v. 4, n. 15, 2024

International Journal of Human Sciences Research

DANCE: A PHYSICAL AND COGNITIVE EXERCISE

Gabriela Larissa Lima da Silva
``Universidade Estadual Paulista`` "Júlio de Mesquita Filho" (Unesp). Botucatu, Brazil

All content in this magazine is licensed under a Creative Commons Attribution License. Attribution-Non-Commercial-Non-Derivatives 4.0 International (CC BY-NC-ND 4.0).

Abstract: Dance has existed for centuries and there is growing interest in its physical and cognitive benefits. This Art is an organized set of rhythmic body movements, which can be accompanied by music, and integrate the motor and sensory systems and cognitive functions such as focus, attention and memorization, in addition to awakening creativity. Here we carried out a bibliographic survey and a questionnaire on self-perception of benefits achieved through dance.
Keywords: Health; Physical activity; Performing arts; Body language; Brain.

INTRODUCTION

Dance can be defined as a set of rhythmic body movements accompanied by music, and is a universal art form, practiced by all human societies and even by other species, such as non-human primates (FAN; MA; GARBER; ZHANG et al., 2016. DALZIELL; COCKBURN;

Many hypotheses have been created about how this activity emerged and what its evolutionary role would be (WANG, 2015). It was initially largely attributed to reproductive behavior, as a way of obtaining sexual partners, in addition to being part of various religious rituals. However, today it is known that this activity goes beyond these perspectives, presenting a very important social role, also configuring a channel for expression and release of energy. Currently, it is even speculated that dance may have appeared from the imitation of movement disorders, since mirror neurons encourage humans to reproduce the movements they observe (TAGHIPOUR; DERAKHSHAN, 2018. LALAND; WILKINS; CLAYTON, 2016).

The act of dancing, in general, implies the need for bodily mobility, and requires the use of functions such as fine motor coordination. There are currently several types of dance, which vary in terms of rhythm, technique, origin, speed, rigor and intention, but despite this, in the current format of society, when a person decides to learn a certain already established dance modality, it implies that she will also use functions such as memory, whether to learn the nomenclature or the sequence of steps in a choreography, and attention, which is essential for most activities that involve learning (ZARDI; CARLOTTI; PONTREMOLI; MORESE, 2021).

In view of the Cognitive-sensorimotor integration and the knowledge of the intimate relationship between neural structure and functions, a question arises to be investigated: how much of these skills involved in dancing noticeably alter the brain and improve the individual's cognitive functions and health? In order to answer this question, a bibliographic survey was carried out to compose this work. Furthermore, in order to ratify the improvement premises, a questionnaire was also applied to investigate physical and cognitive benefits self-reported by dance practitioners.

MATERIAL AND METHODS

To investigate the role of dance in cognition, a bibliographic survey was carried out on the PubMed data platform, from which articles published in international magazines in English were extracted. Systematic reviews were prioritized, which could contribute with a broader view and have a more substantial amount of data.

The questionnaire applied to complement the literature findings consisted of the following questions:

- Basic information (city, age).
- Indicate the types of dance you practice/ practiced;
- How long have you practiced/did you practice any type of dance?
- How many times a week do/did you practice dancing?

• Indicate whether you are a dance teacher, student or professional;

• Do you feel that dancing improves aspects of your physical health (do you notice that it increases your stamina or your strength/endurance and the like)?

• Do you feel that dancing improves your mental health (promotes a feeling of well-being or reduces anxiety, stress and the like)?

• Do you feel that dancing helps your cognition (improves memory/attention/ motor coordination and the like)?

• If you answered yes to any of the last 3 questions, specifically describe the improvements you saw in yourself when performing the dance activity.

• Do you feel that dancing increases your social interaction?

• Describe why you dance and how important this activity is to you.

• If you have already performed a dance, tell us what you thought of the experience.

• Do you see any disadvantages or negative aspects in practicing dance? If yes, please describe.

• If you wish, add information you deem relevant below.

