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Exercise and Alzheimer's: The body as a whole

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ABSTRACT

Objective: Alzheimer's disease has been studied from various areas of knowledge (biomarkers, brain structure, behavior, cognitive impairment). Our aim was to examine the effects of an exercises protocol developed using complexity theory concepts.
Method: Exercise improves neuroplasticity (neuronal ability to change and adapt as a result of experience) through mental and physical skills linked to cognitive-associative brain circuits. Introducing controlled physical and cognitive stimuli, self-organization and connectivity among brain systems enhance. We used tasks with non-linear outputs (several solutions) and learning as order parameter. Tasks were performed simultaneously, at the edge of the error seeking self-organized criticality.
Results: Screening tests data showed a reduction in cognitive impairment, which suggests a reduction disease progression, in terms of executive function. There was a marked improvement in the physical tests: 30 seconds chair stand test (PRE: 8.78 ± 3.46; POST: 9.44 ± 3.68 repetitions) and foot up and go test (PRE: 11.95 ± 5.19; POST: 11.69 ± 4.43 seconds).
Conclusion: Results showed that patient's self-organization was increased; behaviors atrophied or inhibited reappeared. Using these controlled perturbations, Alzheimer's Disease patients were able to manifest improvements in both their mental and physical abilities.

Ejercicio y enfermedad de Alzheimer: el cuerpo como un todo

Palabras clave:
Alzheimer
Ejercicio
Autoorganización
Sistemas no lineares
Imprevisibilidad

RESUMEN

Objetivo: La enfermedad de Alzheimer ha sido estudiada desde varias áreas del conocimiento (biomarcadores, estructura cerebral, conducta, discapacidad cognitiva). Nuestro objetivo ha sido examinar de un protocolo de ejercicio diseñado usando conceptos de la teoría de los sistemas complejos.
Método: El ejercicio mejora la neuroplasticidad (habilidad neuronal para el cambio y adaptación como resultado de la experiencia) a través de las habilidades mentales y físicas vinculadas a los circuitos cerebrales cognitivo-asociativos. La inclusión de estímulos físicos y cognitivos controlados mejora la autoorganización y la conectividad entre los sistemas cerebrales. Hemos utilizado tareas con soluciones no lineales (varias soluciones) y hemos analizado el aprendizaje. Las tareas se realizaron simultáneamente en el límite del error buscando la autoorganización crítica.
Resultados: El análisis de nuestros datos mostró una reducción del deterioro cognitivo, lo que sugiere un enlentecimiento de la progresión de la enfermedad, en términos de la función ejecutiva. Se constató una marcada mejoría en las pruebas físicas: Test de sentarse y levantarse durante 30′ (PRE: 8.78 ± 3.46; POST: 9.44 ± 3.68 repeticiones) y Test de levantarse y caminar (PRE: 11.95 ± 5.19; POST: 11.69 ± 4.43 segundos).

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Conclusión: Los resultados mostraron que la autoorganización del paciente mejoró y que reaparecieron conductas atrofiadas o inhibidas. Utilizando estos estímulos controlados, los pacientes con Alzheimer fueron capaces de manifestar mejoras en sus capacidades mentales y físicas.

Exercício e doença de Alzheimer: o corpo como um todo

Palavras-chave:
Alzheimer
Exercício
Auto-organização
Não-lineares
Imprevisibilidade

