# Drinking in life: The importance of water

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# 1. Abstract

The human body is made up of over 50% water, and this percentage varies with age, gender and weight, and as such it plays a very important part in the organism. However, we often “forget” to drink the necessary amount of water that our body needs everyday so our skin, hair and external appearance start to show signs of distress, which is nothing but a reflection of what is going on in the inside.

Our project is to observe how different amounts of water drunk by different age groups affect them internally and externally. The group of people to be tested will drink different quantities of water over a period of three months and urine tests will be run to observe the different results and indicators in each of the cases. We will also compare their external appearance and how they feel after changing their habits.

This study ultimately intends to help young people understand the impact the quantity of water we need to drink every day has on our organism and educate consumers to make the appropriate decisions concerning their health.

# 2. Keywords

Dehydration, urine, skin, habits, diet

# 3. Background

## 3. 1. Water content in the human body

The quantity of water in the human body varies during the lifetime according to factors of sex, eating habits, age and the fat contents of each human being. For example, men tend to have water content of around 70% and women tend to have an average water content of a 50%, depending on the quantity of adipose tissue, which is usually higher in women, because there is a lower quantity of water per cell. These percentages also vary with age. Babies have a higher average of water content, at around 75% regardless of sex, and this value decreases as the baby grows. Also, in people over 60 years of age the average decreases to reach values of 30-40%.

The adipose tissue or fat in our body can modify the water content of the human body. On comparison, muscular tissue presents a higher water proportion than adipose tissue, which is why fitter individuals have higher water content than the obese. The proportion of adipose tissue also varies depending on the sex of the person. Women generally have a tendency to accumulate adipose tissue in given areas of their body.

## 3. 2. Water content in cells

Water is distributed through our body. Our cells contain water, which is a necessary element to form the cell sap and allows them to capture nutrients and to be able to excrete residual products. Water is the mean by which our cells develop and where they absorb the necessary substances to carry out their bodily functions.

The water content in our body produces two different kinds of liquid: intracellular and extracellular liquid.

### Intracellular liquid

This liquid corresponds to 65% of the water in our body. It is separated from the extracellular liquid by the cellular membrane which regulates the osmosis processes for the intake and exit of the cell substances.

### Extracellular liquid

This liquid corresponds to the other 35% of the water present in our body. It is divided into plasma and interstitial liquid. The plasma is mainly formed by water which contains hormones, amino acids, glucose, mineral salts, antibodies, urea and CO2. The interstitial liquid can be found inside the spaces between cells.

## 3. 3. Water content in organs and tissues

The organs are formed by tissues and cell groups, so it becomes vital to maintain high levels of hydration for the optimal function of the organs in our body. The majority of human organs and tissues contain high quantities of water. Some examples are as follows:

. Blood – 83% - 92%
. Kidneys – 83%
. Lungs – 76% - 80%
. Heart – 76% - 80%
. Muscles – 76%
. Spleen – 76%
. Brain – 75% – 79%
. Liver – 76%
. Small intestine – 75%
. Skin – 70% - 72%
. Bones – 22% - 25%
. Adipose tissue – 10%
. Teeth – 9%

Throughout all the cell metabolic processes, water has a main role, either directly or indirectly:

. Water contained in the blood carries nutrients, hormones, amino acids, residual material and oxygen

. Kidneys filter the liquids in the organism to assimilate the necessary substances and to extract the toxins

. An exchange of gases takes place in the lungs, where the inhalation and exhalation are the main parts of the breathing process. Moistening is essential for the optimal functioning of lungs

. The heart is in charge of pumping blood in our body. It is formed by muscular tissues and these are made up of 76% water

. The teeth contain a small amount of water, but saliva plays an important part. The saliva is a fluid and it contains 95% water. It helps the body to digest the food in the stomach. The intestines are also lubricated with water

. Water content is also important in the tongue performance. A lack of water in the tongue makes the sense of taste nearly impossible

. The eyes must be always lubricated by tears which are made up of 99% water

. Bones also contain a small quantity of water, but it is important for the formation of hematopoietic stem cells. The cells are essential for the formation of red blood cells and the bone marrow must be partially hydrated to carry out its function

. The skin works as a membrane since it allows insulation against heat and cold. It also allows the extraction of waste substances through the process of sweeting

## 3. 4. Intake and elimination of water

Humans cannot synthesise the water they need to perform all their vital functions by themselves, so they have to obtain it from the external sources. The easiest way to do it is through the intake of water by drinking. Two and a half litres of water are the recommended daily intake.

Water is taken in through the mouth where it mixes with the saliva, and then goes down through the digestive system to the stomach. There, a small quantity will be absorbed. The remains go through the small intestine, the duodenum and the jejunum and it will finally be absorbed by the big intestine. The small intestine absorbs 0.65 litres/day and the big intestine absorbs 0.13 litres/day. These numbers are similar to the total amount of water absorbed everyday plus all the substances segregated by the salivary glands, the pancreas, the liver, the bowels and the stomach.

The absorption process of the necessary water takes place quickly compared to the absorption of nutrients. The intake of water shows up in the plasma and the blood cells within five minutes. The water molecules are transferred by a membrane from the bowels to the blood stream, where it is distributed throughout the body, the interstitial liquid and the cells.

Even though water is vital, a small amount has to be discharged. The primary method of discharge is urine, usually a litre and a half every day. The sweat process also discharges water depending on the weather or the activity carried out and lastly through the bowel movements.

## 3. 5. Dehydration and water-associated diseases

The lack of water in our body provokes a process of dehydration [3]. A loss of 1.1% of our body's water can be a cause for dehydration. It can be caused by a number of factors such as heat, physical exercise or diet and can lead to death.

Water has a very important role for the optimal function of the organism, especially for blood pressure regulation. The most important elements are Sodium (Na), Potassium (K), Magnesium (Mg), Calcium (Ca), bicarbonates, sulphates and dry residue.

Even though food can also provide these contents, water also becomes necessary. The possible health problems due to a lack of water ingestion are [3]:

. Osteoporosis, muscle cramps, tooth cavities, lack of sleep, nervous breakdowns and even depression can be caused by the lack of calcium

. Nausea, weakness, irritability and arrhythmia can be caused by the lack of magnesium

. Fluid loss, vomiting and liquid excrements are caused by the lack of sodium. However, a high quantity of sodium can provoke alterations in the blood regulation.

## 3. 6. Benefits for the skin and mental health by staying well hydrated

A good hydration brings many advantages to our body. A beautiful and spotless skin, an increase in our concentration levels, stress reduction and

improvement of our mood can be some. Others can be the following:

. Reduction of constipation

. Hydration of the skin makes it shiny and firm as well as having healthy hair. When the skin is dehydrated we can observe signs of darkness and dryness.

. Reduction in liquid retention and bloating sensation due to the lower quantity of water in the intestines.

. Elimination of toxins through urine and sweat.

. Improvement in blood circulation and optimal intake of oxygen in the tissues.

. Reduction of overweight, since with the ingestion of water we feel full and we do not need to eat as much

## 3. 7. Water in vegetarian food

Fruits and vegetables are very rich in water content and are low in protein and fat [1]. They are a source of carbohydrates, vitamins, antioxidants, fibre and minerals. They help to reduce the cholesterol levels in blood and they improve digestion by providing over 20% of the necessary water for a day.

Table 1: Water content in fruit

| % of water in fruit (x100g.) |
|---|
| • Peach 93.73%-80.68%<br>• Apricot 93.4-77.6%<br>• Lemon 92.31%-88.98%<br>• Melon 91.85%-89.9%<br>• Watermelon 91.45%<br>• White grape91.90%-87.3%<br>• Strawberry 90.95%<br>• Blackberry 90.9%-87.68%<br>• Lime 90.79%-88%<br>• Purple grape 90%<br>• Cherries 89.1%-72.66%<br>• Pear 88.2%-84.14%<br>• Nectarine 87.59%<br>• Pineapple 87.2%<br>• Plum 87%<br>• Orange 86.75%<br>• Apple 85.1%-84.1%<br>• Fig 85.21%-76.33%<br>• Kiwi 83%-82.44%<br>• Olives 79.9%-75.3%<br>• Avocado 78.8%-72.3%<br>• Banana 65.8%-36.1% |

Table 2: Water content in vegetables

| % of water in vegetables (x100g.) |
|---|
| • Cabbage 95.55%-94%<br>• Radish 95%<br>• Tomatoes 94.5%-90%<br>• Asparagus 94%<br>• Celery 94%<br>• Carrots 93%-91%<br>• Spinach 93%-91%<br>• Broccoli92.55%-90.5%<br>• Pumpkin 92%-85%<br>• Onion 92%-89%<br>• Bean 91%-90%<br>• Beetroot 91%-87%<br>• Pea 86%-62%<br>• Corn 82%-75%<br>• Potatoes 81%-66.8%<br>• Sweet potatoes 75.8%-72.5%<br>• Pepper 14.8%-2% |

## 3. 8. Water in animal origin food

Products derived from animals contain between 30% to 70% water [2].

Meat products provide the necessary protein for our body. Fish also provides proteins and is rich in

Omega 3 and rich fats which are necessary for our organism, being an essential energy source.

