Can Exercise Improve the Outlook for People with Dementia?

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ABSTRACT

In this Pathology research paper, we will be looking at whether exercise can improve the outlook for sufferers of Alzheimer’s disease. To do this, we will be examining how exercise increases the production of the neurotransmitter BDNF, and example studies and investigations conducted over the past few years. We will then look at how this research could be put into practice by the NHS, particularly regarding the cost involved. The main thing to remember is that Alzheimer’s is a progressive disease that, at the present time, is still incurable. Exercise could bring some comfort to families with family members with dementia as it is shown that exercise can slow down the progression of the condition. However this is unfortunately, the only “medicine” that is available for sufferers of dementia. There is still hope for the future that the new research of BDNF production can then be combined with drug research to increase the level of hope for dementia patients, and hopefully find a cure.

INTRODUCTION

Over the past 20 years, the life expectancy of an average adult in the United Kingdom has increased by 4.2 years, to an age of 68.6 [1]. However, as with any ageing society, the medical profession is met with the demands of many long term medical conditions. One of the most noticeable medical conditions facing the NHS today is Alzheimer’s disease, with a 137% increase in cases over the last 20 years. Alzheimer’s disease is now the 10th leading cause of death. It is now estimated by the dementia 2012 info graphic that one in three people over the age of 65 will develop dementia [2] which cost the UK £23 billion in 2012. [2]

People, usually, get dementia during their late adulthood. It is caused by the shrinking of the hippocampus which is situated in the brain. Dementia is not a single disease; it is more of a non-specific syndrome - i.e. a set of signs and symptoms. Although dementia is more common in geriatric people, it can also occur in people who are less than 65 years of age. This is known as “early onset dementia”. The affected cognitive areas are mainly: memory, language, attention and problem solving. For a positive diagnosis of dementia, the symptoms must be present for at least six months.

As demonstrated by the work of Dr Liu-Ambrose (2012 Alzheimer’s Association International Conference) [3] the uptake of exercise among elderly patients with such diseases can increase their brain function and help to slow down the progression of the disease. However the implication that this would have on society and the success rate are all something to be considered.

The increase in brain function from exercise has been linked to an increased production on the brain derived neurotropic factor (BDNF) and its receptor is TrkB (Tyrosine Kinase Receptor). This is a secreted protein which is encoded by the BDNF gene. It is part of the neurotrophin family. The neurotrophin family helps with the growth of the nerve cells and the brain. BDNF acts on particular neurones of the central nervous system (CNS) and the peripheral nervous system (PNS). It helps the survival of existing neurones and encourages the growth and differentiation of new neurons and synapses. In the brain, BDNF is mainly active in
the hippocampus, the cortex and the basal forebrain. These areas are vital for learning, memory and higher thinking. This protein is also important for long-term memory (LTM). This has been shown by the work of Dr. John. J. Ratey (Clinical Professor of Psychiatry at Harvard University); he wrote in his book: *SPARK: The Revolutionary New Science of Exercise and the Brain* (Little, Brown 2008): “BDNF gives the synapses the tools they need to take in information, process it, remember it, and put it into context”. [4]

![Diagram of synaptic transmission](image)

Figure [1]

Further investigations such as that of J. Mark Davis, of the University of Carolina, have suggested that exercise can also lead to an increased production of mitochondria in the brain [5] leading to more respiration sites. This leads to a higher level of energy available for the brain allowing it to process information much faster and more efficiently.

**DISCUSSION**

**Case Study 1**

Research carried out by Dr. Liu-Ambrose, director of the Aging, Mobility and Cognitive Neuroscience Lab at the University of British Columbia in Vancouver, greatly supports the idea that increased exercise rates can improve cognitive ability.

In 2012 Dr. Liu-Ambrose presented her finding of a 6 months investigation at the Alzheimer's association international conference 2012. [3] During this investigation a randomized controlled trial of 86 women ages between 70-80 years was conducted to examine the benefits of three different exercise regimens; resistance training, aerobic training and balance and tone training. Each of the exercises were conduction twice a week for 6 months, and all the women prior to the investigation were thought to have a probable mild cognitive impairment.
Each exercise program was progressive; the weight programme built up from the largest amount each woman could handle, and increased as they reached a required number of repetitions; the aerobic programme increased their walking speed relative to heart rate; and the balance and tone training progressed in a similar way.