RESUMO

Objetivo: A doença de Alzheimer tem sido estudada por várias áreas do conhecimento (biomarcadores, estrutura cerebral, comportamento, déficit cognitivo). Nosso objetivo foi examinar os efeitos de um protocolo de exercícios desenvolvidos com os conceitos da teoria da complexidade.
Método: O exercício melhora a neuroplasticidade (a capacidade neural para mudar e adaptar-se, como resultado de experiências) através de habilidades mentais e físicas ligadas a circuitos cerebrais cognitivo-associativos. Apresentando estímulos físicos e cognitivos controladas; auto-organização e aumento da conectividade entre os sistemas cerebrais. Usamos tarefas com saídas não-lineares (várias soluções) e de aprendizagem como parâmetro de ordem. As tarefas foram realizadas em simultâneo, no limite do erro em busca da criticalidade auto-organizada.
Resultados: As triagens de dados testes mostraram uma redução no déficit cognitivo, o que sugere redução na progressão da doença, em termos de função executiva. Houve uma melhora acentuada nos testes físicos: 30 segundos no testes sentar e levantar da cadeira (PRE: 8.78±3.46; POST: 9.44±3.68 repetições) e no teste de levantar e caminhar (PRE: 11.95±5.19; POST: 11.69±4.43 segundos).
Conclusões: Os resultados mostraram que a auto-organização do paciente foi aumentada; reapareceu comportamentos atrofiados ou inibidos. Usando estas perturbações controladas, os pacientes com doença de Alzheimer foram capazes de manifestar melhorias em suas capacidades físicas e mentais.

Introduction

The Alzheimer's Disease (AD) is a neurodegenerative disease characterized by or accumulation of proteins such as Tau or β-amyloid, which causes progressive dementia in adulthood, leading to a state of total disability and death.[1,2] AD currently affects in Spain about 600 000 people (25% of those over 65 years) and about 44 million people worldwide. It is the most common cause of dementia in Europe and perhaps the most common neurodegenerative disease worldwide. The costs of caring for people with this disease in Spain amounted to 37 000 million euros annually.

Exercise has previously been proven to have a positive effect on AD patients. Exercise can increase levels of brain-derived neurotrophic factor (BDNF) and other growth factors, stimulate neurogenesis, increase resistance to brain injury, improve learning and mental performance, arouse the growth of blood vessels, reduce of amyloid load, etc. (Table 1).[3–6] But the point is what kind of training?

Most authors focus on exercises for improving the manifestations of physical fitness in isolation way, and as an indirect result, seek to reduce the advance of the disease. In our opinion, this is an error because nature does not work in that way. There is not a separation between body and mind. All levels, in body and nature, are connected and influence each other. Sport reality shows us that in its different levels (including brain), structure, shape and functionality evolve in time and are closely related to performance.[7–14] This is the result of an evolutionary process through nonlinear interactions in many biological and non-biological systems.[15–20]

Consequently, and following the asseveration: "*I am I and my circumstance*",[21] it is not possible to understand the reality of an individual by isolating of the relationships with his own universe. Interaction means cooperation-opposition among individual systems and environment (physical and social). In fact, a long-standing problem in biological and social sciences is to understand the conditions required for the emergence and maintenance of cooperation in evolving populations.[22,23] Ergo the key strategy we propose is the interaction of well-defined units in order to promote cooperation among body systems, to promote self-organization. That is why we applied the concept of Holistic Training (body systems synergy: *The whole is greater than the sum of its parts)* in order to develop a training program for AD. This is a very interesting tool due to the availability, low cost, no invasiveness and improvement of comorbidities associated with aging.

The concept of self-organization can be expressed as the general tendency of a given system to generate behavior patterns from local interactions of its constituent elements and the relationships with the environment.[8,24–27] This phenomenon enables people to develop sport skills, resolve mental challenges, assimilate training loads and improve, keep body temperature, repair wounds, etc. According to Goodwin, if want to improve the system, the ideal is to investigate the conditions that promote self-organization.[28] It is true that if we review the literature about exercise and AD, we can observe that there are not clear methodologies to deal with AD patients. Perhaps this may be because the sources causes of patients crisis and conditions associated with AD (depression, stress, etc.) are different in each case and display different outputs to the same stimulus. This does not allow generalize as in other study populations.

Method

Subjects

Using complexity theory concepts, we carried out an intervention program in order to diminish the deterioration of cognitive and motor functions with a sample of 18 moderate grade Alzheimer's Disease patients (12 women; 6 men, 75.78 ± 5.53 years; body weight: 64.19 ± 13.15 kg; height: 1.57 ± 0.08 m. Body Mass Index (BMI): 25.84 ± 4.28 kg/m^2). The original sample was bigger but we

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