Table 3: Water content in meat

| **Meat with high water content (x100g.)** |
|---|
| • Lean meat *(calf)* 76.4%<br>• Chicken 75%<br>• Lean meat *(pork)* 75%<br>• Cured Ham 63.5%<br>• Bacon 49%<br>• Ham 48.6%<br>• Sausage 40.8%<br>• Strips of Bacon 8% |

Table 4: Water content in fish

| **Fish with high water content (x100g.)** |
|---|
| • Cod 83%-78%<br>• Clam (boiled) 82.4%<br>• Salmon 77%-67%<br>• Squid 76.8%<br>• Hake 76.2%<br>• Tuna 71%<br>• Crab 70%<br>• Sole 63.7%<br>• Tuna *(canned)* 49.4%<br>• Sardine 45.2% |

## 3.9. Water in fizzy drinks and juices

Fizzy drinks have a high content of sugar and they are used to quench thirst as an alternative to water. This kind of drinks are formed by water, carbon dioxide, sugar, sweeteners and other minor substances which can contain a high number of calories. These types of drinks calm the thirst although they increase the possibilities of excess weight due to their high sugar content. This high sugar concentration makes for a fast hydration, but not effective enough, since the osmosis process in the cells is slower as well as in the small bowel.

Juices are a traditional liquid which is ingested in our country, since they are very easy to prepare. The most consumed fruits are oranges and lemons which contain between 80% to 95% water and they contribute to our hydration by bringing vitamins to our body. They also favour digestion and nutrient assimilation and their water content will depend on their ripeness.

Table 5: Water content in fruit juices

| **Fruit juice with high water content (x100g.)** |
|---|
| • Lemon 93.96%-92.31%<br>• Lime 92.52%-90.79%<br>• White grape 91.90%-87.3%<br>• Pear 91.81%-74.38%<br>• Blackberry 90.9%<br>• Pineapple 90.82%-77%<br>• Orange 90%-88.3%<br>• Plum 88.6%-83%<br>• Apple 88.2%-57% |

# 4. The purpose of the research

In this project we aim to analyse the effects of water consumption among teenagers and teachers in our school, Mare de Déu del Carme in Terrassa (Spain). We will concentrate on the research of the appropriate quantities of water to be drunk every day, keeping in mind the different types of diets.

The optimal quantity of water to be ingested varies from person to person. The right quantity will develop into many benefits, from the physical appearance to the mental balance of the individual.

Not doing so will bring problems but sometimes people forget or neglect healthy habits.

**RESEARCH QUESTIONS**

1. Does our society realize the importance of drinking water?
2. Is it possible for our body to get water by food instead of only drinking it?
3. Is it possible to notice water benefits only in physical changes?
4. Is there only one way to hydrate our body?

**RESEARCH HYPOTHESIS**

**1.** Our society does not know how important it is to maintain an optimal hydration of our body.
**2.** Vegetarian food hydrates more than food of animal origin.
**3.** Drinking the right quantity of water enhances physical appearance.
**4.** Cold water hydrates less than warm water.
**5.** Sugary drinks hydrate less than natural water.

# 5. Method of research

## 5.1. Surveys

We have conducted surveys in our school to find out what level of knowledge our students and teachers have and also uncover information about their health and dietary habits.

### 5.1.1. Water basic knowledge

#### Preparation and design

Based on previous research on optimal quantities of water ingestion, the different forms of water intake, and the factors to take into account for its discharge, we formulate questions about water consumption among our upper school students and our faculty in order to help to develop our project.

#### Population to study

. Teenagers (16 to 18 years old)
. Teachers (20 to 40 years old)
. Teachers over 40

(Total of 301 people)

#### Procedure

Each student in Upper School and each teacher will answer the questions in the survey (sheet of paper) so that we can extract valuable information for our study.
(*See Survey in Appendix I*)

### 5.1.2. Consumption of other drinks instead of water

#### Preparation and design

We direct these surveys to younger teenagers keeping in mind that being hydrated plays an important role in growth and physical development. In most of the cases they bring fizzy drinks or juices to school instead of drinking water, so their development may be seriously affected.

#### Population to study

High school students (12 to 15 years old)

(Total 73 people)

Procedure

We randomly choose three boys and three girls from each class and they are asked to answer the survey on line

(*See survey in Appendix II)*

## 5.2. Food Dehydration

We proceed with a food dehydration process in the laboratory in order to find out the quantities of water of each of the foods.

We wanted to find out the water quantities of each of the foods and the amount of water which has been added to our organism with its ingestion. We have chosen foods from plant and animal origin.

The results of this procedure will help us to choose the best diet to follow in the next experiment, allowing us to design two different menus, with different quantity of water.

Materials

. Drying heater
. Glass containers
. Electric scale
. Foods chosen:

Rice
Macaroni
Spaghetti
Zucchini
Artichokes
Letuce
Pear
Apple
Mandarine oranges
Potatoes
Beans
Bread
Cured ham
Bacon strips
Black pudding
Beef
Pork feet
Pork meat
Hot dogs
Chicken thighs

Procedure

First of all we take a known quantity of each food, weigh it with the scale and record the weights on a chart (day 0).

Then, we put the foods in the dehydration oven (70 degrees) and we let them sit for 24 hours. After that we reweigh them and record in on the chart (day 1). We expect to find a lower weight every day, because food loses water at high temperatures.

We continue doing the same, day by day, till the weight of the food stays steady, that means there is no more water to lose.

We want to estimate the percentage of water in each food by comparing weights between the first and the last day.

*(See chart and pictures in Appendix III)*

## 5.3. Different ways of ingesting water

Experiments are carried out to see the relationship between water consumption and diets, and their effect on the human body.

We compare hydration sensation between drinking cold or warm water, between drinking water or other drinks (fizzy drinks and juices), the quantity of water obtained from different diets and the skin benefits of drinking more than 3 liters every day.

### 5.3.1. Drinking cold and warm water

#### Preparation

Based upon our daily experiences, we conclude that cold water is not as effective against thirst as the room temperature water. We want to find out the level of hydration that each sort provides and its effects on the human body.

#### Materials

. Room temperature water
. Cold water
. Thermometer

#### Population to study

Teenagers (16 years old)

#### Procedure

For five days, we will only drink water at room temperature. We will record the times we drink and which quantity we have to drink to satiate thirst. For five more days we will repeat the procedure, but this time with cold water.
*(See register in Appendix IV)*

### 5.3.2. Well-hydration skin effects

#### Preparation

Water is essential for good hydration and we want to find out what the external and internal effects of it are.
We want to compare skin before and after drinking 3 liters of water every day for three months.
We focus on the facial skin and on the hands due to the high number of wrinkles that often affect these tissues.

#### Population to study

For this experiment we choose individuals with deep facial lines and expressions so that change could be easily perceived.

. 67 year old female
. 56 year old male

#### Procedure

They are asked to drink three litres of water every day for three months and we monitor them every week and take a photograph of their face and their skin (always at the same place and with the same light) that can be easily compared.
*(See pictures in Appendix V)*

### 5.3.3. Water obtained from a given diet

#### Preparation

Some foods contain more water than others, so they will have a positive impact on body hydration. We design a menu keeping in mind the water content of each food included (based on our previous experiment about drying food).

We design a menu with a lot of fruit and vegetables and another with less plant-based food and more animal based food, according to the results obtained in the dehydrating experiment.

#### Population to study

Teenager (16 years old)

#### Procedure

For a week, a diet based upon foods which contain high levels of water will be followed. For one more week this diet will be stopped. During the third

week, a diet with low quantities of water will be followed. The results will be recorded on a chart: ingested water quantity, physical activity carried out and other drinks taken during the duration of the experiment.

(*See menus in Appendix VI)*
*(See water quantities of the ingested foods Appendix III)*

### 5.3.4. Water obtained from fizzy drinks and juices

Preparation

Based upon the results from the surveys on fizzy drinks and juices from the middle school students, we proceed to substitute the ingestion of water for this kind of drinks to find out if there is a real need for water.

Population to study

16 year old teenager

Procedure

We will start with a urine test as a control sample. Then, and for a week, we will record the quantity of water ingested and at the end of the week we will repeat the urine test. The following week only fizzy drinks and juices will be ingested and at the end of it we will carry out another urine test. We will record the quantities of liquids ingested and the amount of urine expulsed.