At the end of the training Dr. Liu-Ambrose found “physiological correlates to the cognitive finding”. There was a “real improvement” with the resistance training group, with an average of over 17% over the baseline on measurements of executive function, and noticeable increase in memory. Further investigation showed that this may have been down to increased blood flow in the brain regions involved with processing and recollecting information.

The other groups however were not as successful, although both groups saw a notable improvement within physical ability they “did not have the same kind of cognitive or brain physiologic gains”. The balance and tone group although they maintained their cognitive ability, did not deteriorate either.

Overall this has demonstrated an increase in cognitive ability and memory within patients suggesting that it is possible to slow down the progression of conditions such as Alzheimer’s disease, however this is subjective on the type of exercise undertaken. This particular study suggests that resistance training is the best way to improve upon cognitive ability, however as said by Dr Liu-Ambrose “patients already have difficulty with planning and prioritisation”, highlighting the issue that for many sufferers of Alzheimer’s disease the benefits from exercise cannot always be obtainable, unless they are encouraged by a 3rd party.

**Case Study 2**

A second study presented at the Alzheimer’s association international conference 2012 [3] was conduction by Dr. Erikson, a cognitive neuroscience researcher at the University of Pittsburgh. His investigation concluded that physical activity “stimulates the release of molecules that promote neuronal growth”.

Within his investigation Dr. Erikson took a group of 120 elderly adults without cognitive impairments and placed them on either a 1 year programme of moderately intense walking or and 1 year programme of stretching and toning – all of the participants had been sedentary for at least 6 months directly prior to the investigation.

Dr. Erikson and his team measured the brain volume and BDNF levels of each participant both at the beginning of the investigation and at the end of 1 year. After a year they found that the group which had been on the walking programme had “a 2% increase in the size of the anterior hippocampus, compared to the stretching
and toning group” and they also had an increased level of BDNF production at a similar rate.

Although this study demonstrates the effect on adults without cognitive impairment, the increased size of the hippocampus and increased levels of BDNF would in theory lead into increased cognitive ability. This leads way to the suggestion that exercise could be used as a preventative for conditions such as Alzheimer’s disease. If exercise can improve the cognitive ability in those without previous cognitive impairment it could raise the levels of BDNF and the size of the hippocampus to such levels that if a Alzheimer’s disease or a similar condition developed that is would have a much slower rate of progression, and complied with the suggestions it can also improve the cognitive ability in those with cognitive impairment, if exercise was maintained once the disease had been developed it could further improve the outlook for suffers.

Further Studies

Further studies also lead to similar conclusions. The study by the University of Edinburgh consisted of taking brain scans of 638 people past the age of retirement during a 3 year period. [6] The results showed that those people who were more physically active had had less brain shrinkage over the three year project. It also showed that those people over 70 who were more physically active had less damage to the white matter in the brain. A combination of the both is thought to be linked to better memory and cognitive ability.

A similar report published in the Annals of Internal Medicine [7] on February 5th 2013 came to similar conclusions. The authors of the study include De. Laura DeFina, medical director of research at The Copper Institute, concluded that “Physical activity changed in midlife may lead to improved fitness levels, resulting in less all-cause dementia with aging”. Their study included the investigation into the fitness levels of nearly 20,000 adults who were then revisited 10 years later when the participants were mainly aged between 60 – 70 years o age. Of the 20,000 participants, 1,659 had received a diagnosis of dementia; however those who were more active during their “mid-life” when the investigation was first started were 40% less likely to develop dementia.

Both of these studies support the idea that exercise can not only improve the outlook for people with dementia such as suffers of Alzheimer’s disease but also reduce the chances of developing dementia in later life. However these are only on a trial basis, and the guarantee that once an exercise program for suffers of the disease was started, due to the nature of the illness it is highly likely that they may not be fully continued so as the benefits can be felt.
How could this be implemented by the NHS?

