

Review

# Cognitive Effects and Educational Possibilities of Physical Activity in Sustainable Cities

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**Abstract:** Life in cities has allowed the development of our capabilities since they have the necessary elements to evolve through successive generations. Our survival and well-being depend on social interactions. However, the excessive comforts offered by cities can be counterproductive to our health. This paper aims to identify the cognitive effects derived from the regular practice of physical activity (PA), as well as the opportunities and characteristics present in cities to enhance this activity and the pedagogical implications that can be extracted from it. Sustainable cities must achieve their ecological goals through economic development that meets the present needs without compromising the quality of the future. Reports reveal that the widespread lack of PA is a major risk factor for both physical and mental health. The literature provides more and more evidence of how physical exercise affects the brain and cognition, and informs us of how and when we perform our daily PA. An analysis of the situation reveals the need to plan an urbanism committed to the promotion of PA accompanied by an analysis of the characteristics of urban spaces demanded by citizens and a necessary programming of recreational and educational activities that encourage the practice of physical exercise.

**Keywords:** brain; cognition; education; physical activity; sustainable cities

## 1. Introduction

Humans are social beings and in our nature is the creation of affiliations with others and with communities. In fact, our survival and well-being depend critically on social interactions and on the ability to create stable bonds [1].

Cities have a great potential to allow and facilitate the development of our capacities and, for the most part, have those elements or components that have been necessary to subsist and evolve through successive generations. Our society, our cities, and our residences, are the result of interaction with other people and the environment, in favor of the general interests of the community. These interactions have given rise to a broad and rich cultural heritage.

It has been shown that social factors have a positive impact on health outcomes [2,3], so interventions to promote social connections are particularly beneficial. One of the main characteristics of the urban environment is the proximity with other people with whom we live and interact. However, societies evolve at the same time as personal needs change. The comforts and services that cities once offered us can become, in some way, counterproductive to our health [3].

Pollution and sedentary lifestyle related to excessive traffic, exacerbated urbanism lacking in natural spaces, the remoteness of the rural environment favored by trade, or the abusive use of new technologies by young people have changed our daily habits and our leisure patterns, which have

become increasingly sedentary [4,5]. These undesirable situations could be solved by planning more sustainable cities.

There is currently a debate in the urban development literature on sustainability and sustainable development of cities. The need to simultaneously achieve the objectives of economic, social and environmental development has been underlined [6,7]. In this way, cities, to be considered sustainable, must achieve their ecological objectives through economic development that meets the needs of the present without compromising the ability of future generations to fulfill their own needs [6,7].

We understand sustainable cities as places where people want to live and work, both now and in the future, since they meet their needs, contribute to a high quality of life, are safe and inclusive, are well planned, built and work, and they offer equal opportunities and good services for all [7].

According to the European Commission Eurobarometer 2018 [5], between 40% and 60% of the population leads a sedentary life, which has coincided with an increase in the rates of overweight and obesity. The countries of northern Europe (Finland, Denmark and Sweden) are in the lead in terms of the amount of physical activity (PA) practiced, around 70%, being between 9% and 14% the average value of population that recognizes not to practice any type of PA.

The same report [5] contemplates four categories on the declared practice of PA or sport: those who do not practice any sport (it may reach 44% in some countries), those that do practically never, those that do not practice it with certain regularity and those that do it regularly.

This lack of PA is, according to the World Health Organization (WHO, 2010) [8], a major risk to health, is the fourth risk factor for global mortality and constitutes the main cause of more than 21% of chest and colon cancers, 27% of diabetes cases and about 30% of ischemic heart diseases. To this is added that physical inactivity has been constituted as a global pandemic responsible for more than 5 million deaths per year through its direct and indirect effects on multiple non-transmittable diseases [9].

The main reason for not doing PA is the lack of time (40%), while improving their health (54%) and their fitness (47%) are the reasons why citizens exercise themselves or practice sport [5].

*Health* is defined by WHO [8] as a complete state of physical, mental and social wellbeing, being physical health the one that we relate to our physiological processes, while mental health is related to our cognitive and social capacities.

Moreover, three dimensions were defined by Dever [10] that shape the quality of life and that are positively influenced by the implementation of healthy life habits: (I) the *physical dimension*, understood as the perception of physical state or health, seeking the absence of diseases; (II) the *psychological dimension* or perception of the cognitive and affective state; and (III) the *social dimension*, related to the perception of intrapersonal and interpersonal relationships.