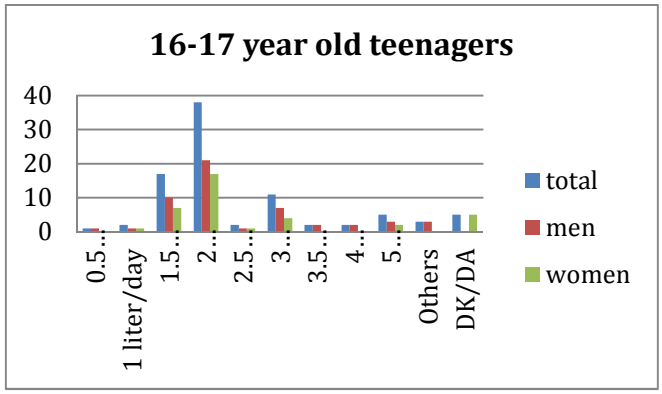
*(See register chart in Appendix VI)*

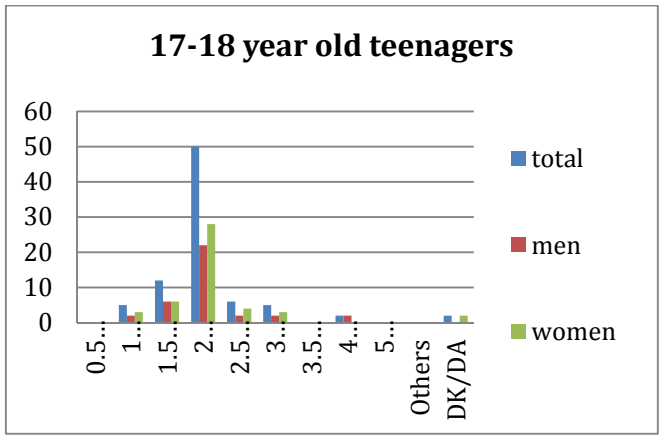
# 6. Results

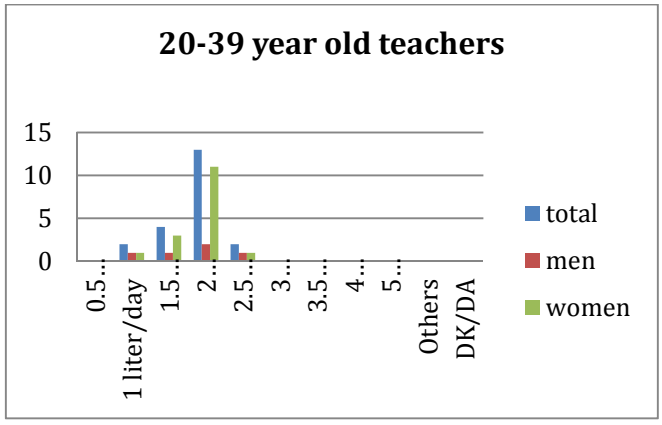
## 6.1 Surveys

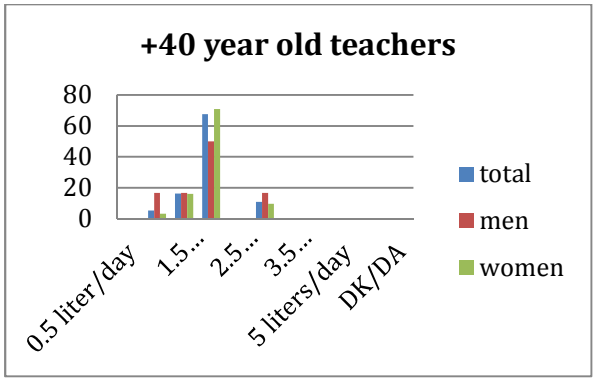
### 6.1.1. Basic knowledge about water and dietary habits

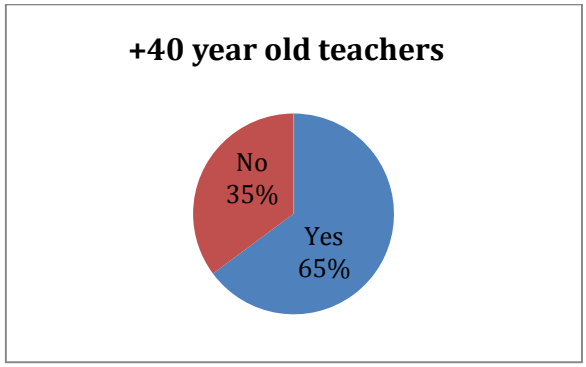
Question 1- What is the optimal quantity of water to drink in one day?



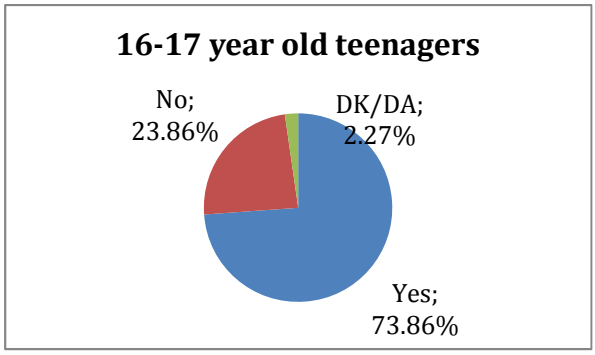



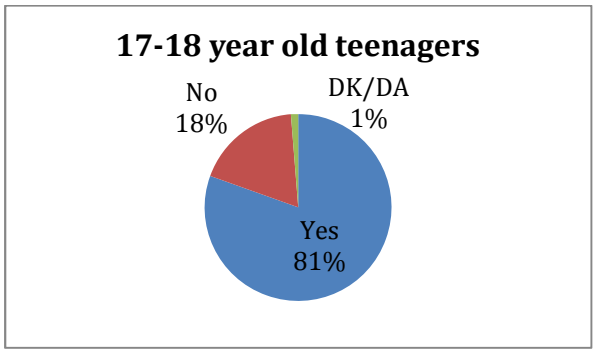



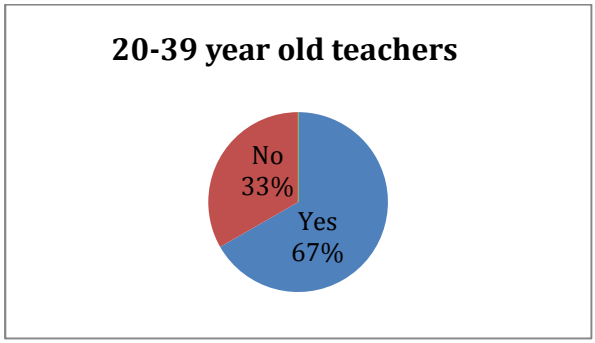


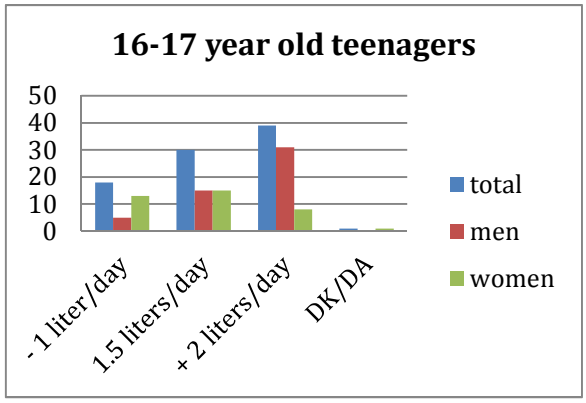

Question 4 - Do you usually drink a lot of water?

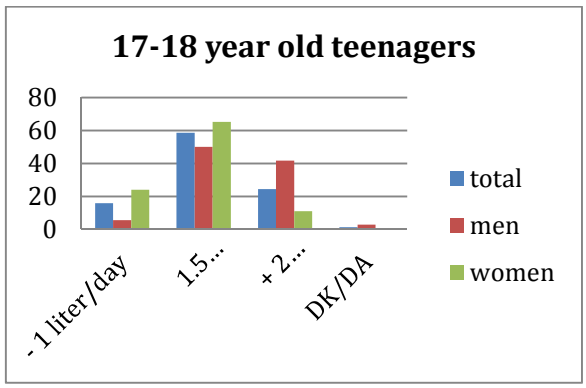


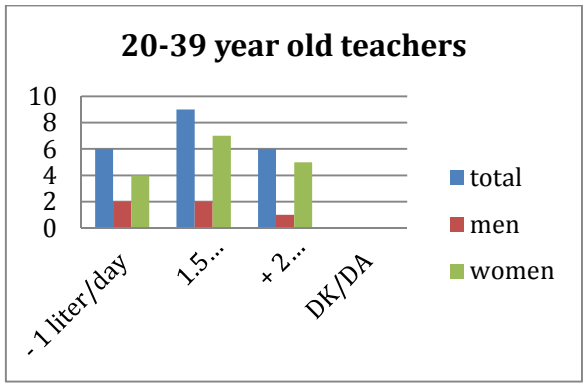



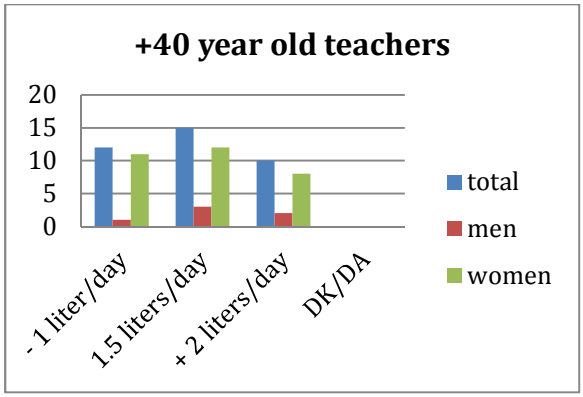




Question 5-How much water do you drink per day?

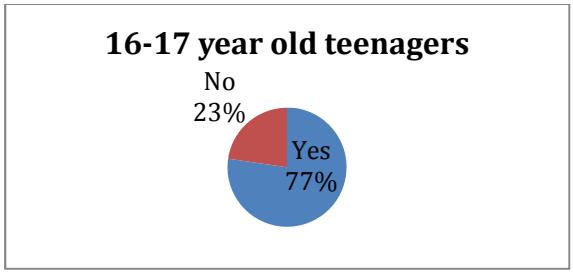


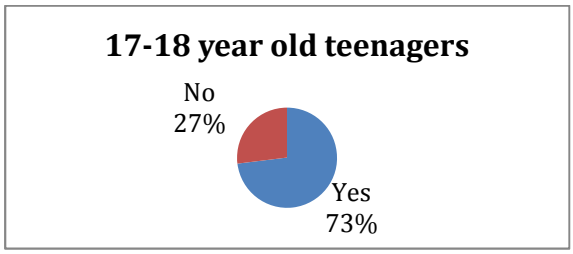



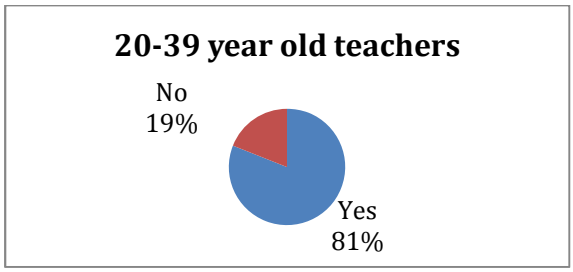



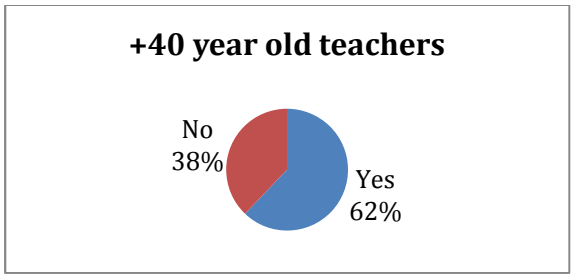



Question 6- Do you usually do strenuous physical activity?

