



## Systemic Blood Pressure Changes in Different Age Group Individuals after Water Ingestion

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### ABSTRACT

*The present study was undertaken to establish the interrelationship between systemic blood pressure and water ingestion (i.e. 2% of the body weight water intake; approximately 1000 ml) in apparently healthy individuals of different age group.*

**Keyword:** *Water ingestion; Systemic blood pressure; Aging.*

### INTRODUCTION

Human aging is characterized by the progressive constriction of the homeostatic reserve of every organ system. This decline, which is often defined as 'homeostenosis' is evident by the third decade of life and is gradual and progressive.<sup>1</sup> This decreased physiologic reserve in the cardiovascular system can be manifested by the

changes in the blood pressure with increasing age.

In view of this point, the present study was undertaken to establish the relationship with systemic blood pressure changes after water ingestion (i.e. 2% of the body weight water intake; approximately 1000 ml) in apparently healthy age group individuals of different age groups (young, middle and old age group).

## MATERIALS AND METHODS

The present study was conducted in the Department of Physiology with the assistance of Ophthalmology department, 'KIMS', Hubli. The study and its conduct were cleared by the institutional ethical committee, KIMS, Hubli.

## METHODS

Investigations were carried out in 50 young age, 50 middle age and 50 old age individuals before and after water ingestion. Statistical analysis was done by using student 't' test by considering paired and unpaired 't' test.

## RESULTS

In the present study, it was observed that there was increase in systemic BP immediately after water ingestion, in all the three age group individuals, irrespective of their age. However, this increase in systemic BP with water ingestion was not significantly different among the different age group individuals, when the effect was compared amongst these individuals.

## CONCLUSION

In the present study, an attempt was made to reveal the immediate effect of water drinking on systemic blood pressure changes in different age group individuals. There was a significant increase in systolic blood pressure, diastolic blood pressure, pulse pressure and mean arterial pressure in all the 3 age group subjects immediately after water ingestion.

## SOURCE OF DATA

The subjects of the present study were First year MBBS and DMLT students and patients, who were visiting OPD of Ophthalmology department, KIMS hospital, Hubli. Before including the subjects for the study, all the subjects were assessed clinically by thorough history taking and detailed clinical examination.

History taking included, the past, recent and acute illnesses of the subject. Only subjects, who have fulfilled the inclusion criteria, were included in the study. The study was conducted between 8 AM -10 AM in order to avoid changes due to circadian rhythm.

The study groups consist of 150 subjects of different age groups as follows

Younger age group, i.e. 15-25 yrs (N=50).

Middle age group, i.e. 30-40 yrs (N=50).

Older age group, i.e. 60-75 yrs (N=50).

They were selected on the basis of the following inclusion and exclusion criteria. Trials with water (study trial) and without water (control trial) were conducted on same group of subjects on the same day.

## INCLUSION CRITERIA

1. Fifty, healthy young individuals (15-25yrs), Fifty, healthy middle age individuals (30-40yrs) and Fifty, apparently healthy elderly individuals (60-75yrs).
2. Individuals of both sexes of above mentioned age groups.

## EXCLUSION CRITERIA

1. Individuals, who are <15yrs and > 75 years.
2. H/o Hypertension.
3. H/o Diabetes mellitus.
4. H/o taking any medications, which affect the systemic blood pressure / or intraocular pressure.
5. People on any type of drugs / medications, which may influence the study.

The subjects were treated with due respect during the meetings and when the tests were being conducted on them. Doubts raised by them before, during or after the tests were patiently addressed and ascertained that they were cleared of it.

## METHODS OF COLLECTION OF DATA

Following parameters were recorded and entered in a separate proforma for each subject.

### I. RECORDING OF ANTHROPOMETRIC PARAMETERS

1. HEIGHT (in cm) measured in the subject, standing without shoes, by standard tailor tape.
2. WEIGHT (in kgs) measured by a standard weighing machine with minimum clothing.
3. BODY MASS INDEX ( $\text{kg}/\text{m}^2$ ) was calculated by considering height and weight.

### II. RECORDING OF PHYSIOLOGICAL PARAMETERS

All these parameters were recorded in lying down position

Systolic and Diastolic blood pressure in both the arms was recorded by both the Palpatory and Auscultatory methods at every 15minutes for 1hr, using Mercury Sphygmomanometer. Then the Pulse pressure was calculated by formula, SBP-DBP and MAP was calculated by formula,  $\text{DBP} + 1/3\text{PP}$ .