Regarding this, research in the field of neuroscience demonstrates the need for PA to improve our cognitive performance and maintain a healthy brain state [11–13]. This is coupled with the fact that the usual practice of PA and the knowledge of the positive effects that it produces in the body can be important stimuli to promote the acquisition of healthy lifestyle habits [14].

As we know, our environment determines the amount of PA we perform, however, we need to know which types of environments favor the PA or the level of participation. Understanding how and what places incite citizens to perform AP is necessary because this information will allow the development of urban strategies to stimulate PA.

The effect of the environment on behaviors and their relationship with the PA in different types of locations (for example, home, work, shopping centers and sports facilities) has been studied. Most of the PA is performed at home and at work, while the highest moderate to vigorous physical activity relationships were achieved in sports facilities and during daily transfers [15,16].

Eurobarometer [5] also shows us that a great part of PA takes place in informal places, such as parks and outdoor spaces (42%), at home (32%), on the way between work and home, in schools or buying. However, 15% of Europeans do not even walk for 10 min in a row in a week and 12% sit for more than 8.5 h a day.

To alleviate this situation and contribute to a significant increase in the amount of PA carried out, in turn setting the active habits in people, we can resort to those elements present in cities that, well used and managed in a healthy way from the educational field, can help us to develop and maintain our physical and mental capacities.

Among the most noteworthy elements of the cities that have contributed to the development and maintenance of our cognitive, physical and social skills, we must maintain those with which we will necessarily have to interact to maintain a healthy physical and psychological state. We can highlight the rest of citizens, citizenship norms, the urban and natural environment, culture (music, sculpture, architecture, literature, and folklore), gastronomy, commerce, etc.

In view of the above, there is no doubt that the sustainable design of cities and their pedagogical use by educational institutions, as we show below, can and should be erected as an unbeatable scenario for the development and maintenance of these personal abilities from the beginning and throughout life. Considering that, the study hypothesis was that the practice of PA contributes in a very significant way on brain and cognitive performance-enhancing, being highly recommendable the pedagogical use of the resources that the city offers for it.

The objective of this review is to identify the cognitive effects derived from the regular practice of PA, as well as the opportunities and characteristics present in the cities to enhance this activity and the pedagogical implications that can be extracted from it. It is important not only to show the effect that PA has on human brain and cognition, but also how this activity can be carried out, providing useful and affordable options to the population.

To do this, we consider two factors: the characteristics of urban environments and the possible educational implications. On the one hand, we consider the great potential that cities have to facilitate the practice of physical activity. On the other hand, we describe how the resources offered by cities can be used from a pedagogical point of view to establish active habits from childhood and to build a citizenship connected with their physical, social and cultural environment.

## 2. Data Collection

We conducted a literature review for this paper. Relevant articles were identified by searching PubMed and Web of Science from 2000 to 2018 for studies evaluating the association among PA, sustainable cities and cognition in children and adults, relating it to the possible pedagogical opportunities derived. Two review authors independently extracted the data from included documents.

Our search strategy combined various terms for PA (e.g., physical activity, activity, physical education, physical condition, sports, and aerobic exercise), sustainable cities (i.e., sustainable cities, environment, active cities, and active spaces) and cognition (i.e., cognition, cognitive development, cognitive performance, psychological processes, and executive functions), comprised in key words, in titles and in abstracts. Additional articles and books were mainly identified from reference lists of included studies and relevant reviews.

## 3. Our Brain as a Result of Our Social Experience

In humans, certain parts of the brain are much more developed than in other species. One of the most accepted hypotheses about this greater development is what is known as *the social brain hypothesis*, proposed by the British anthropologist Robin Dunbar after a study with different primates in which it became clear that those species that live in more extensive and complex social groups show a more advanced brain development [1]. According to this hypothesis, life in society offers a series of advantages but also imposes certain demands (the ability to coordinate, to put the collective interest before the individual, to put oneself in the place of the other, etc.). Faced with it, the humans have developed adaptive mechanisms [2,3], which have been accompanied by changes in the structure and function of the brain, especially in the middle prefrontal region and the temporoparietal junction, promoting its development.

