Dissertation Academic Paper

Title: The effect of supplementary water consumption on the cognitive performance of young adults aged 18-25.

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Student Declaration In Respect of Individual Work

I declare that the whole of this work is the result of my individual effort and that all quotations from other authors have been acknowledged.

Dissertation submitted in partial fulfilment of the requirements of the University of Wales for the Degree of Bachelor of Science with Honours.

Signed:..............................................

Date:......................................................
Abstract

Background- While the effect of dehydration on cognitive function in adults has been extensively studied, there is little research on the effect of supplementary water consumption on cognitive performance.

Methods- 29 young adults aged 18-25 (13 Male and 16 Female) were randomly allocated to a group that received additional water or a group that did not. Each participant completed a set of tasks to determine baseline and then repeated them after an interval of 30 minutes. Improvements from baseline to retest were calculated for each participant. 24 hour-recalls were used to assess fluid intake and to get an idea of hydration status at baseline.

Results- Supplementary water consumption has a positive effect on the cognitive performance of young adults. Participants in the intervention group showed significant improvements in results after fluid intake for the single letter cancellation task (p=0.008) and the auditory span number recall (p=0.009) when compared to participants in the control group. It was also shown that the volume of water consumed between tests had an effect on the level of improvement from baseline to retest. The 24 hour-recall showed that 72% of the participants were drinking less fluid throughout the day then is recommended by the European Food Safety Authority.

Conclusions- As a group overall fluid consumption was below recommendations. Supplementary water consumption improved the performance of individuals on tests of attention and short term memory. The volume of fluid consumed may have had an effect on the level of improvement between tests.

Keywords: Cognitive function, Adults, Hydration, Fluid intake, Attention, Memory
Introduction

Water is the main constituent of the body, with approximately 60% of body weight made of water. Water has many functions within the body. It is required as a building material for cells and is present in every cell and tissue within the body. It is also used as a reaction medium within the cell, allowing reactions to take place and is involved in all hydrolytic reactions (Jéquier and Constant, 2009). Severe dehydration has a large effect on the function of the cardiovascular and respiratory systems, the digestive tract, the reproductive system, the liver and the kidney and may be a life threatening condition (Szinnai et al., 2005).

Dehydration is defined as the loss of 1% or greater of body weight as a result of fluid loss (European Hydration Institute, 2016). Dehydration can be acute, as from a bout of intense exercise, or chronic, resulting from less than adequate rehydration of daily water losses over a period of time (Kleiner, 1999). A study by Ganio et al (2011) demonstrated that mild voluntary dehydration that occurs naturally throughout the day might reduce cognitive functioning. Despite the fact that effects of dehydration have been extensively studied, results describing the positive effects of drinking water on cognitive performance in adults are limited and often contradictory (Lieberman, 2007).

Fluid balance in the body is maintained by homeostatic mechanisms. Water upkeep occurs by the renal system, adjusting the amount of urine being produced. The thirst sensation encourages water intake (Masento et al., 2014). The loss and gain of water within the body
maintains total body fluids within narrow limits. Fluid intakes are generally considered to be adequate enough to maintain water balance in the body (D'Anci, Constant and Rosenberg, 2006). If water balance is not kept within the limits it may lead to dehydration, causing severe side effects on the individual, such as influencing the ability to perform specific tasks. Recent studies have shown that mild dehydration has an adverse effect on the cognitive performance of men at a mean level of -1.59 % dehydration (Ganio et al., 2011).

As hydration is a state of balance in the body, over-hydration may also be a problem for the body. Over-hydration is known as hypernatremia, as there is too much fluid in the body it causes the cells in the body to swell. The drinking of excess water can be a result of psychiatric disturbance (Wiseman, 2002) or as a result of taking drugs, such as anticholinergic medications which may cause a dry mouth or psychotropic drugs which alter brain function (Sawka, 2004). Hypernatremia is rare, as a very large volume of water, 10-15 litres is required to be drank over a period of just a few hours. The individual may not have a sense that they have drunk too much and as a result may not use the toilet (Wiseman, 2002). However, this is not a normal response to over-hydration in a healthy individual, as there would be an increase in the production of urea in the kidney and this would cause an increase in the sensation of the need to urinate.