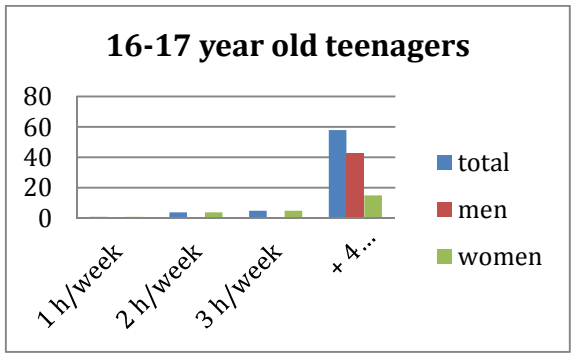


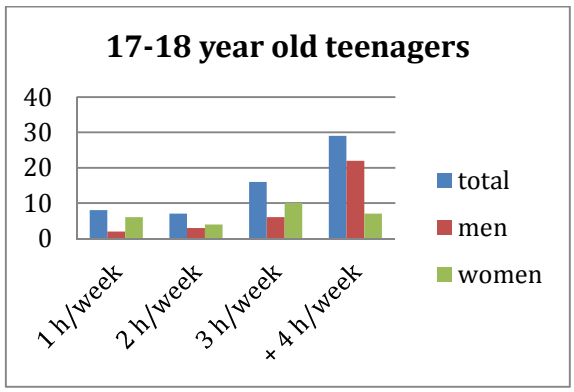



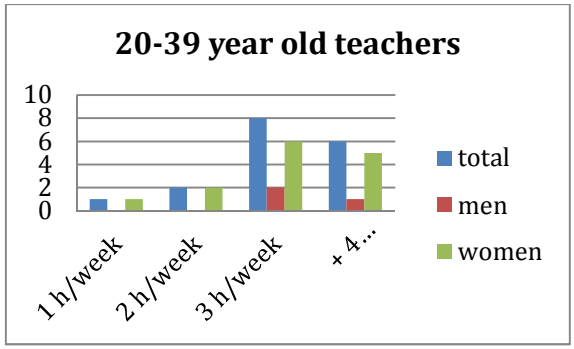



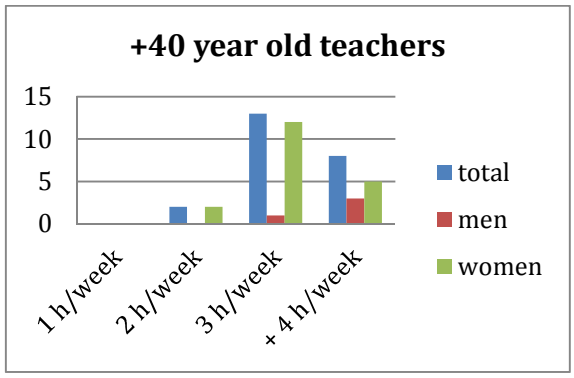




Question 7- How many hours a week do you practice sport or exercise?

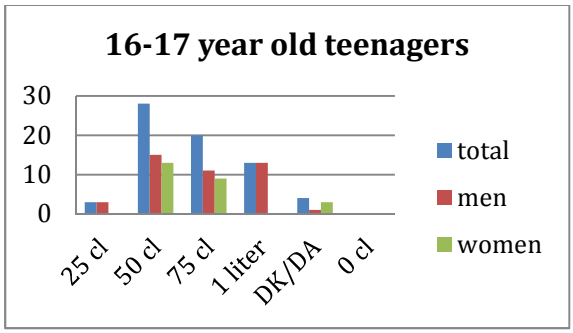


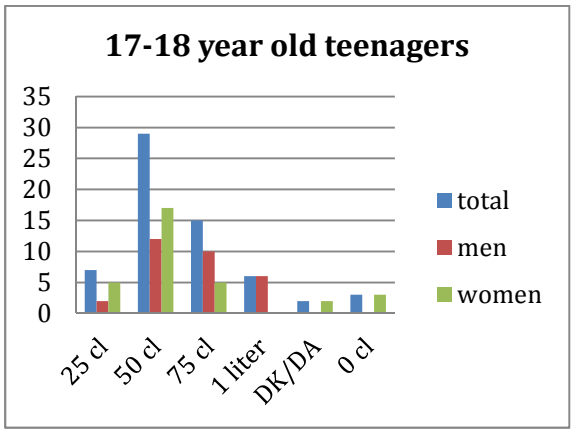



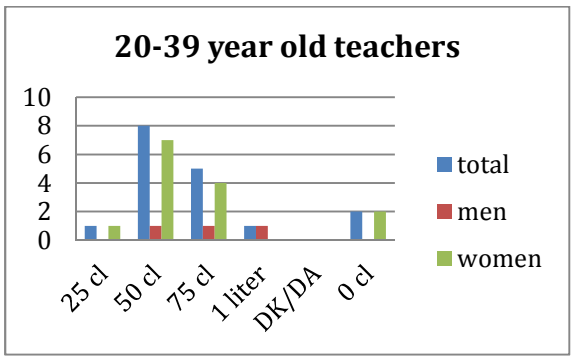



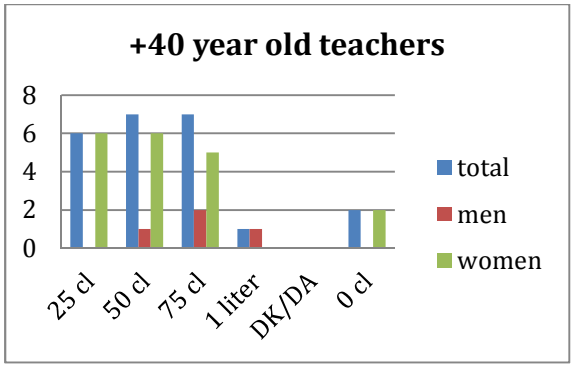



Question 8- How much water do you drink during training?

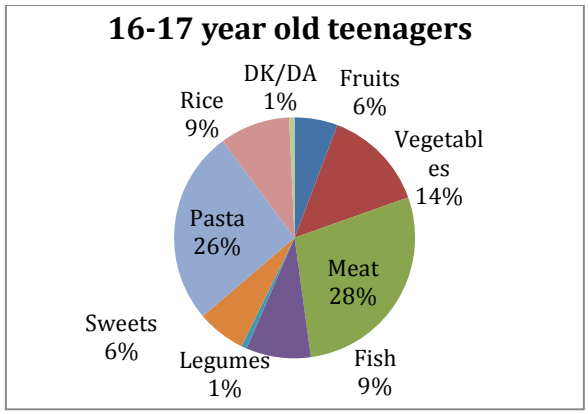


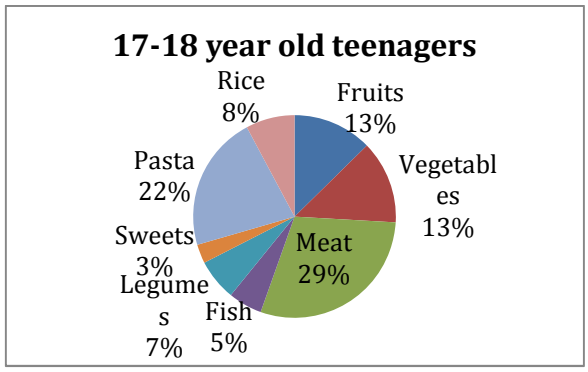



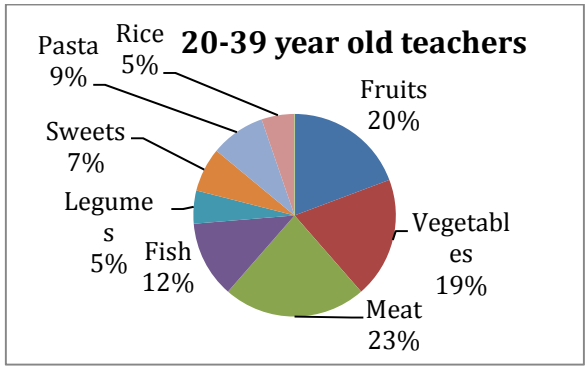



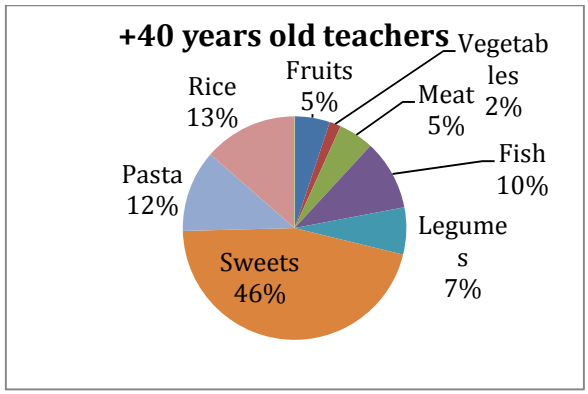




Question 9-Which kind of food do you eat more frequently?