RESULTS AND DISCUSSION

LITERATURE

In relation to bibliographical research, it was notable that in recent decades many articles focused on this topic have been produced. Part of the articles focused on observing the effects of dance as a strategy for reversing or slowing down cognitive decline, both natural with age and resulting from neurodegenerative diseases and other syndromes, while another part focused on observing the effect of dance on adults. under normal conditions.

A review work encouraged a discussion about the cognitive and neural processes involved in the execution, expression and observation of dance, in this case involving not only the dancers themselves, but also the public, thus expanding the perception of the value of this modality, which is beyond of simple physical activity. Among the cognitive aspects covered are the dancers' motor control, their timing and synchronicity, the critical roles played by sequential learning and memory; the strategic use of visual and motor imagery; the insights into the neural coupling between action and perception obtained through the exploration of the brain architecture mediating the observation of dance; and the public's perception of this process (BLÄSING; CALVO-MERINO; CROSS; JOLA et al., 2012).

Another work pointed to dance as a form of intracerebral synchronicity, considering that it expands the synchronicity of at least 7 neural aspects: Sensory, Motor, Cognitive, Social, Emotional, rhythmic and Creative, making it a very comprehensive and multifaceted activity. Furthermore, dances involving more than one person require group work for interpersonal synchronicity, and it has been pointed out that the motivation for dancing is the intrinsic reward obtained with this synchronicity, which leads to an improvement in interpersonal coordination (BASSO; SATYAL; RUGH, 2020).

A study carried out with salsa dancers aged between 49-70 years compared the group's executive functions and spatial memory with a group of non-dancers in the same age group, and it was seen that dance played a positive role in executive functions in a way general (NOGUERA; CARMONA; RUEDA; FERNÁNDEZ et al., 2020).

A meta-analysis based on randomized clinical trials that aimed to investigate the

effectiveness of dance interventions on cognition in patients with mild cognitive impairment concluded that dance interventions are capable of causing small to moderate positive effects in some cognitive domains. This review followed all necessary validation criteria, and only 5 studies met the inclusion criteria to be evaluated (CHAN; WU; DENG; YAN, 2020).

Although this study was conducted on elderly people with mild cognitive decline, some studies have identified that it is possible to observe the positive effects of dancing on healthy elderly people, so that the enjoyment of the activity is not restricted to the treatment of specific conditions (KROPACOVA; MITTEROVA; KLOBUSIAKOVA; BRABENEC et al., 2019).

A systematic review that selected 35 studies out of 1,051, whose purpose was to investigate whether dancing counteracts age-related cognitive and brain declines also concluded that this activity has a protective effect on the cognition of elderly people. The studies included in this review were distributed into 3 main categories: comparison of the performance of regular dancers with that of a sedentary control group with no record of dancing or other sporting activities, comparison between regular dancers and a non-sedentary control group, or even, comparison between dancers with a control group without information about their physical activities or without reliable control of their level of physical fitness. Generally speaking, many included studies observed cognitive gain for the group of dancers in relation to the others, but there was emphasis on the cognitive function of memory, and it was suggested that dance has the potential to induce brain plasticity because dancers also need to learn and remember new movements and steps, as opposed to other physical activities (MUIÑOS; BALLESTEROS, 2021).

A descriptive systematic review that focused on answering the question "What is the influence of dance practice on neuroplasticity in mature brains?" screened 1071 studies, of which 8 were selected. From the analysis of these studies, it was observed that dancing generates positive structural and functional changes. Among the structural changes, an increase in hippocampal volume, gray matter volume in the left precentral and parahippocampal gyrus, and white matter integrity were observed. Functional changes included changes in cognitive function, such as significant improvement in memory, attention, body balance, psychosocial parameters and altered peripheral neurotrophic factor (TEIXEIRA-MACHADO; ARIDA; DE JESUS MARI, 2019).