Humans drink for various reasons, particularly for hedonic ones, but most of drinking is due to water deficiency which triggers the regulatory or physiological thirst (Popkin, D'Anci and Rosenberg, 2010). However, as each individual is different and experiences different things
throughout their daily lives it is difficult to set an exact recommendation for how much fluid should be consumed each day. Fluids are generally consumed not to quench an individual’s thirst, but as components of everyday foods such as fruits, soup and dairy products (Popkin, D’Anci and Rosenberg, 2010). An average of 19% of fluid intake is consumed through food that is eaten throughout the day (Campbell, 2007).

The European Food Safety Authority (EFSA) have set recommended guidelines for fluid intakes; 2000ml of fluid for females and 2500ml for males to be consumed per day. However, there is a lack of empirical evidence to support the amount of additional fluid individuals should consume (Masento et al., 2014). Ferreira-Pêgo reported that less than 50% of the women and approximately 60% of the men from 13 different countries in the study did not comply with the adequate intake values of water from fluids (Ferreira-Pêgo et al., 2015). Trends in under consumption of fluids seem to be similar in different areas across the world, while recommendations may differ.

Research by Gibson and Shirreffs to examine the typical fluid intakes of adults aged 19-65 in the UK showed that on average men had a fluid intake of 2.5 Litres a day while women had an intake of 2 Litres a day (Gibson and Shirreffs, 2013). Young adults may be more likely to consume drinks high in sugar and also have a higher intake of alcoholic beverages than other population groups (O’Leary et al., 2012). In a study on a British sample of university students 56.1% of the participants binge-drunk weekly (Atwell et al., 2011). Dehydration may occur although fluid intake is high as alcohol acts as a diuretic (Hobson and Maughan,
Balaghi’s study on the fluid intake of university students showed that both men and women had a daily intake that was significantly lower than the recommendations (Balaghi et al., 2011).

Cognitive function can be divided into several different categories: memory functions, attention functions, executive functions, psychomotor functions, and language skills (D’Anci, Constant and Rosenberg, 2006). There is insufficient information available to determine the level and length of dehydration that will produce an effect of the cognitive performance of the individual (Lieberman, 2007). Past studies have also shown that mild dehydration in adults aged between 18 and 25 years can cause alterations in aspects of cognitive function such as concentration, alertness and short term memory (D’Anci, Constant and Rosenberg, 2006). This has also been shown to be true in a study conducted by (Ganio et al., 2011).

Intervention studies allow for the researcher to alter one specific factor and allows for this alteration to be examined. Some intervention studies have shown a beneficial effect of drinking water on cognitive performance. Intervention studies that have been carried out on children have found that recall was improved after water consumption (Benton and Burgees, 2009), as well as having an effect on performance on visual attention and memory tasks (Edmonds and Burford, 2009). Benton (2011) also observed that the behaviour and concentration of children was improved when they had been given water.
Majority of the evidence and research that is available on water consumption and cognitive function is based on studies on children. Few studies have been based on the effects of water consumption in young adults. As a result of this it is hard to find conclusive evidence to support or deny the effects of water consumption on cognitive functions in young adults.

Further research is required to provide evidence of the full effects.

The aim of this research project is to examine whether supplementary water consumption has an effect on cognitive performance and concentration levels of young adults between the ages of 18 and 25.
**Materials and Method**

This is a cross sectional study, consisting of a survey of participants aged 18-25 years. Participants were recruited from an opportunistic sample of friends and family of the researcher. Block randomization was used to allocate small groups of participants into the control and intervention groups. Randomisation was used to prevent bias (Woodward, 1999). Before meeting with each group, the researcher flipped a coin to decide if the group would be in the intervention or control group. Each group completed the single letter cancellation task and number span recall task to determine a baseline score, participants then repeated the tasks a second time after 30 minutes, before completing a 24 hour-recall.