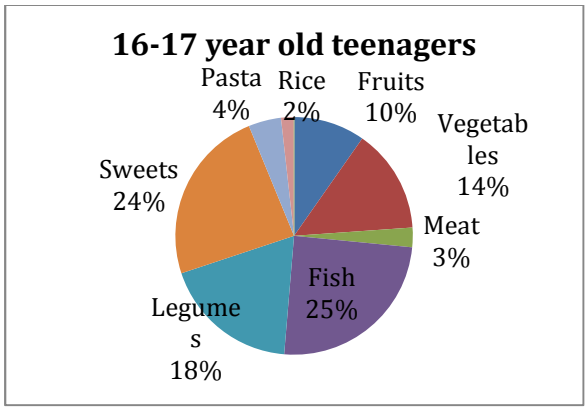


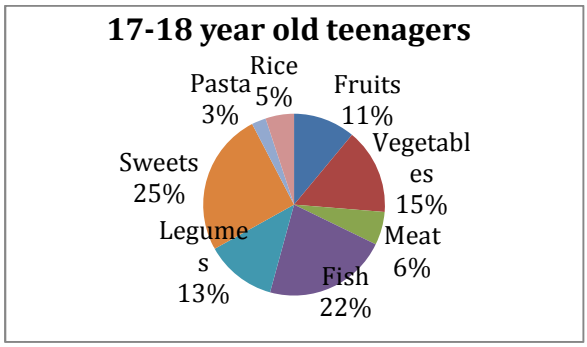



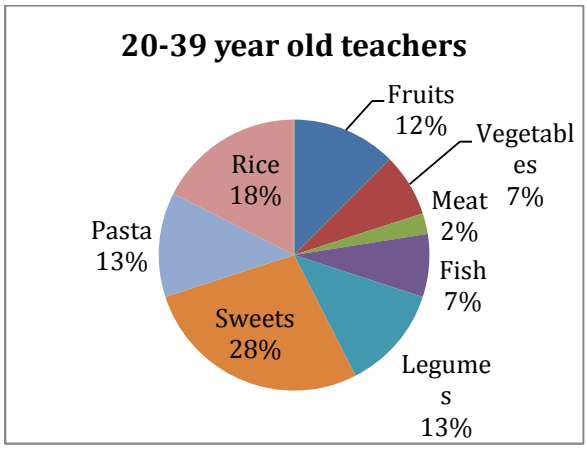



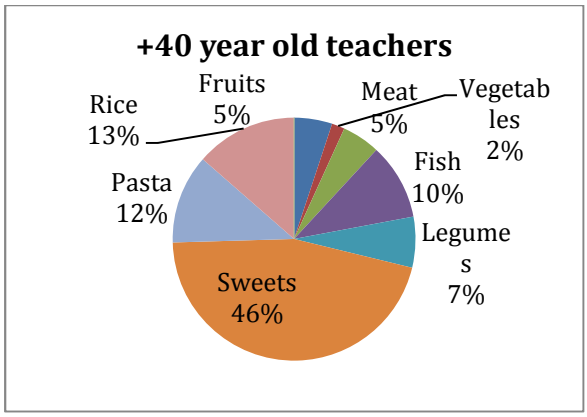



Question 10- Which kind of food do you hardly ever eat?

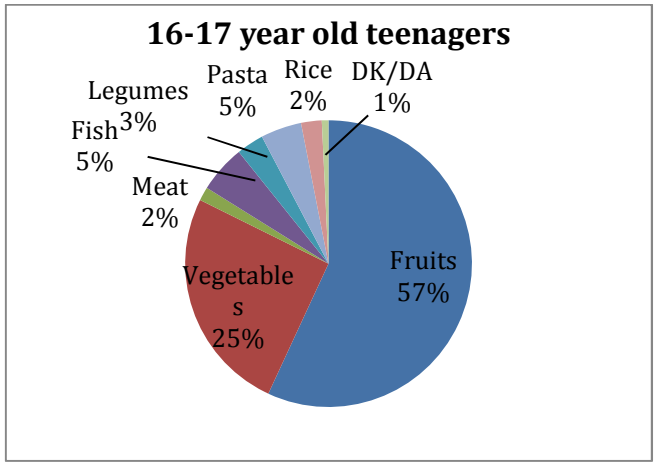


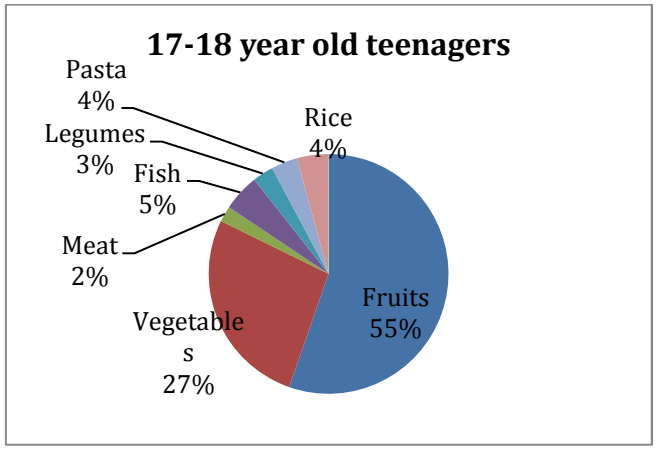



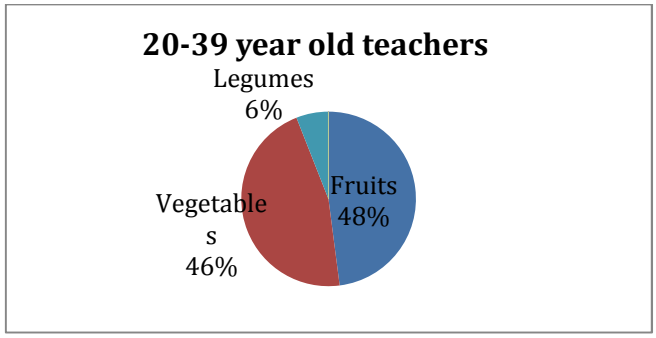



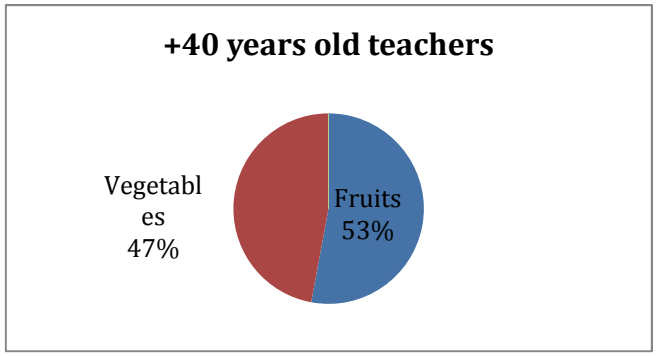




Question 11- Which group of food do you think has more quantity of water?

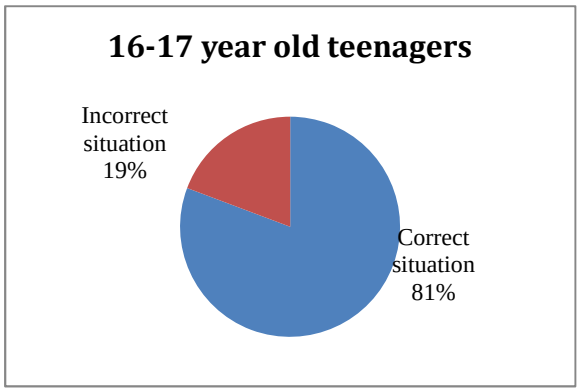


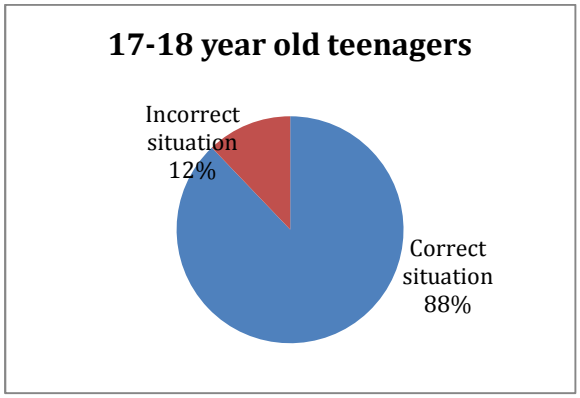



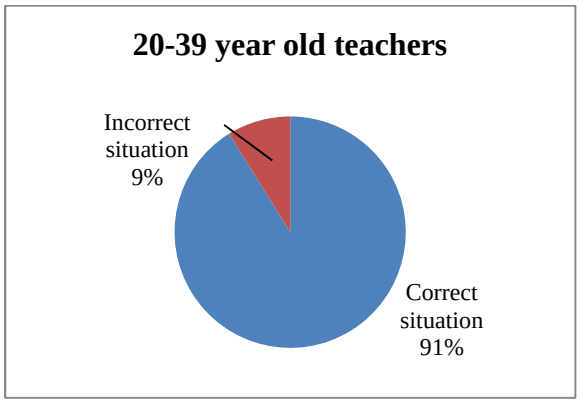



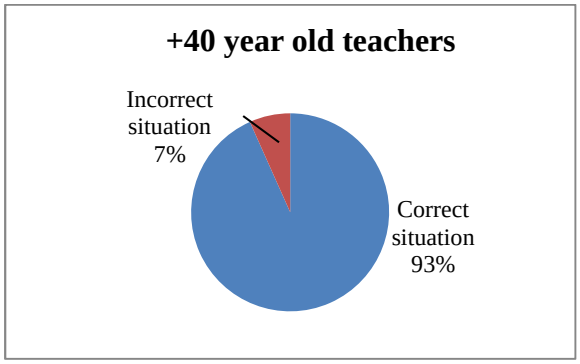



Question 13- Which is, in your opinion, the best situation about water and dietary habits?