**Water ingestion** (2% of body weight or 1000 ml of water): Drinking water of 1 liter was given to each subject.

## STATISTICAL ANALYSIS

Statistical analysis was done by using the 'SPSS software' under the guidance of bio-statistician of KIMS, Hubli.

All the values are presented as Mean $\pm$  Standard deviation (Mean $\pm$ SD). Comparison of mean values of parameters between the 2 trials (control and study) was done by paired "t" test and between the 3 different age groups by unpaired "t" test.

P value >0.05 was taken as 'non significant', P value <0.05 was taken as 'significant' and P value <0.01 and <0.001 was taken as 'highly significant' in this study.

## RESULTS

A summary of observations and results of the present study is as follows. In this section, the results related to three groups i.e. Young age (15-25 yrs), Middle age (30-40 yrs) and Old age (60-75 yrs), before and after water ingestion are represented as young, middle and old respectively.

**ANTHROPOMETRIC DATA**

The anthropometric data of different age group subjects are shown in Table no 1. There was no

**Table no.1:** Anthropometric data of study subjects.

significant difference in Height, Weight, and BMI in these three group individuals.

| Age groups | Height (cm) | Weight (kg) | BMI (kg/m <sup>2</sup> ) |
|------------|-------------|-------------|--------------------------|
| Young      | 164±6.2 N.S | 58±7.7 N.S  | 21±2.7 N.S               |
| Middle     | 161±7 N.S   | 57±6 N.S    | 21±2 N.S                 |
| Old        | 159±4.5 N.S | 56±5.3 N.S  | 21±1.8 N.S               |

N.S-Non significant

**VITAL DATA BEFORE AND AFTER WATER INGESTION**

Vital data like systemic blood pressure changes in all the 3 age group subjects, before and immediately after water ingestion is shown in Table no. 2.

**SYSTEMIC BLOOD PRESSURE**

The Systolic, Diastolic, Pulse pressure and Mean arterial blood pressure in all these three age group subjects was significantly higher, immediately after water ingestion, compared to that of before water ingestion in the respective group.

**Table no.2:** Systemic blood pressure changes in different age group individuals before and after water ingestion (mmHg).

| Parameter      | Age groups | Before   | After    | 't' value | 'P' value | Significance |
|----------------|------------|----------|----------|-----------|-----------|--------------|
| Systolic BP    | Young      | 118±7.1  | 126±7.1  | 10.14     | <0.0001   | H.S          |
|                | Middle     | 120±6.25 | 125±6.45 | 9.44      | <0.0001   | H.S          |
|                | Old        | 130±8.0  | 136±8.6  | 6.47      | <0.0001   | H.S          |
| Diastolic BP   | Young      | 74±7.5   | 77±7.5   | 4.61      | <0.001    | H.S          |
|                | Middle     | 78±6.3   | 82±7.8   | 2.41      | <0.05     | S            |
|                | Old        | 80±5.8   | 86±6.0   | 2.94      | <0.01     | S            |
| Pulse Pressure | Young      | 43±7.6   | 47±7.3   | 3.1       | <0.01     | S            |
|                | Middle     | 42±7.1   | 43±6.8   | 4.44      | <0.001    | H.S          |
|                | Old        | 50±6.9   | 50±7.8   | 2.39      | <0.05     | S            |
| MAP            | Young      | 89±6.3   | 93±6.4   | 7.05      | <0.0001   | H.S          |
|                | Middle     | 92±5.9   | 96±6.9   | 4.37      | <0.001    | H.S          |
|                | Old        | 96±5.7   | 102±6.2  | 2.99      | <0.01     | S            |

N.S-non significant, S- significant, H.S- highly significant.

**COMPARISON OF SYSTEMIC BLOOD PRESSURE CHANGES IN YOUNG AND MIDDLE AGE INDIVIDUALS BEFORE AND AFTER WATER INGESTION**

Systemic blood pressure changes in young and middle age subjects, before and after water ingestion is shown in Table no.3.

There was no significant change in the systemic blood pressure i.e. systolic blood pressure, diastolic blood pressure, pulse pressure and mean arterial pressure in middle age individuals when compared to that of young age individuals immediately after water ingestion, though there was an increase in systemic blood pressure in each group when considered separately.