The intervention group received water during the 30 minute interval between tasks and were encouraged to drink as much as they liked, while the control group were unaware that the intervention group were receiving water. However, participants in the control group were not stopped from drinking fluids if they wished, but they were not encouraged to do so. Edmunds and Burford (2009) used a similar method with a control group and an intervention group in their study, the intervention group were encouraged to drink as much as they could from the water that they were given.

There were two tasks chosen to examine different aspects of cognitive function to observe the effect of hydration on participant’s performance. These were the single letter cancellation task and the number span recall task. (For research tool see appendix A). The single letter cancelation task and similar memory tasks and methods have been used to examine the effects of supplementary water consumption on the cognitive performance of children (Edmonds and Burford, 2009). A similar method was used by Benton and Burgess
(2009) when examining the effect that the consumption of water has on the memory and attention of children.

The single letter cancellation tasks are pencil and paper tests that are used clinically and in research settings as a measure of attention, visual-spatial scanning abilities and visual-spatial dysfunctions such as special neglect (Uttl and Pilkenton-Taylor, 2001). The single letter cancellation task looked to examine the attention and concentration of the participant. Participants were given one minute to complete the test by putting a line through the letter ‘H’. Scores were calculated by counting all of the correct cancellations and subtracting the number of cancellations that were wrong away from this. Letter cancellation tasks are commonly used in clinical settings to examine functions of patients, particularly patients that have experienced an injury to the brain (Lezak, 2004).

The number span recall task examined the participants short term memory by looking at how many number sequences could be written down correctly after being given to the participant verbally by the investigator. Ten number sequences were read to participants at the rate of one digit a second, participants were then given time to recall and write this sequence down. The total number of sequences correct gave the score for the test. A random number generator was used to create the number sequences.

In addition to the cognitive tests the 24 hour-recall was used to get an estimation of the hydration status of the participant at the baseline test before intervention. It was also used to look at different patterns of fluid consumption and trends among the age group. The 24 hour-recall method was chosen as it is quick and simple to perform and causes minimum
disruption to the participant (Thomas and Bishop, 2007). 24 hour-recalls assess the actual consumption of an individual. A single 24 hour-recall may not be sufficient to calculate an individual’s typical food intake; multiple recalls are needed to achieve this. However, 24 hour-recalls on different individuals can give a measure of the intake of the sample population (Gibson, 2005).

During data collection, the researcher introduced each task to the participants and described how to complete the tasks before they began. For the single letter cancellation task participants were told to target the letter ‘H’ and if they made a mistake to simply continue. They were then told that they would be given a minute to complete as much of the task as possible. Once it was clear participants understood the task they were told to begin and asked to stop after the minute.

For the number span recall participants were instructed to listen as the researcher read out a number sequence and were told that after the researcher had finished speaking they should then write the sequence down. Participants were told that there would be a total of 10 sequences and that they increased in length as they progressed. It was then clarified that each participant understood the task and could hear the researcher clearly before the researcher began the task.

The tests were conducted in small groups of 2-3 people to allow for resource and time constraints. The 24 hour-recall was completed individually after the tests had been completed. All tests and recalls were completed in places that were familiar and
comfortable for the participants, with few distractions and free access to bathroom facilities.

This study was approved by the Cardiff School of Health Sciences ethics panel of Cardiff Metropolitan University prior to data collection (Ethics Reference 7326) (See Appendix B for ethical approval letter). Each participant was asked to complete a consent form after being informed what was required to take part before they completed any tests (See Appendix C for participant information sheet and consent form).