The biggest and most obvious difference between *Homo sapiens* and simians is human social behavior. Although the thought that men and animals differentiate in their cognitive abilities constitutes the most common belief, the truth is that intelligence and thought go hand in hand with life in society, which has pushed man to perfect his ability to connect with other minds, imitate, understand intentions and exchange information, creating a culture of cumulative character [1,2,17]. In addition, the importance of other humans in the individual development and the strong tendency to the grouping of the human species is well known. The evidence is found in the diverse documented cases of children who were abandoned from very young and had to grow in the absence of other humans, developing serious and persistent alterations in their development.

The notion of being human needs the presence of other people, of a social environment, of a culture that molds its brain to make it what it is, in a human brain. Without the presence of other people who transmit the cultural baggage learned over the years, a person would never develop behaviors and skills such as speaking or writing, much less use a wheel or fire. It is thanks to life in relation to other human beings that we are what we are and we know what we know [17].

An emerging field of study, known as *social neuroscience*, has arisen from the growing interest in the study of mental processes that have been designed and specialized in the perception of socially relevant stimuli and in the patterns of our social behavior [17]. Its purpose is the study of the way in which biological aspects influence social relations and how these social relations in turn modulate biological functions. Moreover, it has been pointed out the existence of certain brain regions that tend to be activated when the content of mental processing is social. Although a priori the mental abilities required to carry out a successful social interaction may seem similar to those required by other daily non-social aspects, the incorporation of neuroimaging techniques has shown that this is not the case. It has been found that the brain regions activated during the processes of inference about the mental state of other people differ from those activated during inferential processes related to characteristics of the physical world. The same applies to processes such as episodic memory, categorization or even aspects as basic as the perceptual ones [1].

Nevertheless, all these brain functions and mental processes depend not only on social interaction for its correct development. There is a motor component in every cognitive act that is also necessary (if not essential) for its correct development and that has also contributed to the human being has been configured in the way he has done it.

In this sense, although any physical activity carried out is beneficial, to obtain the best possible results, WHO [8] establishes global recommendations and general standards of PA to prevent diseases, reduce sedentary activity and seek an adequate state of physical and cognitive health.

For young people 5–17 years old, the PA to be performed must be mostly aerobic and must consist mainly of playing games, sports, recreational activities, physical education or exercises scheduled in the context of the family, school or recreational activities [8]. In these activities, of moderate to vigorous intensity, a minimum of 60 min a day should be invested, although any PA performed over this time interval will provide a greater benefit to health [18].

For adults from 18 to 64 years of age, it is recommended the practice of 75–150 min of moderate-intensity aerobic PA (in sessions with a minimum of 10 min duration), based on leisure and recreational activities, walking, bicycling, occupational activities (work), domestic chores, games, sports or exercises scheduled in the context of daily, family and community activities [8]. In any case, and to obtain greater results for health, moderate aerobic activity could be increased to 300 min per week, or 150 min of intense physical activity, aerobic, or an equivalent combination of these [5,8].

#### 4. Benefits at the Cerebral Level of the Aerobic Exercise with Cognitive Load

The processes related to the motor act consists both of a motor and a cognitive component. The first one is associated to those parameters related to the implementation of the motor act in the muscles (the precision of the movement, the execution force, its temporal aspects, etc.) [19]. However, special attention has been paid from psychology to the cognitive or internal components of the action [20,21],

in which we can find aspects such as the intention to act and the planning of the phases of which the motor act is composed [19].

The study of the effects of regular physical exercise on cognitive functioning has increased significantly in recent years, motivated to a large extent by the findings of current cognitive neuroscience [11,22]. This discipline aims to assess the effects of joint PA with cognitive function training programs taking into account brain plasticity [12], and having been shown that this plasticity takes place throughout the whole life of human beings, although it is the young people who benefit the most from the intervention programs [19].

The relation between the practice of PA that imply a cognitive demand with a lower age-related atrophy have been shown by different magnetic resonance studies, even with differential patterns of activation, which may suggest an improvement of functional cerebral plasticity [13,23,24].

Recent research has shown that PA performed on a regular basis favors the occurrence of permanent structural changes in various areas of the brain [13,23,25]. These changes include the increase in blood vessels and therefore the supply of nutrients and energy in certain neural areas [24].

The nervous system as a tissue and the mind or cognition as its function, also benefit from the practice of physical activity, having shown that a regular practice of aerobic exercise produces structurally and functionally changes [11,22,26]. In fact, the physical condition is nowadays understood as one of the moderators between the effect of PA and cognitive function [27].