Although there is this range of evidence showing a positive and differential role of dance on the nervous system, work carried out comparing non-professional senior dancers (n=28) with non-sedentary control group participants without any dance experience (n=29), who were similar in age, education, IQ score, lifestyle and health factors, and fitness level, detected no differences in cognitive domains between the groups, indicating that dancing twice a week has no additional effects on mass volume gray and cognitive functioning when a certain lifestyle or physical activity and fitness level are achieved (NIEMANN; GODDE; VOELCKER-REHAGE, 2016). This specific study made an extremely compatible selection between the group of dancers and the control group of non-dancers, therefore not using a random sample of the population. The choice of IQ similarity between the groups can be questioned, given that this is a work that aims precisely to measure the cognitive component.

IQ is a measure that expresses an individual's intellectual capacity based on reference criteria and comparisons, establishing a

relationship between their mental and chronological age. Several authors, since the 20th century, have indicated that there may be a correlation between an individual's IQ and their performance on neuropsychological tests (WARNER; ERNST; TOWNES; PEEL et al., 1987).

When it comes to cognition, it is clear that it is also very important to consider that the samples evaluated will be heterogeneous, especially in groups of humans, as in addition to the wide diversity of genetic characteristics, humans, in general, present an extremely varied repertoire of cognitive experiences, which can reflect directly on brain structure and cognitive domains. This factor of diversity of experiences is very difficult to control, as researchers need to prioritize the smallest possible intervention in the lives of research subjects. Activities such as reading, crafts and debate circles, for example, were not taken into consideration, in the articles, even though they can also be strong enhancers of cognition, and may be present in an unidentified form both in groups of dancers and in groups of non-dancers.

Although it is important to control the factors, a very corresponding and selected control group sample would not reflect the general population. An approach that could be interesting would be to make use of random samples, collect information about all individuals' activities and indicate them in scientific work, so that if any specific item caught attention, it would be individually analyzed or removed from the sample.

In addition to the effects of dancing on neural processes, it also has widely known physical benefits, since it consists of a physical exercise, being an alternative to a sedentary lifestyle with the potential for high adherence as it is very adaptable to the most diverse conditions (BRUYNEEL, 2019). It can contribute, like other types of physical activity, to quality of life by reducing the risk of cardiovascular diseases, among other undesirable outcomes in sedentary conditions (RODRIGUES-KRAUSE; FARINHA; KRAUSE; REISCHAK-OLIVEIRA, 2016). There are even reports that dance is capable of improving motor skills in children with down syndrome (MCGUIRE; LONG; ESBENSEN; BAILES, 2019).

Another point associated with physical activities is the release of hormones and messengers related to the feeling of well-being, such as endogenous opioids. Physical exercise is widely considered protective factors for mental illness, having an effect comparable to the use of antidepressants. It is possible to observe beneficial effects from this perspective even in single sessions of activity (MIKKELSEN; STOJANOVSKA; POLENAKOVIC; et al, 2017; GUSZKOWSKA, 2004; PELUSO and ANDRADE, 2005; CHEN, NAKAGAWA, AN et al, 2017; PORTUGAL, CEVADA, MONTEIRO-JUNIOR et al, 2013; DESLANDES, MORAES, FERREIRA et al, 2009).

A similar pattern is expected for dance, given that its execution depends on movement, which implies the same type of response.

In addition to the benefit of the exercise itself, some studies have already observed that sensorimotor integration is improved in dancers and musicians compared to people who do not practice these activities (KARPATI; GIACOSA; FOSTER; PENHUNE et al., 2016).

In view of these data, the most interesting experimental pattern to conclude something about the influence of dance as a cognitive stimulator are precisely the designs that compare dancers with groups of non-sedentary people who do not practice dancing, because physical activity in itself already induces, for example, increased hippocampal neurogenesis, which is a very relevant process for memory and learning, and what would be

worth evaluating is whether dance presents greater cognitive improvement than other types of physical activity.