A pilot study was conducted on a small sample of the test population. Pilot studies are used to help when designing a research protocol to help identify any faults in the procedure and allow for changes to be made before conducting the full study (Teijlingen van and Hundley, 2002). For the pilot study research tool, see Appendix D. The pilot study led to reducing the amount of time for the letter cancellation task from two minutes to one minute as participants were able to cancel all ‘H’s in the two minutes of the first test and this did not allow for improvement on the post intervention test. It was also found that using the same number sequences for the auditory number span recall would not work as participants were able to recognise and remember the patterns from the first testing. Therefore, it was necessary to create a second list of number patterns for the second number recall task. The results of the pilot study were not taken into consideration for the results of this paper and the participants that took part in the pilot did not take part in the final testing.

To investigate the effect of supplementary water consumption and cognitive performance the change scores were calculated from pre-test to post-test.
Results

The final sample of 29 participants (16 females; 13 males) ranged in age from 18 to 25 years (M= 21.24, S.D. = 1.06) and majority of participants were currently in full time college education. Participants were divided randomly into two groups, control (12) and intervention (17).

Table 1

Demographics of participants displaying gender, age and activity level.

<table>
<thead>
<tr>
<th>Gender</th>
<th>45% Male 55% Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age Mean (SD)</td>
<td>21.24 (1.057)</td>
</tr>
<tr>
<td>Activity</td>
<td>Sedentary: 34.5% (n=10)</td>
</tr>
<tr>
<td></td>
<td>Moderately Active: 44.8% (n=13)</td>
</tr>
<tr>
<td></td>
<td>Highly Active: 20.7% (n=6)</td>
</tr>
</tbody>
</table>

Table 1 shows that both genders took part in the study. The mean age of participants was 21. Participants were typically moderately active.
Table 2

Demographics of participants showing the divide of participants between control and intervention groups by gender, age and activity.

<table>
<thead>
<tr>
<th></th>
<th>Control (n=12)</th>
<th>Intervention (n=17)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>50% Male, 50% Female</td>
<td>41% Male, 59% Female</td>
</tr>
<tr>
<td>Age Mean (SD)</td>
<td>21.33 (1.155)</td>
<td>21.17 (1.014)</td>
</tr>
<tr>
<td>Activity</td>
<td><strong>Sedentary:</strong> 33.33% (n=4)</td>
<td>35.35 (n=6)</td>
</tr>
<tr>
<td></td>
<td><strong>Moderately Active:</strong> 33.33% (n=4)</td>
<td>52.9% (n=9)</td>
</tr>
<tr>
<td></td>
<td><strong>Highly Active:</strong> 33.33% (n=4)</td>
<td>11.8% (n=2)</td>
</tr>
</tbody>
</table>

Table two shows that there was comparable age and gender between the intervention and control groups.

The information from the 24 hour-recall found that 72% (n=21) of the sample were not meeting the recommended fluid intakes as set by the European Food Safety Authority.

Compliance of the intervention group to the intervention was measured by monitoring how much water was consumed in the half hour interval between the tests. Participants in the intervention group consumed on average 850ml of water (range = 250-1,420ml; SD = 344). All participants in the intervention group drank water in the interval and were encouraged to do so.
No participant from the control group drank water in the interval. Participants were not stopped from consuming water if they wished however they were not encouraged to do so.

**Table 3**

Result of pre and post intervention for the letter cancellation showing the mean, standard deviation and % difference for all participant, control group and intervention group.