**Table no.3:** Comparison of systemic blood pressure changes in young and middle age individuals before and after water ingestion (mmHg).

|                     | SBP     |         | DBP    |        | PP     |        | MAP    |        |
|---------------------|---------|---------|--------|--------|--------|--------|--------|--------|
|                     | Before  | After   | Before | After  | Before | After  | Before | After  |
| <b>Young age</b>    | 118±7.1 | 126±7.1 | 74±7.5 | 77±7.5 | 43±7.6 | 47±7.3 | 89±6.3 | 93±6.4 |
| <b>Middle age</b>   | 120±6.2 | 125±6.4 | 75±7.3 | 77±8.0 | 44±7.1 | 48±6.8 | 90±5.9 | 93±6.9 |
| <b>'t' value</b>    | 1.49    | 0.5     | 0.58   | 0.56   | 0.64   | 0.59   | 0.92   | 0.08   |
| <b>'P' value</b>    | >0.05   | >0.05   | >0.05  | >0.05  | >0.05  | >0.05  | >0.05  | >0.05  |
| <b>Significance</b> | N.S     | N.S     | N.S    | N.S    | N.S    | N.S    | N.S    | N.S    |

N.S-not significant, S-significant, H.S-highly significant.

**COMPARISON OF SYSTEMIC BLOOD PRESSURE CHANGES IN MIDDLE AND OLD AGE INDIVIDUALS BEFORE AND AFTER WATER INGESTION**

Systemic blood pressure changes in middle and old age group subjects, before and after water ingestion is shown in Table no.4.

There was no significant change in the systemic blood pressure i.e. systolic blood pressure, diastolic blood pressure, pulse pressure and mean arterial pressure in old age individuals when compared to that of middle age individuals immediately after water ingestion, though there was an increase in systemic blood pressure in each group when considered separately.

**Table no.4:** Comparison of Systemic blood pressure changes in middle and old age individuals before and after water ingestion (mmHg)

|                     | SBP     |         | DBP    |        | PP     |        | MAP    |         |
|---------------------|---------|---------|--------|--------|--------|--------|--------|---------|
|                     | Before  | After   | Before | After  | Before | After  | Before | After   |
| <b>Middle age</b>   | 120±6.2 | 125±6.4 | 75±7.3 | 77±8.0 | 44±7.1 | 48±6.8 | 90±5.9 | 93±6.9  |
| <b>Old age</b>      | 130±8.0 | 136±8.6 | 80±5.8 | 86±6.0 | 50±6.9 | 50±7.8 | 96±5.7 | 102±6.2 |
| <b>'t' value</b>    | 0.52    | 0.52    | 1.83   | 1.4    | 0.82   | 1.97   | 1.77   | 0.25    |
| <b>'P' value</b>    | >0.05   | >0.05   | >0.05  | >0.05  | >0.05  | >0.05  | >0.05  | >0.05   |
| <b>Significance</b> | N.S     | N.S     | N.S    | N.S    | N.S    | N.S    | N.S    | N.S     |

N.S-not significant, S-significant, H.S-highly significant

## COMPARISON OF SYSTEMIC BLOOD PRESSURE CHANGES IN YOUNG AND OLD AGE INDIVIDUALS BEFORE AND AFTER WATER INGESTION

Systemic blood pressure changes in young and old age individuals, before and after water ingestion is shown in Table no.5.

**Table no.5:** Comparison of Systemic blood pressure changes in young and old age individuals before and after water ingestion(mmHg).

|                     | SBP     |         | DBP    |        | PP     |        | MAP    |         |
|---------------------|---------|---------|--------|--------|--------|--------|--------|---------|
|                     | Before  | After   | Before | After  | Before | After  | Before | After   |
| <b>Young age</b>    | 118±7.1 | 126±7.1 | 74±7.5 | 77±7.5 | 43±7.6 | 47±7.3 | 89±6.3 | 93±6.4  |
| <b>Old age</b>      | 130±8.0 | 136±8.6 | 80±5.8 | 86±6.0 | 50±6.9 | 50±7.8 | 96±5.7 | 102±6.2 |
| <b>'t' value</b>    | 1.81    | 0.93    | 2.44   | 0.81   | 0.13   | 1.44   | 2.64   | 0.17    |
| <b>'P' value</b>    | >0.05   | >0.05   | >0.05  | >0.05  | >0.05  | >0.05  | >0.05  | >0.05   |
| <b>Significance</b> | N.S     | N.S     | N.S    | N.S    | N.S    | N.S    | N.S    | N.S     |

NS-not significant, S-significant, HS-highly significant.