Although, all the research suggests that an increase in physical activity across an average person’s lifetime can reduce the risk of developing Alzheimer’s disease in later life, and can also slow down the progression of the disease, the question still remains as to how the NHS can act upon this information.

Currently, within the NHS the “fit for life” campaign among many others are encouraging people to do more exercise and eat more healthily to combat the risk of obesity. However, not many people realise that a healthier and more active lifestyle could lower the risks of developing Alzheimer’s disease. According to the British Heart Foundation’s Physical Activity Supplement, in 2008 just 39% of men and 29% of women meet the Government’s recommended amount of exercise of 30 minutes of more of moderate or vigorous activity on at least 5 days a week. [8] This suggests that in order to help prevent the onset of Alzheimer’s disease the British public would have to increase their average physical activity by a significant amount.

The NHS could go about this in a number of ways. Firstly they could target the age group which are most at risk of developing the disease, in the hope than any benefit from the extra exercise could slow down the progression and onset of it. In 2010, men and women between the ages of 65 and 74 on average spent 23 minutes and 16 minutes respectively on physical activity daily. [8] At a period of a person’s life where exercise could have the greatest impact regarding Alzheimer’s disease the rate of exercise would have to be significantly greater to have a noticeable effect. As BDNF production is best produced during short bursts of exercise spinning classes specifically designed for the elderly or such like which encourage a fast heart rate but minimise the risk of injury could be effective. However, as research has shown if exercise is conducted over a long time period of many years it can significantly increase the overall BDNF production in the brain and thus the risk of developing Alzheimer’s disease. This presents the second way the NHS could put the research into practice, by targeting a much younger audience. On average men and women only spend 5 and 6 hours respectively a week doing any kind of physical activity including house work and walking. It therefore may be more beneficial for the NHS to target a much younger audience of young adults who should theoretically have more energy to fit in exercise, so as they can develop “good habits” to carry forward into old age.

The main problem with this however is education. For many schemes such as this the only way to get through to people is to education them as to why exercise is so good for them. As the developments in science revealing the possibility that exercise could potentially link to a much lower risk of developing Alzheimer’s disease are relatively recent, they are not well known. It may be the case that educating the general public on the issue could stimulate some into taking up more exercise.
The main factor for the NHS however is cost. In an unstable economic climate with cutting costs, the NHS may not have the means of funding a large publicity drive on energy to prevent and slow down the progression of Alzheimer’s. However, dementia cost the NHS around £23 billion in 2012, so it would not be unreasonable to suggest that the cost of publicity in the short term could relieve the NHS of some of the pressure in the long term.

**CONCLUSION**

To conclude although many investigations support the idea that the uptake of exercise can reduce the risk of developing Alzheimer’s disease, it can also aid in regaining some of the cognitive ability of sufferers of the condition. However as mentioned before the investigations which have currently been undertaken were completed in controlled conditions with scientific input, however due to the nature of the illness, many suffers Alzheimer’s disease and other forms of dementia lack organisation skills and often find in difficult to engage in group activities, so any exercise undertaken would have to be carefully monitored by support groups and/or family member.

Regarding the prevention of Alzheimer’s, although studies have supported the theory that doing more exercise during your midlife can reduce your chances of developing the disease it is still only an idea of progress. An exercise campaign launched by the NHS would have to be carefully considered for feasibility and cost, and the only logical target group would be a much younger audience, so the outcomes of the project could only be observed 30-40 years later.

However the main thing to remember is that Alzheimer’s is a progressive disease that, at the present time, is still incurable. However the element of exercise could bring some comfort to families and sufferers as it may slow down the progression of the disease. Unfortunately this is all that can be offered for sufferers, however the hope is that this new research into BDNF production combined with drug research in the future could bring a new level of hope to the thousands of people affected by the illness in one way or another.
[1] The Guardian, Sarah Boseley - healthy life expectancy is shortening in the UK than abroad (5th March 2013) - Page 2


[8] British Heart Foundation Physical Activity Supplement 2012 – Page 6

Figure [1] http://jordan-tesch.wikispaces.com – Page 3