<table>
<thead>
<tr>
<th></th>
<th>Pre -test Mean (SD)</th>
<th>Post -test Mean (SD)</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All</strong></td>
<td>82.82 (12.03)</td>
<td>89.83 (11.88)</td>
<td>8.46</td>
</tr>
<tr>
<td><strong>Control</strong></td>
<td>81.42 (14.59)</td>
<td>85.42 (12.56)</td>
<td>4.88</td>
</tr>
<tr>
<td><strong>Intervention</strong></td>
<td>83.82 (10.22)</td>
<td>92.94 (10.67)</td>
<td>10.88</td>
</tr>
</tbody>
</table>

Table 3 shows that all participants improved between the pre and post intervention test for letter cancellation. There was a bigger difference in intervention than control. This was statistically significant (Paired Sample T test \( t = 2.853 \) df = 28 \( p = 0.008 \)). (See Appendix E1)
Table 4

Result of pre and post intervention for the auditory span number recall showing the mean, standard deviation and % difference for all participant, control group and intervention group.

<table>
<thead>
<tr>
<th></th>
<th>Pre -test Mean (SD)</th>
<th>Post -test Mean (SD)</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All</strong></td>
<td>6.14 (1.88)</td>
<td>6.69 (1.28)</td>
<td>8.96</td>
</tr>
<tr>
<td><strong>Control</strong></td>
<td>5.85 (2.08)</td>
<td>6.33 (1.07)</td>
<td>8.2</td>
</tr>
<tr>
<td><strong>Intervention</strong></td>
<td>6.35 (1.77)</td>
<td>6.94 (1.39)</td>
<td>9.3</td>
</tr>
</tbody>
</table>

Table 4 shows that all participants improved between pre and post intervention test for the auditory number recall task. There was a bigger improvement for participants in the intervention group than the control group. This was statistically significant (Paired Sample T Test $t = -2.828$ df = 28 $p = 0.009$). (See Appendix E2)
**Figure 1** To explore links between the fluid an individual drank and individual test results for the intervention group for the letter cancellation task.

![Effect of Fluid Volume on Letter Cancellation Results](image)

This suggests people with higher scores have moderate fluid intakes. Lower or very high intakes had lower results. Volume of fluid intake and difference between test result shows a small positive correlation ($r=+0.185$ Spearman’s Correlation) however, this was not statistically significant ($p=0.336$). (See Appendix E3)
From Fig. 2 there is an unclear relationship between the fluid intake of an individual and the improvement in results for number span recall. Volume of fluid intake and difference between test result shows a small negative correlation ($r=-0.26$ Spearman’s Correlation) however this was not statistically significant ($p=0.895$). (See Appendix E4)
Discussion

The aim of this study was to examine the effect of supplementary water consumption on the cognitive performance and concentration levels of young adults between the ages of 18 and 25.

The findings of this study suggest that supplementary water consumption has an effect on the cognitive performance of young adults. Overall improvements in test scores were seen for both the intervention group and the control group for both the letter cancellation task and the auditory number span recall task. However, there was a larger improvement for the participants in the intervention group for both tasks. The improvement in the control group would be expected as repeating a task results in thought learning, which may be the reason for the increase. Grandjean and Grandjean (2007) defined this thought learning reaction as “the improvement in performance that can occur on neuropsychological measures simply because of repeat exposure to test procedures and stimuli.” (Grandjean and Grandjean, 2007). This thought learning reaction needs to be taken into account when considering results. However, the increase in the intervention group cannot simply be put down to thought learning as it would be assumed that the results would improve similar amounts to the control group. Therefore, it can be concluded that supplementary water consumption must have an effect on concentration levels of young adults. Variations in the level of improvement suggests that the volume of water consumed also has an effect on the ability to perform specific tasks. The findings of this intervention study shows similar results to the results found by Edmonds and Burford (2009) which showed that children who drank additional water during the school day performed better on visual attention and memory tasks.
Table 3 shows the results of the pre and post intervention test for both the intervention group and the control group. It shows that there was an increase of 8.46% in the mean result of the letter cancellation task across all of the participants. However, the rise in the mean result was larger in the intervention group with 10.88% difference in the averages compared to the rise of 4.88% difference in the mean for the control group. This was shown to be statistically significant using a paired sample t-test (p = 0.008). These findings were similar to the findings of Edmonds at al. (2013) that showed positive effect of water consumption on Letter Cancellation task, with a higher elevation in results between baseline and retest for the water group (Edmonds et al., 2013).