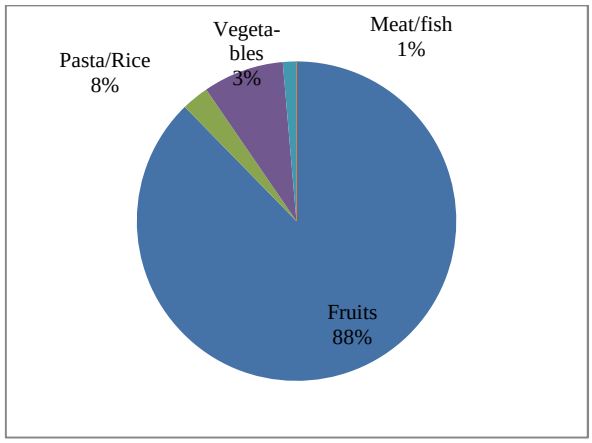



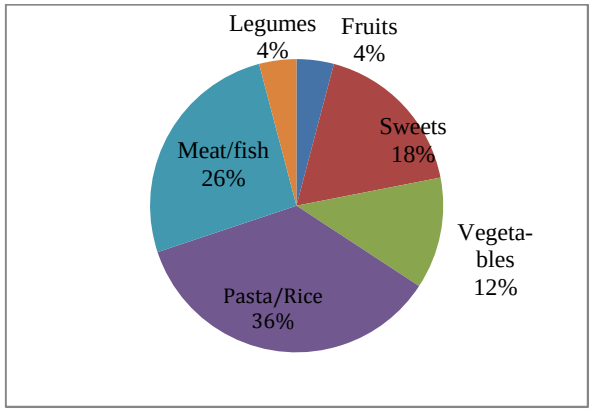

**Consumption of other drinks instead of water**

(Teenagers 12-15 years old)

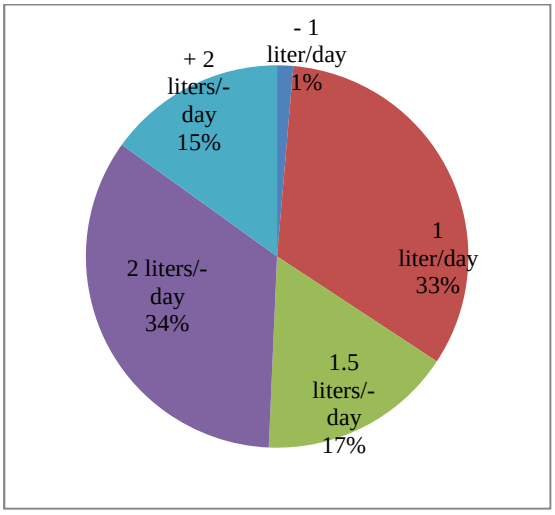
1-Which food group do you think has more quantity of water?



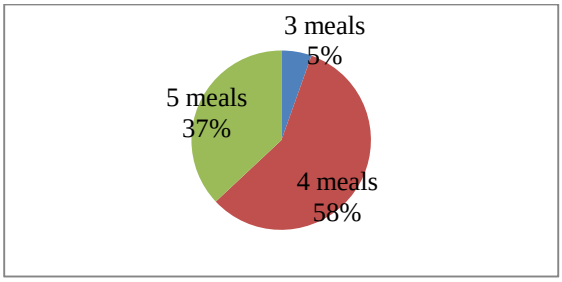

2-Which food groups do you eat more often?



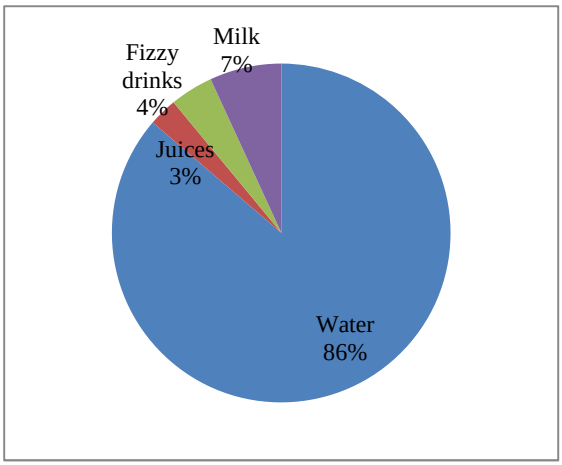
3. How much water do you drink per day?



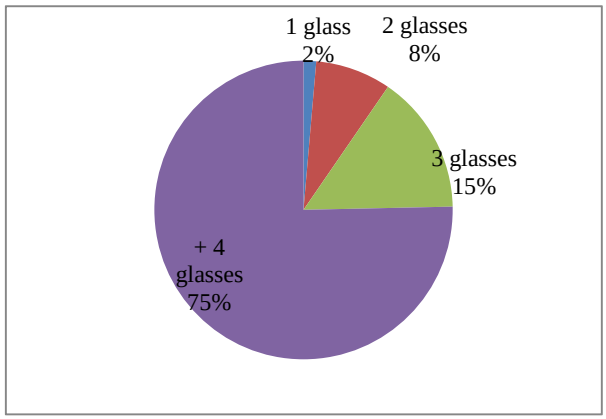

4.How many meals do you usually have per day?



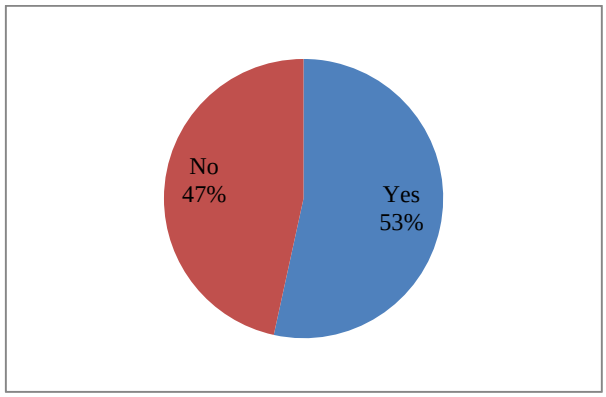

5.Which types of drinks do you drink per day?



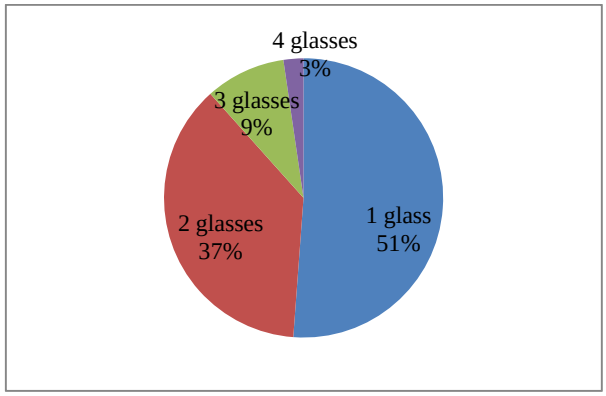

6.How much of each type of drink do you usually drink per day?



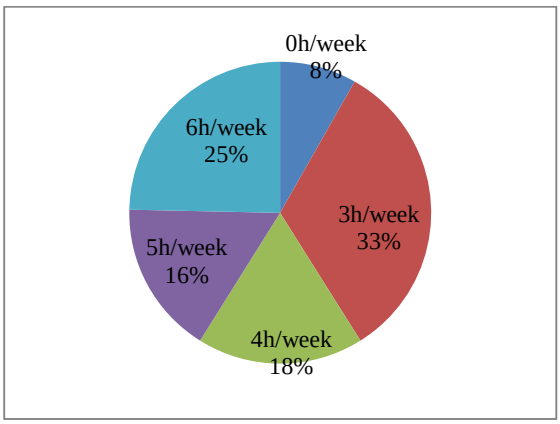

7.When you drink something that is not water, do you feel thirsty later?



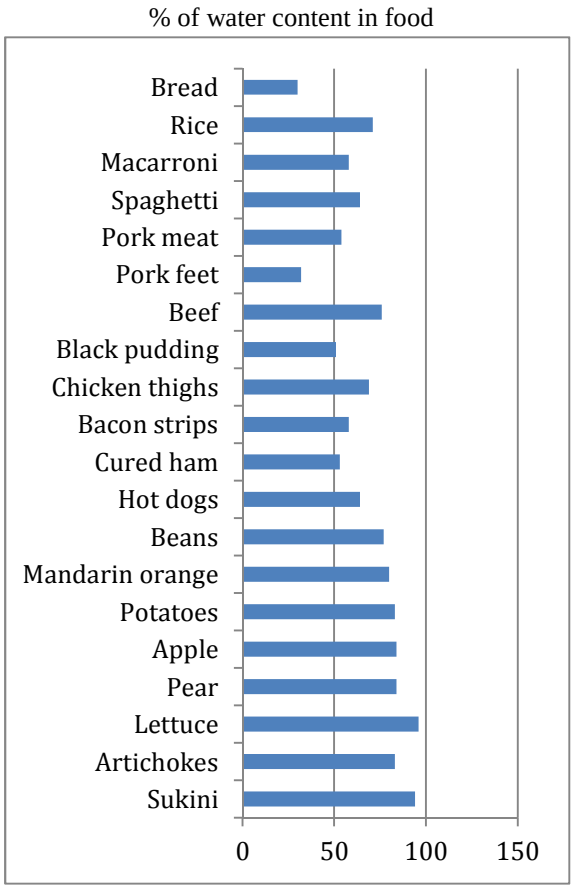

8.After drinking something that is not water, how many glasses of water do you need to avoid dehydration sensation?



9.How many hours a week do you practice sport? (Without counting P.E at school)




### 6.1.2. Food dehydration




### 6.1.3 Sensation of thirst from cold and warm water

According to the experiment, we calculate the average amount of water the individuals need to drink to avoid dehydration and a sensation of thirst.