QUIS

Regarding the questionnaire applied in this study, 27 responses were obtained, with participants aged between 8 and 50 years, with the mean, median and mode corresponding to 26. All people who responded were from the city of Botucatu.

Of the responses recorded, 59.3% of people practice ballet, 37% practice jazz, 33.3% practice Latin rhythms, 25.9% practice contemporary dance, 22.2%

do fit dance, 18.5% do tap dancing, 18.5% do ballroom dancing, 14.8% do hip hop, 11.1% do k-pop, 7.4% do flamenco, 7.4% belly dance and 3.7% practice reaggaton/samba and forró/ free step, considering that each individual was able to select more than one option.

Regarding the time spent practicing dance, 14.8% of the sample practiced for less than 6 months, 7.4% practiced from 6 months to 1 year, 11.1% practiced between 1 and 3 years, 29.6%

have been practicing between 3 and 6 years, 22.2% for 6 to 20 years and 14.8% have been practicing for 20 years or more.

40% of the sample reported practicing once a week, while 30% reported practicing 2 or 3 times a week and the other 30% reported practicing 5 times or more per week.

21 out of the 27 participants identified as students, 8 participants identified as teachers, and only 3 identified as professional dancers, again with participants selecting more than one category.

96.3% of participants (26 individuals) reported noticing an improvement in aspects of their physical health (strength and resistance), 100% reported an improvement in their mental health (sense of well-being, reduced stress) and 96.3% reported an improvement in their cognition (memory, attention, coordination), while 92.6% (25 individuals) reported that dance activity increases their social interaction.

Regarding the open question about describing the identified improvements, 23 responses were obtained, describing the improvements and also highlighting points such as improved body awareness and increased general disposition and self-esteem. The answers are listed below:

> "Strength/endurance and motor coordination mainly"
>
> "More proactivity in general tasks, improved muscular resistance and improved mental health"
>
> "Dance gave me a lot of lung and physical resistance, and was also great post-gym cardio. It is the reason for the serotonin released in my body. A day of dancing is as if there were no problems in life and as if everything was a bed of roses, it helps a lot psychologically, with self-esteem and self-confidence, I also feel a big difference!"
>
> "Motor coordination, flexibility, fat loss, feeling of well-being, etc."
>
> "I have noticed an improvement in my mood, I have been sleeping earlier and better (something I have always had problems with), I feel very good, both physically and emotionally, after a class."
>
> "Self-esteem"
>
> "Happy and healthy!"
>
> "I feel more aware of my body, my limits, my difficulties. I found a new activity to improve myself and that requires different ways of overcoming things than studying or working, which does me a lot of good."
>
> "In addition to the significant evolution in body awareness, I also realize that it is a moment that allows me to forget about a heavy and frustrating routine"

"more happiness and feeling that life makes sense"

"I'm much happier, it's good for my self-esteem and helps me control anxiety when it appears. It also helps a lot to develop motor coordination, physical conditioning and creativity."

"Improvement of physical resistance, well-being, balance"

"I feel motivated to improve and learn new things, I feel excited for the next classes."

"Improves endurance and strength, motor coordination, attention and memory"

"Greater body awareness, less back pain, greater freedom of movement"

"Dance is a physical activity that provides great benefits. It could even be considered therapy. Through dancing, the student can develop many skills such as: concentration, discipline, rhythm, coordination, safety, self-confidence and many more. Dance can be a great tool that helps overcome problems and even traumas."

"Mobility and spirit"

"Disposition and motor coordination"

"Memory, agility in physical activities and physical resistance."

"Greater disposition, helped me with depression."

"It's a way of connecting with your own body, whether emotionally, physically or cognitively, of working on body perception and control"

"Every time I left dancing I felt lighter, happier, more energetic. It seemed that when I was there, all the problems disappeared, because it was an environment where I could unload all that, so I felt happier, calmer, with more energy."

"Through dance, with the creation of choreographies and the study of steps to be later taught, I activate memory and moving the body with dance, increases the willingness for other activities, which promotes physical and mental well-being."