The results of the auditory number span recall (Table 4) show an increase in the mean result of 8.96% between the pre and post intervention tests. The average increase in the results was higher in the intervention group with a difference of 9.3% between the means while the control group had a difference of 8.2%. This difference in results was shown to be statistically significant using a paired sample t-test (p=0.009). This improvement is similar to the findings of Benton and Burgess (2009) that conducted a similar, short term memory test on 40 school children. This study showed that recall was improved on the occasion that the children had consumed water (Benton and Burgess, 2009).

Figure 1 clearly shows that consuming water had an effect on the concentration of the participants and their ability to complete the letter cancellation task that they were given. However, there was a small number of individuals who only improved a small amount or did not improve at all. Figure 1 also suggests that the amount of fluid that is consumed between tests has an effect on the level of improvement between tests. Participants who drank small
volumes of water improved less than those who drank larger amounts. However, those that drank excessive amounts improved less than participants who drank moderate volumes. Therefore, it could be concluded that the volume of fluid that is consumed has an effect on the individual’s ability to complete the task. Too little or too much fluid intake in the short interval between the tests resulted in the participant improving less than those who had a moderate amount. These findings could be compared to the findings of Rogers et al. (2001) that showed that fluid intake had a negative effect on test results of participants who had a lower level of thirst at the beginning of tests (Rogers, Kainth and Smit, 2001).

Figure 2 shows an unclear relationship between the volumes of fluid consumed between the tests and the improvement of results for the number span recall task. Different volumes of intake may have different effects. Intake of larger volumes of water in a short period of time may have a negative effect on some cognitive functions, such as short term memory. However, the level of water that needs to be consumed to have a negative effect is not clear and this may be an area that needs further research in order to determine this level.

The results of the 24 hour-recall showed that 72% of the sample were not meeting the recommended fluid intake as set by the European Food Safety Authority. This is higher than the numbers that have previously been reported in studies such as the one conducted by Ferreira-Pêgo (Ferreira-Pêgo et al., 2015). The intakes that were reported in the study show similar findings to that of Balaghi’s study on university students, which showed that both men and women had significantly lower intakes than the recommendation (Balaghi et al., 2011).
There are a number of limitations to this study. A larger sample size may have given more accurate results (Woodward, 1999). The small sample size (n=29) was obtained from family and friends of the researcher and it was felt that because of this they gave the tests their full attention and were as accurate as they could have been when completing the 24 hour-recall. The 24 hour-recall didn’t give a very accurate measure of how hydrated the participant was when completing the tasks as the recall was done for the day before completing the tasks, it didn’t take into account the time of day that the test was completed or allow for variations in the fluid intake levels. The 24 hour-recall was assumed to be an average day and that fluid intake would have been the same if not very similar on the day of the study. However, a single 24 hour-recall may not be sufficient enough to calculate an individual’s typical consumption (Gibson, 2005). This means that participants in the control group may have been more hydrated than those in the intervention group at the beginning of the pre intervention test. Different measurements of hydration status could have been used to examine the hydration status of participants at the beginning of the tasks and after the intervention, such as measuring the osmolality of a urine or blood sample (Shirreffs, 2016).

The complexity of assessing cognitive functioning can be a problem when studying the effect of hydration as there is a wide range of specific functions and skills. Although there are a wide variety of neuropsychological tasks that can be used to assess cognitive function they often require the use of more than one function and these functions may not be equally affected by hydration status (Adan, 2012). This makes it difficult to compare findings across studies unless the same or very similar tests have been used in all of the studies. Comparing findings against other studies can be difficult when different tasks are used as
they rarely measure the same abilities. Edmonds and Burford (2009) stated that “pure tasks
that assess only one cognitive function are extremely rare (if they exist at all)” (Edmonds
and Burford, 2009). This highlights the importance to develop a standard system of
measurements for different cognitive functions to be used in future research in this area.