Drinking warm water: 2.1 litres/day to quench thirst sensation

Drinking cold water: 1.58 l/day to quench thirst sensation

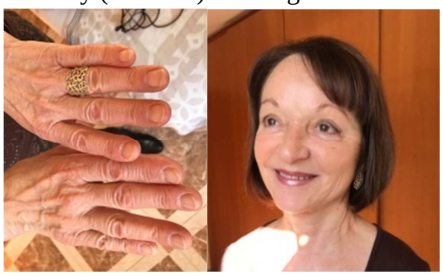
### 6.1.4. Effects on the skin

<u>Female</u>

First day (month 1): 67.3 kg

Month 2: 66.6 kg

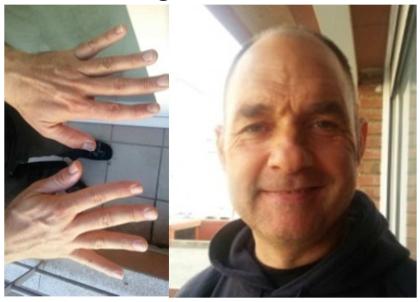
Last day (month 3): 66.1 kg



Male

First day (month 1): 84.2 kg

Month 2: 84 kg



Last day (month 3): 83.7 kg

### 6.1.5. Meat and vegetable menu

Water drunk during the first week (vegetable menu)

| | **Morning** | **Midday** | **Snack** | **Night** |
|---|---|---|---|---|
| **Mon.** | 0.50 l. | 0.00l. | 0.25 l. | 0.50 l. |
| **Tues.** | 0.50 l. | 0.25 l. | 0.25l. | 0.50 l. |
| **Wed.** | 0.10 l. | 0.50 l. | 0.25 l. | 0.50 l. |
| **Thurs.** | 0.25 l. | 0.50 l. | 0.00l. | 0.75 l. |
| **Fri.** | 0.50 l. | 0.25 l. | 0.25 l. | 0.75 l. |
| **Sat.** | 0.50 l. | 0.25 l. | 0.00l. | 0.75 l. |
| **Sun.** | 0.00l. | 0.50 l. | 0.00l. | 0.10 l. |

Water drunk during the third week (meat menu)

| | Morning | Midday | Snack | Night |
|---|---|---|---|---|
| **Mon.** | 1.25l. | 0.00l. | 0.50 l. | 0.50 l. |
| **Tues.** | 1.25l. | 050 l. | 0.50 l. | 1.00l. |
| **Wed.** | 0.50 l. | 1.00 l. | 0.50 l. | 1.00 l. |
| **Thurs.** | 0.25 l. | 1.00 l. | 0.00l | 1.50 l. |
| **Fri.** | 1.25l. | 0.50 l. | 0.50 l. | 1.50 l. |
| **Sat.** | 1.25 l. | 0.25 l. | 0.00l. | 1.50 l. |
| **Sun.** | 0.00l. | 1.00l. | 0.00l. | 0.50 l. |

## 6.1.6 Fizzy drinks and juices

Urine tests

| | Control | Drinking water | Drinking juices |
|---|---|---|---|
| **Qualitative urine analysis** | | | |
| **pH** | 5.62 | 5.68 | 5.64 |
| **Density** | 1.029 g/ml | 1.034 g/ml | 1.023 g/ml |
| **Glucose** | negative | negative | negative |
| **Proteins** | negative | negative | negative |
| **Cethonics** | negative | negative | negative |
| **Urobilinogen** | normal | normal | normal |
| **Bilirubine** | negative | negative | negative |
| **Hemoglobine** | negative | negative | negative |
| **Urinary sediment** | | | |
| **Red blood cells** | 0 | 0 | 0 |
| **White blood cells** | 0 | 0 | 0 |
| **Epithelial cells** | 2 | 8 | 5 |
| **Bacteria** | lacking | lacking | lacking |
| **Yeast or other parasites** | not observed | not observed | not observed |

# 7. Conclusions

## 7.1 Experiment conclusions

### 7.1.1 Upper school and teacher surveys

The average ingestion of water of all the groups is 1 litre to 1.5 litres. They all think that the quantity of water they ingest on a daily basis is correct. We can also verify that a large segment of the surveyed population develops physical activities for three or more hours a week. They agree that plant based foods, and, especially fruits provide higher quantities of water and these are present quite often in their diets, even though they also ingest high quantities of meats. The least ingested foods are fish and different types of beans.

### 7.1.2. Food dehydration

Plant based foods contain more water than animal foods. We have also verified that vegetal foods provide higher quantities of water when eaten in a raw state. When cooked, they lose all the contained water very quickly so they should not be cooked for a long time. Animal foods contain less water and this water disappears slowly when they are cooked.

### 7.1.3. Sensation of thirst cold and warm water

With the results of the experiment we can see that we drink more room temperature water to satiate our thirst than when we drink cold water, so it means that cold water quenches thirst and hydrates better than room temperature water, because individuals at our experiment needed less cold water to feel well-hydrated than drinking room temperature water.

### 7.1.4. Skin effects

After three months drinking 3 liters/day (a higher quantity than recommended) we observe physical changes, both in males and females.

We can notice skin benefits with a reduction of wrinkles and other skin marks.

If we compare photographs and weights, we can conclude that drinking the recommended quantity of water every day, during a long period of time (more than three months) people can reduce wrinkles and lose weight.

### 7.1.5. Meat and vegetable menu

A diet based on plant based origin food more than meat provides our body with more water than a diet based on animal based food. That is because, as we could prove in our food drying experiment, even cooked, fruit and vegetables contain more water than meat in general.

### 7.1.6. Fizzy drinks and juices

By observing the quantities of liquid ingested and expulsed, we can see a certain balance between both processes, even though the quantity ingested is a bit higher than the discharge. We can also conclude that there is less quantity of urine with the ingestions of sweet drinks or juices so there is no balance between the ingestion and the expulsion. That could be explained because of the sugar content is higher in this kind of drinks. So, even though they quench thirst almost immediately, a high sugar concentration is not beneficial for our cells, as they need more water to balance out the extra sugar. So, we can conclude that fizzy drinks and juices hydrate less than simple water.

If we analyze urine, there is no significant difference between samples; which means drinking other drinks instead of water is not unhealthy for our kidneys, and the only danger is the high sugar and fat level in our blood and, thus, in our cells.

## 7.2 Research conclusions

1. Teenagers in general do not know how important it is to maintain a proper hydration of our body. Although many drink a correct amount of water, they don't really know what it is the recommended quantity and why. Teenagers usually prefer drinking other types of drinks, such as juices or fizzy drinks, without realizing how negative sugar effects can be.

2. Plant based origin food provides more water than animal based food; which is why it is important to add fruit and vegetables to our daily diet to ensure that enough water is given to our cells directly.

3. Drinking more water daily and over a long period enhances physical appearance, skin benefits and weight loss.

4. Cold water satiates more than room temperature water. Drinking cold water reduces the quantity of water to feel well-hydrated.

5.Sugary drinks, in general, hydrate less than water. Fizzy drinks and juices calm thirst faster (or this is only a sensation), but our body feels dehydration more quickly with only drinking sugary drinks.

## 7.3 Recommendations

To guarantee a well-hydrated level of our body we should:

. Increase fruit and vegetable consumption in our dietary habits.
. Drink between 2 and 3 liters of water every day.
. Avoid drinking a lot of sugary drinks such as fizzy drinks or juices.

## Acknowledgments

Mr Miquel Bayó (Laboratory Head) M. Bayó Boada Terrassa (Spain)

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Leonor Clarés (Deputy Head) Col·legi Mare de Deu del Carme (Terrassa)

Paul Tompkins (Head of the Foreign Languages Department) Col·legi Mare de Deu del Carme

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[2]BIESALSKI Hans Konrad, GRIMM Peter. (2007). Nutrición, Texto y Atlas. Madrid (Spain): Editorial Médica Panamericana

[3] SUSAETA. (Unknown). Atlas ilustrado de fisiología humana. Madrid, Spain: Susaeta ediciones S.A.

## Links of interest

Food and Agriculture Organization of the United Nations (FAO)
http://www.fao.org/home/en/

Agriculture Department of the United States (USDA)
https://ndb.nal.usda.gov/ndb/nutrients/index

Community of Madrid Government (Spain)

- Nutrition and fruit and vegetables
http://www.madrid.org/cs/Satellite?blobcol=urldata&blobheader=application%2Fpdf&blobheadername1=ContentDisposition&blobheadervalue1=filename%3DT034.pdf&blobkey=id&blobtable=MungoBlobs&blobwhere=1352883450648&ssbinary=true

- Nutrition and water
http://www.madrid.org/cs/Satellite?blobcol=urldata&blobheader=application%2Fpdf&blobheadername1=Content-Disposition&blobheadervalue1=filename%3Dt068.pdf&blobkey=id&blobtable=MungoBlobs&blobwhere=1352883450714&ssbinary=true

Hydration for health (H4H)
https://www.h4hinitiative.com/es/ciencia-de-la-hidratacion/laboratorio-de-hidratacion/hidratacion-para-los-adultos/agua-en-el-cuerpo

# Appendix I

Basic knowledge survey

*(Upper school students 16-17 years and teachers)*

1- Which is the best quantity of water to drink in one day? *(open answer)*

2- How old are you?