Regarding the question "Describe why you dance and how important this activity is to you", we obtained the following answers:

"For development as a child, and because I really like dancing! Yes"

"I like dancing because of the sensations it gives me. Both physically and emotionally, I like feeling all the muscles in my body being worked and getting to know more about it, I like being able to unload all my daily stress there, being able to distract myself from everyday problems."

"Bodily expression, mental and physical health"

"At first it was the cure for depression, today I can no longer do without it for countless reasons"

"It's an activity that I believe has potential, and that I can see improvements during practice. Plus, I feel like it's just something that makes me feel good."

"For distraction. It helps me make my week better. Take life more lightly."

"I've liked dancing since I was very little and I've been taking dance classes since I was in kindergarten. When I dance, I feel like I can release all my emotions and energy, and it helps me reduce stress, etc."

"Currently I don't dance, but dancing has helped me a lot with my hyperactivity and attention deficit, it helped me use that energy and focus on dancing, at the end of each rehearsal I felt calm inside me."

"I've always loved dancing, I've done ballet at different times in my life. Currently, the importance has been to improve my

health, I was quite sedentary, and I wanted to do something that I liked, so I turned to dancing."

"Dance is very important in my life, since I started dancing again my physical and mental health has improved a lot. I can't see myself without dancing!"

"I dance because it makes me happy. Dancing is important to me because it is what brings me life and what makes me feel alive. These days I even made a beautiful mistake… For some reason, I went to say "my life" and accidentally said "my dance".

"Dance is the ultimate expression of feelings. It's a big part of my life."

"I dance as a form of physical exercise to improve my health in general, although tap dancing is a dance that I like to practice for the sake of practicing, to see myself improving. And also, my biggest incentive is that it allows me to spend more time with the love of my life."

"It helps me with my health and mentally, especially for me who likes physical activity and movement, as well as helping me keep my cholesterol a little lower"

"I have always admired ballet and imagined myself being a ballerina, it has always been a dream and besides, it is the physical activity that most closely matches my personality"

"I love dancing, it's good for the mind"

"I dance for love, to forget the bad side of life, to feel good about myself and be happy. For me, dancing is one of the most precious and important things in mental matters. It is important not only for the mind, but also for health, it helps us with posture, health, self-love and countless other good things."

"Dance has always been part of my life, it's who I am."

"Dancing makes me happy"

"I dance to express myself, improve as a person and transmit art through movement. I feel more human when I have the possibility of expressing myself this way."

"I dance because I love it. I enjoy learning and also teaching. The end result is rewarded with the joy of being able to see that my work brings joy and well-being to other people."

"It's already part of who I am and my own artistic and personal development, how to express myself and connect with the world."

"To get to know my body better, because it's good for me emotionally too."

"Breaking the paradigms of society and for traditional family reasons, in the case of forró."

"I like learning new things to do with my body. I think it allows us to explore our bodies beyond the movements it makes on a daily basis."

"Having hobbies is important and fun, ballet is one of mine."

"The way I express myself and let go."

Regarding the question "If you have already performed a dance, tell us what you thought of the experience.", the answers below were obtained:

"Yes, but it's been a while, cool and a little scared lol and it was very good!"

"I really enjoyed the experience. It was good to be able to meet more people who danced, to get to know other types of dance too."

"Excellent for self-evaluation and challenging as a physical activity"

"It was incredible, surreal"

"I already did some independent performances, even before I started taking jazz classes. Most left me very nervous and insecure, but satisfied after finishing."

"It's always cool to be able to show other people how beautiful dance can be."

"It was really cool, at first you get a little apprehensive as people enter the performance space, you kind of have an idea of how many people will watch the performance, but overall it's very satisfying to present the dance, people really like it."

"It's a bit nervous before the performance but it's a really cool and unique experience."

"Yes, I did. I found it to be a fantastic and unique experience. Being able to express feelings and emotions through movements. It's unique and liberating!"