These tests were chosen as they have been used in a number of different studies on
different age groups. Letter cancellation tasks are frequently used in clinical and research
settings as a quick measure of concentration and attention in participants (Uttl and
Pilkenton-Taylor, 2001). The tests were adapted to suit the age group that were being
studied however the main principle and background of the test was the same as other
studies.

Ethical constraints prevented the researcher from manipulating the amount of fluid that the
participants consumed, as a result there was a wide range of volumes being consumed and
although it can be assumed that fluid intake has an effect, it is difficult to conclude how
much fluid it takes to have a positive impact on cognitive performance. While consuming
too much fluid may also have a negative impact on cognitive performance it is unclear from
current studies what level of fluid intake has negative effects. Many studies that have been
conducted on the effect of hydration status on cognitive functions in adults have forced
dehydration on participants, there are few studies that look at the effect of extra fluid
consumption. This may be an area that needs further research to determine the frequency
and volume of fluid that has an effect on cognitive performance. It is clear that the effect of
fluid intake on cognitive function plateaus at some level of intake and so research may be
needed to determine this level and investigate the negative effects on cognition of going beyond this level of consumption.

Findings suggest that it may be important to encourage people of all ages to consume fluids throughout the day. For children, consumption of fluid throughout the day may help them to focus and learn better while at school. As part of the Welsh Network of Healthy School Scheme water is available free of charge and consumption is actively promoted in schools. For schools complying with the scheme pupils are allowed to have water bottles on their table during the school day and there are water coolers to allow students to refill bottles when required (Department of Health, 2006). Although it is becoming more popular, some schools do not allow children to consume fluids during class time as teachers do not want students needing to go to the toilet. This may be having a negative effect on children at school causing them to become more restless and making them unable to work to their full abilities.

In the workplace fluid consumption should also be encouraged, especially in occupations that require high levels of concentration such as people operating heavy machinery or surgeons as being fully hydrated may help them to focus better. In wales 70% of the working age population are in employment, making the work place a good setting to encourage healthy habits such as good hydration practices (Healthy Working Wales, 2015). The Corporate health standard helps to promote healthy habits in the workplace across the UK. This includes access to clean and hygienic drinking water for all employees (Healthy Working Wales, 2015).
Future research could be conducted in the area on different population groups, such as office workers or the elderly. Dehydration in the elderly has been shown to be a predictor of increasing frailty, deterioration in cognitive function and performance and an overall reduction in quality of life (Warren et al., 1994). As the UK has an aging population a study on the effect of hydration on the elderly may be useful to help understand further the impact that it has on this population group. In the older population it has been shown that cognitive function can indicate the onset of functional decline in dehydrated patients. This can further impact task processing leading to functional decline and a reduction in quality of life (Wilson and Morley, 2003). Studies in this area may be important to develop an intervention model for the elderly, especially in care homes, which have a higher incidence of dehydration when compared to the same age residing at home (Wolff, Stuckler and McKee, 2015). Research may also be important to determine if hydration status should be considered when assessing patients for conditions such as dementia, brain injury and other cognitive performance evaluations (Grandjean and Grandjean, 2007).

To conclude, drinking water throughout the day to ensure adequate hydration levels has a positive effect on the concentration levels and short term memory of young adults. However, over hydration may have a negative effect on these functions and fluid intake should be spread throughout the day and not taken in large quantities in a short period of time. The participants in this study are not meeting the recommended fluid intakes sat out by the European Food Safety Authority. Therefore, it may be important to develop a strategy that encourages young adults to increase their fluid intake in their daily lives. Development of standardised tests of cognitive functions would be a major development
that would help for future studies to be easily compared against each other. Further research may also be required to determine the amount of fluid intake that causes a negative effect on cognition.
References


