256-200737030-00003.

Sainz de Baranda, P., y Ayala, F. (2010). Acute effect of stretching on agility and coordination of fast movements in Division I football players. Kronos, 9, 21-28. [In Spanish]

Shrier I. (2004) Does stretching improve performance? A systematic and critical review of the literature. *Clin J Sport Med, 14,* 267-73.

Silva, I. A., Amorim, J. R., Carvalho, F. T. de, & Mesquita, L. S. de A. (2017). Effect of a Proprioceptive Neuromuscular Facilitation (PNF) protocol on postural balance in elderly women. Fisioterapia e Pesquisa, 24(1), 62–67. doi:10.1590/1809-2950/16636724012017 [In Portuguese]

Stone M, Ramsey MW, Kinser AM, O'Bryant HS, Ayers C, Sands W. (2006). Stretching: Acute and chronic? The potential consequences. *Strength Cond J*, *28*, 66-74.

Thompson, P. (2007). Muscle cramp syndromes. *Handbook of clinical neurology, 86,* 389-96.

Vernaza, P., Illera, D. y Paz, C. (2010). Flexibility and health in students of the rehabilitation team. *Revista Facultad Ciencias de la Salud. Vol. 12* (2), p. 21-27. [In Spanish]

Zmijewski, P., Lipinska, P., Czajkowska, A., Mróz, A., Kapuściński, P. & Mazurek, K. (2020). Acute Effects of a Static vs. a Dynamic Stretching Warm-up on Repeated-Sprint Performance in Female Handball Players. *Journal of Human Kinetics, 72*(1) 161-172. https://doi.org/10.2478/hukin-2019-0043