"The experience was wonderful! How much I grew, how much fun I had in the process and on the day of the presentation… I can't wait to perform again!"

"Very good"

"only as a kid, but it was amazing and I loved it"

"It was nice to stop and reflect on this wonderful thing that is dancing! I hope I helped and served you as expected!"

"Yes, I like it, but dancing is just a hobby"

"At first it was a little scary, but in the end, when you finish, it's an incredible feeling that you can do anything"

"The feeling of going on stage is unparalleled. In performances with many people and large choreographies it is even more exciting. Being part of an organized whole full of dedication."

"I gave many presentations. And in all of them I felt fulfilled."

"A delightful bonding experience with both the cast and the audience, a way to show the world what you have to offer as art."

"Incredible, from the rehearsals, the beforehand and the presentation itself."

"I found it an incredible feeling of freedom."
"Yes. It was very cool!"

"Dancing with others is frustrating and a much bigger logistical challenge than dancing. It's always nice to produce something, but the steps leading up to it aren't particularly nice."

"It's something unique and magical."

From the answers to the open questions, it was possible to see that dance has a very relevant role not only for physical health and cognition, but also for the mental health aspect of practitioners, having been identified as a way to increase the self-esteem, bring happiness and even help deal with depression. Physical activities have the property of increasing the release of molecules related to well-being, therefore, this finding is consistent with what is already established in the literature. Furthermore, dance in particular has its own performative character, which implies disinhibition and confidence, making it very powerful also from a conscious point of view, going beyond molecular signaling.

The dance performances, in turn, provoke a series of diverse reactions, according to the testimonies. For some people, there is the implication of prior stress, which is followed by a pleasant sensation. The predominance of feelings in the responses was euphoria and satisfaction. The majority of participants reported having enjoyed the experience, and it is possible that it is a strong motivator for maintaining this activity in people's lives in the long term. One individual, in turn, attributed the negative aspects to group work, which may indicate that social interaction is a relevant factor for this experience, although this opinion is not so representative.

Furthermore, a single negative aspect of dancing in the field dedicated to this was listed.

> *"Depending on the dance, I tend to feel a lot of pain in my knees and spine, especially during ballet jumps. However, when practicing activities in parallel to dancing, such as Pilates, I notice a significant reduction in these pains.* "This comment was atypical for the sample obtained, and may be associated with particular limitations. The individual pointed out the problem and a particular solution, and despite this, this participant still indicated the perception of other improvements resulting from the dance.

In the space dedicated to additional comments, there were two relevant responses:

> "Dance is very important as a hobby, art, culture and form of expression, but many ballet schools can be toxic when they demand that students have a (thin) body standard, so it is necessary to find a welcoming and professional school."

> "Dancing is more than exercise. It's quality of life."

The first additional comment brings up a very relevant discussion from a social point of view: the imposition of specific body standards. The participant points out that there are schools that push for a type of aesthetic standard and schools that do not encourage it in the same way. Although dance has many intrinsic benefits, other issues associated with this experience cannot be ignored, and it is extremely important to search for healthy environments, where there is tolerance and acceptance, not only from instructors, but also from classmates.

The second additional comment reflects a perception of the impact of dance in different aspects, and summarizes in general terms the notes made via the form. In short, it is possible to observe that people who responded to the questionnaire generally feel satisfied practicing dance and are able to attribute significant life improvements to this practice. Few reservations were highlighted, such as some challenging group work situations and other issues related to individual physical limitations. In view of the above, we observed that our self-report data are in line with what was previously pointed out in the literature, given that there was majority agreement regarding cognitive enhancement, improved physical well-being and increased social interaction, in addition to a consensus regarding the impact on Mental Health.

The studies listed, as well as the form, did not focus on a specific dance modality, however, based on the data in the form, they all seemed to have the same type of impact on the research subjects. Some of the studies did not report the frequency of the activity performed, which could potentially explain part of the divergent results between the studies found in systematic reviews and meta-analyses. Separating the data by age group and frequency may in the future shed light on what is actually important for the cognitive result of the sport.