3- Gender *(one option)*

- Male
- Female

4- Do you usually drink a lot of water? *(one option)*

- Yes
- No

5-How much water do you drink in one day? *(one option)*

- Less than 1liter
- 1.5liters
- More than 2 liters

6- Do you usually do physical activity? *(one option)*

- Yes
- No

7- How many hours a week do you practice sport?*(one option)*

- 1 hour
- 2 hours
- 3 hours
- + 4 hours
- No (Answer 6 = No)

8- How much water do you drink during training? *(If question 6 your answer was YES) (one option)*

- 25cl
- 50cl
- 75cl
- 1liter
- None

9-Which kind of food do you eat more frequently? *(multiple option)*

- Fruit
- Vegetables
- Meat
- Fish
- Legumes
- Sweets
- Pasta
- Rice

10- Which kind of food do you hardly ever eat? *(multiple option)*

- Fruit
- Vegetables
- Meat
- Fish
- Legumes
- Sweets
- Pasta
- Rice

11- Which group of food do you think has more quantity of water?*(multiple option)*

- Fruit
- Vegetables
- Meat
- Fish
- Legumes
- Sweets
- Pasta
- Rice

12- How many times do you go to the toilet to urinate? *(one option)*

- 3 times a day
- 5 times a day
- +6 times a day

13- Which is, in your opinion, the best situation about water and dietary habits?*(multiple option or not)*

# Appendix II

## Consumption of other drinks instead of water survey

Teenagers between 12-15 years

1-Which group of food do you think contains more quantity of water? *(only one option)*

- Fruits
- Candy
- Vegetables
- Pasta / rice
- Meat / fish
- Legumes

2-Which groups of food do you eat more often? *(only one option)*

- Fruits
- Candy
- Vegetables
- Pasta / rice
- Meat / fish
- Legumes

3-How much water do you drink in one day? *(open answer)*

4-How many meals do you usually do in one day? *(only one option)*

- 3 meals
- 4 meals
- 5 meals

5-Which types of drinks do you drink in one day? *(only one option)*

- Water
- Juices
- Fizzy drinks
- Milk

6-How many glasses of this drink do you drink in one day? *(The drink you have chosen in question 5) (only one option)*

- 1 glass

# Appendix III

## Food drying register chart

| Food | 1st weight (g.) | Last weight (g.) | % of water |
|---|---|---|---|
| Zuchini | 93.53 | 5.17 | 94.47% |
| Artichokes | 79.04 | 13.46 | 82.97% |
| Lettuce | 33.39 | 1.43 | 95.72% |
| Pear | 89.09 | 14.02 | 84.26% |
| Apple | 63.33 | 9.88 | 84.40% |
| Potatoes | 111.63 | 18.53 | 83.40% |
| Mandarin orange | 62.39 | 12.6 | 79.80% |
| Beans | 74.51 | 16.99 | 77.19% |
| Hot dogs | 39.85 | 14.26 | 64.21% |
| Cured ham | 10.34 | 4.89 | 52.70% |
| Bacon strips | 66.34 | 27.8 | 58.09% |
| Chicken thighs | 97.73 | 29.78 | 69.52% |
| Black pudding | 60.61 | 29.58 | 51.20% |
| Beef | 153.69 | 36.88 | 76.00% |
| Pork feet | 60.61 | 41.57 | 32,25% |
| Pork meat | 153.69 | 70,47 | 54,14% |
| Spaghetti | 39.8 | 14.16 | 64.42% |
| Macaroni | 45.22 | 19.17 | 57.60% |
| Rice | 46.025 | 13.3 | 71.10% |
| Bread | 32.45 | 22.6 | 30.35% |

## Pictures during the experiment

PREPARATION 06/02/2018




DAY 0 06/02/2018

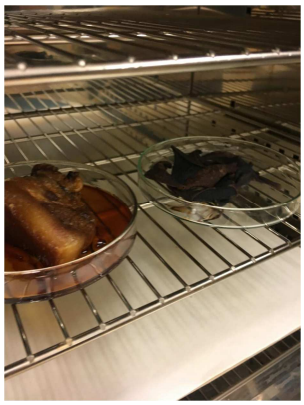
DAY 1 07/02/2018

DAY 2 08/02/2018

DAY 3 09/02/2018

DAY 7 13/02/2018

DAY 10 16/02/2018



DAY 14 20/02/2018

DAY 15 21/02/2018


DAY 16 22/02/2018

# Appendix IV

## Cold and warm water register chart

| Teenager 1 | | | | |
|---|---|---|---|---|
| DAY | NATURAL WATER drunk to satisfy thirst | | COLD WATER drunk to satisfy thirst | |
| | Quantity (l.) | Tº (ºC) | Quantity (l.) | Tº (ºC) |
| 1 | 2.62 l. | 22.1ºC | 2.1 l. | 14ºC |
| 2 | 3.17 l. | 22.5ºC | 1.33 l. | 14ºC |
| 3 | 1.97 l. | 22ºC | 1.33 l. | 14ºC |
| 4 | 2.2 l. | 22ºC | 1.58 l. | 15ºC |
| 5 | 1.25 l. | 22ºC | 2.07 l. | 19ºC |
| Teenager 2 | | | | |
| 1 | 1.6 l. | 20.6ºC | 1.4 l. | 16ºC |
| 2 | 2.3 l. | 21ºC | 1.8 l. | 16ºC |
| 3 | 2 l. | 21ºC | 1.5 l. | 15ºC |
| 4 | 2.1 l. | 21.3ºC | 1.3 l. | 15ºC |
| 5 | 1.8 l. | 21ºC | 1.4 l. | 15ºC |

## Appendix V

**Face and hands pictures**

| November 13th | November 20th | November 27th | December 4th | December 11th | December 18th | December 25th | January 1st | January 8th | January 15th | January 22nd | January 29th |
|---|---|---|---|---|---|---|---|---|---|---|---|

| November 13th | November 20th | November 27th | December 4th | December 11th | December 18th | December 25th | January 1st | January 8th | January 15th | January 22nd | January 29th |
|---|---|---|---|---|---|---|---|---|---|---|---|

# Appendix VI

## Menu with food rich in water- Week 1

| WEEK OF FRUIT AND VEGETABLES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **MEALS** | | **MONDAY** | **TUESDAY** | **WENSDAY** | **THRUSDAY** | **FRIDAY** | **SATURDAY** | **SUNDAY** |
| **MORNING** | **BREAKFAST 11h** | Cured ham sandwich | Ham sandwich | Ham sandwich | Ham sandwich | Cured ham sandwich | 2 toasts with a piece of black pudding and a coffee with milk | Milk and cookies. |
| **MIDDAY** | **LUNCH** | Sandwich Potatoes omelette and aubergines<br><br>1 Mandarin orange | Green beans with eggs and cured ham strips<br><br>1 pear | Grilled chicken with salad | Boiled potatoes with tender beans | Dry beans with grilled sirloin | Nothing | Grilled artichokes and sukini . |
| **AFTERNOON** | **SNACK** | Nothing | 3 pieces of chocolate biscuit | 1 piece of chocolate biscuit | Nothing | 1 liquorice | Nothing | Nothing |
| **NIGHT** | **DINNER** | Grilled sukini with 2 beef chops and lettuce with tuna | Pork cheeks with onion, potatoes and pepper in the oven | Pizza with: green pepper, egg, sukini and onion<br><br>1 mandarin orange | Chicken broth with grilled noodles and loins<br><br>1 iogurt | Green salad (carrot, lettuce, pepper, tuna and onion) with cod. | Pizza with: green pepper, egg, sukini and onion | Bread with tomato and ¼ black pudding.<br>Macedonian dessert (1 apple, 1 pear, 1 tangerine) |

## Menu with food rich in water- Week 3

| WEEK OF MEAL | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **MEALS** | | **MONDAY** | **TUESDAY** | **WENSDAY** | **THRUSDAY** | **FRIDAY** | **SATURDAY** | **SUNDAY** |
| **MORNING** | **BREAKFAST 11h** | Cured ham sandwich | Cured ham sandwich<br>4 mini-chocolate croissants | Ham sandwich | Cured ham sandwich | Ham sandwich | 1 toast and ½ of black pudding | 1 chocolate cup and 1 coiled puff pastry |
| **MIDDAY** | **LUNCH** | Omelette sandwich | Spaguetti with tomatoes and mea | rice with bacon | Boiled potatoes with black pudding | Macarroni with tomatosauce and meat<br>Chicken thighs with fries | 1 toast | Potatoes and beef |
| **AFTERNOON** | **SNACK** | Christmas sweets | Cured ham and toasts | 2 toasts<br>1 mandarine orange | 1 cup Hot chocolate | 1 toast | 1 toast<br>1 cup hot chocolate | None |
| **NIGHT** | **DINNER** | Cured ham sandwich | Hamburguer with boiled potatoes<br><br>1 iogurt | Fried chicken fingers | Pork meat with potatoes (oven) | 2 hot dogs | Bacon and cheese sandwich | Pudding sandwich |

# Appendix VII

## Water ingested and expulsed during week 1

| Day | Water ingested (l.) | Q. of liquid expulsed (l.) | Extras (l.) |
|---|---|---|---|
| Mon. | 0.50 l. | 0.480 l. | Chocolate Milk 0.2l.<br>Soup 0.25l. |
| Tues. | 0.75 l. | 0.970 l. | Chocolate Milk 0.2 l.<br>Orange juice 0.25 l. |
| Wed. | 0.75 l. | 0.755 l. | Chocolate Milk 0.2 l. |
| Thurs. | 0.50 l- | 0.77 l. | Chocolate Milk 0.2 l.<br>Orange juice 0.25 l. |
| Fri. | 0.75 l. | 0.45 l. | Chocolate Milk 0.2 l.<br>Orange juice 0.25 l. |
| Sat. | 1.25 l. | 0.55 l. | Chocolate Milk 0.2 l.<br>Orange juice 0.25 l. |
| Sun. | 1.10 l. | 0.955 l. | Chocolate Milk 0.2 l. |