Moreover, PA together with cognitive stimulation regulate factors that increase neuroplasticity and resistance to brain death. However, the complexity of this type of activity makes it necessary to specify more precisely what kind of activities (for example, complex versus simple) and what duration are necessary for their effects to be truly significant and represent a palliative factor in the manifestation of symptoms of cognitive dysfunction in old age [1].

This modification of brain structures can be explained by the plastic capacity of the brain, both structural and functional, with a better cognitive response in diverse tasks (memory, attention, speed of processing, cognitive flexibility, inhibition, etc.) as a consequence. Participants in studies that performed physical exercise at moderate to vigorous intensity (from 40% to 80% of maximum oxygen consumption [VO<sub>2</sub>max]) acts positively on different aspects of general and mental health, as well as on other cognitive functions such as the speed of response, short-term memory or motivation [22,28,29]. They also presented better results in cognitive tasks such as processing speed, selective attention and short-term memory [24].

Most studies that have been developed in this field have investigated the effect of regular PA on executive functions [11,30,31], but also on others such as short-term memory [21,32], attention [33] or language processing [34].

A potentially beneficial effect of PA in terms of cognitive decline and incidence of dementia are also suggested by these studies, posing various mechanisms as mediators of this association such as the reduction of cardiovascular risk factors, inflammation and oxidative stress, the increase of the production of trophic factors and neurogenesis [1]. However, the effects of regular PA also depend on the type of activity or exercise performed, its duration, the frequency with which it is performed and the intensity at which it is carried out.

For example, punctual, assiduous and repetitive PA causes alterations on most of the systems and organs of the person, which may end up being long-lasting alterations. This is known as regular effects on exercise [35]. Thus, the organism adapts and produces different anthropometric and physiological changes with an increase in the functional level of the individual; that is, an improvement of our capacity and our effectiveness.

Among the most known responses of the organism to the practice of PA, we could highlight the increase in size, strength, tolerance and tone of the muscles; the prevention of the loss of flexibility over the years the increase in thickness and strength of the ligaments and tendons, and the deposit of calcium and other minerals in the bone. It is also important to mention the reduction of body fat;

the improvement of the posture preventing back pain; the increased excretion of harmful substances; the improvement of digestion; and the positive impact on relaxation and sleep [35].

It is believed that these benefits associated with the regular practice of PA are moderated by the improvement of physical condition [22,36,37]. Physiological adaptations at a cardiovascular level, which are associated with physical exercise performed on a regular basis, have also been associated with brain adaptations and have been linked to improvements in cognitive performance [37,38].

Both the changes produced by regular PA and the relationship between the chronic practice of PA and general cognitive functioning can be explained starting from the premise of the *cardiovascular hypothesis*, which states that chronic exercise leads to neuronal maintenance and proliferation in different brain areas in addition to causing the growth of new blood capillaries.

These functions are favored by the intervention of BDNF (brain-derived neurotrophic factor) and IGF-1 (insulin-like growth factor-1 or somatomedin) in the hippocampus, cortex and cerebellum, stimulated by PA, which consequently has been shown to have repercussions at the level of cognitive function [39]. Both proteins have shown a permanent increase in their production with durable interventions of regular PA [24,40] and could be determinant as preventive factors of brain degeneration, long-term enhancers and for the development and protection of new neurons. In this sense, the BDNF plays an important role in the process of long-term synaptic plasticity, which in turn is fundamental for the connectivity changes that underlie learning [41].

On the other hand, although our knowledge about postnatal neurogenesis remains incomplete, it seems very likely that the birth of new neurons in the hippocampal area contributes to the learning process and consolidation of memory in humans [42]. Some research studies have shown that after the practice of PA the levels of cerebral neurotrophic factors are regulated (and even increased), which has been associated with an improvement in short and long term learning after short sessions of intense exercise [42–44].

By analyzing the possible benefits that PA has on cognition, we find in several reviews and meta-analyses that they have a significant relationship between aerobic capacity and cognitive performance in pre-post comparisons [27,45–50], not to mention that the practice of PA during childhood or youth can increase brain resilience in adulthood [51].

## 5. Opportunities of Physical Activity with Cognitive Load Offered by Green Spaces of the City

Cognitive enrichment from an early age, mainly related to participation in cognitively stimulating cultural and leisure activities that involve PA and social relationships, have been associated in several studies with a lower risk of cognitive decline and the development of dementia decades later. Therefore, participation in this type of activity shows a protective and beneficial effect at the cerebral level that is maintained throughout the life of the person and that is especially interesting, since it supposes a factor that can be controlled or modified with relative ease [1].