When it comes to a question about the cognitive aspect, removing confounding factors can be an arduous task, and most of the work obtained in the literature review did not focus on this aspect, limiting itself to investigating the majority of physical activities, not including other cognitive activities present in the groups. Despite this, the majority of studies, however divergent, observed improved performance in one or more cognitive domains of dancers, which may suggest that this is an effect of high magnitude.

In the case of the form, as it is a self-report and relies on spontaneous contributions, it is possible that there is a sample bias, given that there is the possibility that people more closely involved with dance may be more willing to respond to a survey of this type. type, implying potential unintentional filtering. Furthermore, self-reporting is also not free from other confounding factors.

CONCLUSION

From the content exposed, it is possible to conclude that dancing plays an important role for the brain and for people's general health, given that it is a physical activity that demands learning, being a relevant cognitive stimulus. Furthermore, dance can still be an important means of promoting social interaction, which is fundamental for the human species. With this, associated with other characteristics of this activity, we can also point out that it is an important instrument to prevent mental illness.

Regardless of whether the cognitive impact of dancing is large or small, its metabolic and cardiovascular results combined with its value as a well-being tool are enough for this activity to be widely recommended.

The different modalities, the need for little or no equipment and adjustable frequencies, make this activity very adaptable to the most diverse conditions and realities.

With this, it can be concluded that dance is an accessible, very comprehensive activity that implies gains in several aspects for the individual, including the fact that it is a great ally in maintaining mental health, a growing concern in our society.

REFERENCES

BASSO, J. C.; SATYAL, M. K.; RUGH, R. Dance on the Brain: Enhancing Intra- and Inter-Brain Synchrony. Front Hum Neurosci, 14, p. 584312, 2020.

BLÄSING, B.; CALVO-MERINO, B.; CROSS, E. S.; JOLA, C. et al. Neurocognitive control in dance perception and performance. Acta Psychol (Amst), 139, n. 2, p. 300-308, Feb 2012.

BRUYNEEL, A. V. Effects of dance activities on patients with chronic pathologies: scoping review. Heliyon, 5, n. 7, p. e02104, Jul 2019.

CHAN, J. S. Y.; WU, J.; DENG, K.; YAN, J. H. The effectiveness of dance interventions on cognition in patients with mild cognitive impairment: A meta-analysis of randomized controlled trials. Neurosci Biobehav Rev, 118, p. 80-88, 11 2020.

CHEN C, NAKAGAWA S, AN Y, ITO K, KITAICHI Y, KUSUMI I. The exercise-glucocorticoid paradox: How exercise is beneficial to cognition, mood, and the brain while increasing glucocorticoid levels. Front Neuroendocrinol. 2017 Jan;44:83-102. doi: 10.1016/j.yfrne.2016.12.001. Epub 2016

DALZIELL, A. H.; PETERS, R. A.; COCKBURN, A.; DORLAND, A. D. et al. Dance choreography is coordinated with song repertoire in a complex avian display. Curr Biol, 23, n. 12, p. 1132-1135, Jun 17 2013.

DESLANDES A., MORAES H., FERREIRA C., VEIGA H., SILVEIRA H., MOUTA R., POMPEU F.A., COUTINHO E.S., LAKS J. Exercise and mental health: many reasons to move. Neuropsychobiology. 2009;59(4):191-8. doi: 10.1159/000223730. Epub 2009

FAN, P. F.; MA, C. Y.; GARBER, P. A.; ZHANG, W. et al. Rhythmic displays of female gibbons offer insight into the origin of dance. Sci Rep, 6, p. 34606, Sep 30 2016.

GUSZKOWSKA M. Wpływ ćwiczeń fizycznych na poziom leku i depresji oraz stany nastroju [Effects of exercise on anxiety, depression and mood]. Psychiatr Pol. 2004.

KARPATI, F. J.; GIACOSA, C.; FOSTER, N. E.; PENHUNE, V. B. et al. Sensorimotor integration is enhanced in dancers and musicians. Exp Brain Res, 234, n. 3, p. 893-903, Mar 2016.

KROPACOVA, S.; MITTEROVA, K.; KLOBUSIAKOVA, P.; BRABENEC, L. et al. Cognitive effects of dance-movement intervention in a mixed group of seniors are not dependent on hippocampal atrophy. J Neural Transm (Vienna), 126, n. 11, p. 1455-1463, 11 2019.

LALAND, K.; WILKINS, C.; CLAYTON, N. The evolution of dance. Curr Biol, 26, n. 1, p. R5-9, Jan 11 2016.

MCGUIRE, M.; LONG, J.; ESBENSEN, A. J.; BAILES, A. F. Adapted Dance Improves Motor Abilities and Participation in Children With Down Syndrome: A Pilot Study. Pediatr Phys Ther, 31, n. 1, p. 76-82, 01 2019.

MIKKELSEN K, STOJANOVSKA L, POLENAKOVIC M, BOSEVSKI M, APOSTOLOPOULOS V. Exercício e saúde mental. Maturitas. 2017.

MUIÑOS, M.; BALLESTEROS, S. Does dance counteract age-related cognitive and brain declines in middle-aged and older adults? A systematic review. Neurosci Biobehav Rev, 121, p. 259-276, 02 2021.

NIEMANN, C.; GODDE, B.; VOELCKER- REHAGE, C. Senior Dance Experience, Cognitive Performance, and Brain Volume in Older Women. Neural Plast, 2016, p. 9837321, 2016.

NOGUERA, C.; CARMONA, D.; RUEDA, A.; FERNÁNDEZ, R. et al. Shall We Dance? Dancing Modulates Executive Functions and Spatial Memory. Int J Environ Res Public Health, 17, n. 6, 03 17 2020.

PELUSO MA, GUERRA DE ANDRADE LH. Physical activity and mental health: the association between exercise and mood. Clinics (Sao Paulo). 2005 Feb;60(1):61-70. doi: 10.1590/s1807- 59322005000100012. Epub 2005.

PORTUGAL E. M. M.; CEVADA T; MONTEIRO- JUNIOR R. S., TEIXEIRA T.G., DA CRUZ E. R., LATTARI E., BLOIS C., CAMAZ A. D. Neuroscience of exercise: from neurobiology mechanisms to mental health. Neuropsychobiology. 2013;68(1):1-14. doi: 10.1159/000350946. Epub 2013

RODRIGUES-KRAUSE, J.; FARINHA, J. B.; KRAUSE, M.; REISCHAK-OLIVEIRA, Á. Effects of dance interventions on cardiovascular risk with ageing: Systematic review and meta- analysis. Complement Ther Med, 29, p. 16-28, Dec 2016.

TAGHIPOUR, M.; DERAKHSHAN, N. Hypothesis on the Origin of Dance: Mirror Neuron System and Imitation from Movement Disorders. World Neurosurg, 120, p. 604, 12 2018.

TEIXEIRA-MACHADO, L.; ARIDA, R. M.; DE JESUS MARI, J. Dance for neuroplasticity: A descriptive systematic review. Neurosci Biobehav Rev, 96, p. 232-240, 01 2019.

WANG, T. A hypothesis on the biological origins and social evolution of music and dance. Front Neurosci, 9, p. 30, 2015.

WARNER, M. H.; ERNST, J.; TOWNES, B. D.; PEEL, J. et al. Relationships between IQ and neuropsychological measures in neuropsychiatric populations: within-laboratory and cross-cultural replications using WAIS and WAIS-R. J Clin Exp Neuropsychol, 9, n. 5, p. 545-562, Oct 1987.

ZARDI, A.; CARLOTTI, E. G.; PONTREMOLI, A.; MORESE, R. Dancing in Your Head: An Interdisciplinary Review. Front Psychol, 12, p. 649121, 2021.