For example, lifetime exposure to green space can influence cognitive aging. It has been shown that the amount of leisure space in childhood and adulthood is important to explain the change in cognitive function in later stages of life. Greater proximity to public parks from infancy to adulthood may help decrease the rate of cognitive decline in later life although these environmental associations are always sensitive to individual characteristics [52].

While the number of studies dealing with the relationship between proximity to parks and the health of users is limited, there is growing evidence that living near a park or green area is related to greater physical and mental health. There are multiple factors that determine the incidence of the existence of parks on the amount of PA and therefore its effects. Easy-access and connectivity are some of the main urban elements that influence on this aspect.

Several studies reported associations between access to parks and PA [53]. In total, 6181 people from 12 cities in 8 different countries participated in The International Physical Activity and Environment Network (IPEN) Adult Study, which determined that living near a park (less than 1 km) can contribute with up to 1/6 of the PA recommended per week. People who live less than 1 km

from a park make more PA and more moderate to vigorous PA in their free time. This happened in all the cities studied.

The associations between connectivity and speed of transit with the use of parks and PA by neighborhood residents has also been studied [54]. People with higher connection density are more likely to use parks and participate in PA. In addition, participants with slower traffic routes to parks were more likely to use them.

These characteristics are particularly important for young children, adolescents and the elderly who have less access to facilities. The availability of spaces for PA can be very relevant for those who cannot drive and whose activity is often limited to the immediate distance they can walk or ride a bicycle.

The higher housing density predicted greater PA in boys, but not in girls [55]. Neighborhoods with greater proximity between homes and a greater proportion of parks area are associated with greater PA in young children.

The use of pocket parks promotes moderate to vigorous PA in comparison with the existing playground space in other nearby parks as well as being more cost-effective metabolically. When perceived as attractive and safe destinations, pocket parks can increase PA by encouraging families with children to walk there [56].

It is also increasingly common to find outdoor public gyms specially designed for the elderly. It has been shown that wellbeing and physical results are associated with this mode of exercise and social programs. However, there are some challenges, for example, safety and the ease of the terrain to locate the exercise park, the control of the factors environmental for safety (non-slippery ground and equipment) and the logistics itself to run the exercise program [57].

The presence and proximity of recreational areas seems to be especially relevant for adolescent girls, whose levels of PA decrease substantially as they go through puberty. Girls who live near more parks, particularly near those that offer walking facilities and with active characteristics, participate more in moderate to vigorous physical activities compared to those with fewer parks [58].

Girls' PA is more affected by the social effects, while the PA of boys is more strongly influenced by the availability of the facilities. The number of recreational facilities in combination with formal activities is positively associated with girls' activity. However, a significant interaction with young children (0–5 years of age) and the presence of parents are negatively associated with PA in parks [59].

Nevertheless, we must bear in mind that the association between PA and access to parks differs according to the socio-demographic, housing and neighborhood characteristics of adolescents [60].

In addition, greater availability of the park, its quality and the use with friends were associated with a higher probability from teenagers of using a park. To promote the use of parks to foster PA among urban adolescents, it is necessary to increase awareness of park availability, improve perceptions of its quality and use social networks [61].

In a large study [62], 174 neighborhood parks in 25 major cities (population 4,100,000) were analyzed. They found that parks were less used in low-income neighborhoods than in high-income ones. In large part, this is explained by fewer supervised activities and marketing/outreach programs. Programming and marketing were associated with 37% and 63% more hours of moderate to vigorous PA per week in the parks, respectively. Offering more programming, using marketing tools and installing new systems to exercise can help to increase population PA.

However, other social and environmental factors can influence the use of recreational elements such as vandalism, which may lead to a decrease in physical activity in urban public parks, some couples with a lascivious behavior and public consumption of alcohol [63].

These environmental and social determinants also influence the intensity levels of PA in parks. The amenities, the result of vandalism, the size of the park, high-speed streets, sidewalks and temperature conditions will influence the intensity of the PA. Men are more likely to be observed walking and doing vigorous activity compared to sedentary people. High-speed streets, sidewalks and low-income neighborhoods are associated with lower probabilities of performing vigorous PA [64].

Obviously, the characteristics of the park affect the number of visitors and therefore the type and amount of PA. A well-designed game facility has the potential to increase park visits and encourage visitors to stay physically active [65]. The most important characteristics of the park for PA are maintenance (96.2%), feel safe (95.4%), relaxing atmosphere (91.2%), easy access (91.7%) and shady trees (90.3%). Good park maintenance was considered as the most important [66].

Some studies have also analyzed the influence of parks for dogs on the amount of PA that their owners do [67,68]. Although these parks can contribute to increase the PA of their owners, the proportion of moderate to vigorous PA of the participants was limited.

Given the above, it is clear that there exists sufficient evidence of how the recreation areas which are located in the cities favor the maintenance of a healthy body and mind [69], but for this, as we have also seen, it is necessary to take into account certain criteria that strengthen its sustainability.

## 6. How Can These Activities Be Implemented with an Educational Objective

Cities can offer a very interesting scenario in which to develop healthy physical activities impregnated of didactic and cognitive character.

We must not forget that the different civilizations have used their cities as the main habitat for their development and survival. Therefore, in addition to being an element conducive to socialization and PA, in cities we find many elements and facilities created by citizens to meet their own needs, which could serve as a focus of truly meaningful learning [19]. That is, museums, shows, markets and shops, fairs, and natural elements such as rivers, beaches and urbanism itself, among other elements, can be very attractive environments in which to develop both healthy and significant didactic activities [6,70–72].

As we have seen in previous sections, an emerging corpus of multidisciplinary research supports the existence of beneficial effects of aerobic exercise on certain aspects of brain function particularly important for education [22].

Moreover, a meta-analysis based on the results obtained in forty-four different studies concluded that the levels of PA correlate with several categories of cognitive performance of school-age children, including the intelligence quotient (IQ), academic performance and mathematical and verbal tests outcomes [42]. The magnitude of the effect was similar to that observed in another review of longitudinal studies, which could suggest that early intervention in the development of PA habits can have significant consequences for the rest of a person's life [41].

PA is related not only to health, but also to brain development throughout life, being able to link levels of PA with school performance [42]. Thanks to the growing number of publications, research and evidence in this regard, we are increasingly aware of the mechanisms by which exercise influences mental capacity and academic performance, allowing us to contribute more effectively to achieve in the students greater academic benefits by developing exercise programs [41].

For all of the above, it is important to consider cognitive training as an educational intervention, as it is considered a promising new approach to fight brain deterioration associated with age [1]. In addition, it has been found that participation in enriched activities within an educational framework stands as a protective factor of the brain throughout life [19].

Hiking or cycling through parks, trails, hills, riverbanks and beaches, in small groups and close to the city, is a very attractive task that can be accompanied by activities of research and analysis of the various natural components: flora, fauna, geology, etc. [6]. Thus, in addition to reach our physical and healthy objectives, we will acquire a greater knowledge of our natural environment. Likewise, walks to monuments and museums can help us to know and better understand the history of our city, the results of political decisions and the product of economic activity [70–72].

A good planning of this type of activity could exercise our capacity of orientation and our spatial memory too, involving all the cognitive functions related to space management and orientation [73,74]. If public transportation is also used, a didactic function is added to teach the correct use of public services and civic behavioral norms [9,70].

Visiting theme parks and museums of different arts and sciences complete the possibilities of acquiring knowledge and understand other contents that are not so close in an active way. In fact, these institutions usually have programs or packages of activities for schools, and other educational entities, specially organized and designed according to the age or educational level of the visitors [75].

The attendance to shows and festivals (cinema, dance, music, theatre, etc.) stand out for their emotional charged character. These encounters with art not only favor socialization, but also refresh and exercise our cognitive components related to emotions [2,69], which are one of the most important component to work body language in education. In addition, visit and participation to folklore and gastronomic festivals are magnificent socializing environments that invite us to exercise the rest of senses and cognitive functions at the same time we can do PA [2,15].

Finally, walking through stores, markets and street markets can have an appropriate duration to achieve the desirable effects related to the PA [15]. In this case, the knowledge of the products and the trade activity can help us to improve and to keep our logical mathematical capacities in good condition [76].

## 7. Discussion

Searching methods and tools that encourage the increase of PA constitutes a very interesting and current field of innovation and research. New technologies are a very useful tool in our daily and work activities, however, the lack of PA and its consequences are a serious side effect [5].

Today, in many of our tasks, PA has been relegated or removed from our daily activities (communication, education, shopping, etc.). Although there are already programs and institutions that try to alleviate this situation, the problem has not been solved [5], so it is necessary to implement new forms or methods of PA management, perhaps integrating it within the culture, urban and pedagogical environment.

By and large, the relationship between regular PA and cognitive functioning is well documented [26], and, in addition, this important research topic shows the existence of a positive relationship between PA and cognitive performance. However, although the research carried out in the last decade has represented a great advance in this field, there are still crucial aspects that require investigation.

In this context, studies that show that punctual and regular aerobic PA seems to be a good stimulus for the triggering of structural changes at the neural level [22,23,32,36,77,78] that, consequently, seem to have a positive impact on cognitive performance [38,79] are relevant.

Pollution, sedentary lifestyle, excess traffic, urbanism lacking in natural spaces, distance from the natural environment, or the abusive use of new technologies are challenges to be solved by planning more sustainable cities. Therefore, if we understand the sustainable city as one that contributes to the quality of life, which is well planned and offers equal opportunities for all [7], it is necessary to provide it with green spaces and recreational areas that enable and encourage citizens to the practice of AP.

The sustainable design of cities, and their pedagogical use by educational institutions, can and should be established as an unbeatable setting for the development and maintenance of these personal capacities from the beginning and throughout life. The data suggest that physical fitness in children is associated with better cognitive performance in executive control tasks. This idea is directly facing the current educational context, where schools are under pressure to dedicate more time to academic content and less to physical education. The results indicate that programs that promote the acquisition of active life habits do not only improve physical health, but also cognitive and academic performance [41]. Therefore, a new approach is required in the design of cities and educational programs, so that each day we get closer to the global recommendations of PA [8] to prevent diseases, reduce sedentary activity and seek an adequate physical and cognitive health status.

It has been proven that punctual physical exercise, carried out in an assiduous and repetitive way, causes alterations on most of the systems and organs of the person, being able to become lasting alterations. This is known as regular effects on exercise [39]. Thus, the organism adapts and produces

different anthropometric and physiological changes, producing an increase in the functional level of the individual; that is, an improvement of our capacity and our effectiveness. Therefore, we must encourage citizens to carry out the PA that meet these requirements of effort to maintain a state of physical and mental health.

For example, we have previously read how a closer proximity to green spaces and recreational areas beneficially influences our quality of life [52,69]. However, we have also seen how it is not only essential to increase the number of leisure areas but also we must take into account the factors that will determine significantly in their mode and amount of use. This is why cities should show a greater proportion of green spaces and leisure areas in relation to the meters built [52]. We must increase the number of parks per inhabitant in such a way that all citizens have a nearby recreational area (less than 1 km), with easy access on foot or by bicycle [53–55]. In this sense, pocket parks seem to be an effective and economical solution [56].

It is also necessary to offer recreational areas that respond to the demand according to the age of the users [57–60]. Not all citizens are interested in the same spaces and activities and that is why it is not enough to build the park. If we want to promote PA, we will also have to take into account socioeconomic factors as well as the income level of the neighbors [62,64]. In addition, it is necessary to keep the place in good condition [63,65,66] and carry out a parallel work of advertising and programming of activities to be carried out in the park that encourages the participation of citizens. [61,62].

To adopt the necessary measures that allow us to increase PA, both in the educational field and in the urban area, more research is needed to know what the physiological and cognitive demands of the different activities are in both areas. Only in that way can we act to increase the realization of some of them and modifying or eliminating others.

## 8. Conclusions

In conclusion, this review reveals that the regular practice of PA contributes in a very positive way to cognitive development, increase neuroplasticity and resistance to cognitive decline, and improve cognitive performance. In this sense, we find that cities can gather the necessary elements to favor the practice of PA of the population in general, especially thanks to the presence of parks and green areas. Nevertheless, it is still necessary to develop a better urban organization that takes into account the socio-economic factors of the population to avoid inappropriate sedentary habits and promoting citizens' physical activity.

Moreover, these elements can be used in parallel for the improvement of pedagogical practice, not limiting education only to school spaces, but taking advantage of the natural, historical, artistic and social resources that cities offer us. Thanks to the opening of the school to the environment in which it is hosted we can resort to all these resources offered by the city, so that the students acquire more active habits, learn in a more meaningful way and develop a more critical thinking.

This study suggests a research framework which will become increasingly important in the future but, to be able to advance in this area, more research related to the estimation of the amount and type of PA that citizens perform in their daily tasks is required.

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