## DISCUSSION

Aging is the process of becoming older or a process that is genetically determined and environmentally modulated.<sup>2</sup>

An increase in systemic blood pressure has always been taken as an inevitable consequence of ageing in industrialized societies, leading to hypertension in a high proportion of elderly subjects. However, the characterization and definition of what constitutes the hypertension in the elderly has changed over the years. Data obtained during the Framingham Heart Study, which had a follow up for 30 years, concluded that the systolic blood pressure shows a continuous increase between the ages of 30 and 84 years or over. Diastolic blood pressure, however, has a varying pattern with ageing, increasing until the fifth decade and

There was no significant change in the systemic blood pressure i.e. systolic blood pressure, diastolic blood pressure, pulse pressure and mean arterial pressure in old age individuals when compared to that of young age individuals immediately after water ingestion, though there was an increase in systemic blood pressure in each group when considered separately.

slowly decreasing from the age of 60 to at least 84 years of age. This leads to a steep rise in pulse pressure with ageing.<sup>3</sup>

Other pathophysiological factors, which contribute to the increase in systemic BP with aging include decreased baroreceptor sensitivity, increased responsiveness to sympathetic nervous system stimuli, altered renal sodium metabolism and an altered Renin- aldosterone relationship.<sup>4</sup>

A marked pressor response to water drinking has been observed in the elderly individuals and in the patients with autonomic failure. Water drinking in normal human subjects increases sympathetic nerve traffic, leading to peripheral vasoconstriction. This sympathetic activation is not accompanied by significant changes in arterial blood pressure.<sup>5</sup>

In the present study, an attempt was made to reveal the immediate effect of water drinking on systemic blood pressure changes in different age group individuals. There was a significant increase in systolic blood pressure, diastolic blood pressure, pulse pressure and mean arterial pressure in all the 3 age group subjects immediately after water ingestion. These findings correlate with the various studies done on this aspect previously.

In a study conducted by Jens Jordan et al., it was showed that the water drinking significantly and rapidly raises sympathetic activity. Indeed, it raises plasma norepinephrine levels as much as the classic sympathetic stimuli or by caffeine and nicotine. Water drinking, also acutely raises the blood pressure in older normal subjects.<sup>6</sup> Similarly, in a study conducted by Callegaro et al., it was showed that in hypertensive and normotensive individuals, acute water ingestion elicits a pressor response, an effect that is most likely determined by an increased vasoconstrictor sympathetic activity and is counterbalanced by an increase in blood pressure and heart rate by vagal modulation.<sup>7</sup>

Ravikiran Kisan et al., showed in their study, that in both men and women, the systolic BP and the diastolic BP were significant. They concluded their study with the findings that water ingestion of 2% body weight causes increased absorption of water within 15 minutes so as to increase the blood volume, which in turn causes an increase in blood pressure.<sup>8</sup>

In the present study, it was also attempted to compare the systemic blood pressure changes immediately after water ingestion between the

different age group individuals, by comparing the effect.

There was a significant increase in systemic blood pressure (systolic, diastolic, pulse pressure and mean arterial) immediately after water ingestion in young as well as in middle age group individuals, when considered separately. However, these changes in BP were not significantly different when this effect was compared among these group individuals. The findings of the present study correlate with the various studies done on this aspect previously. In the present study, an attempt was made to reveal the immediate effect of water drinking on systemic blood pressure changes in different age group individuals. There was a significant increase in systolic blood pressure, diastolic blood pressure, pulse pressure and mean arterial pressure in all the 3 age group subjects immediately after water ingestion. These findings correlate with the various studies done on this aspect previously.

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Similarly, in a study conducted by Callegaro et al., it was showed that in hypertensive and normotensive individuals, acute water ingestion elicits a pressor response, an effect that is most likely determined by an increased vasoconstrictor sympathetic activity and is counterbalanced by an

increase in blood pressure and heart rate by vagal modulation.

Similar to the above findings, it is evident in the present study that, there was a significant change in the systemic blood pressure (systolic, diastolic, pulse pressure and mean arterial), immediately after water ingestion in middle as well as in old age group individuals separately. However, these changes in BP were not significantly different when the effect was compared among these group individuals. In the same manner there was a significant change in the systemic blood pressure and heart rate by vagal modulation.

Similar to the above findings, it is evident in the present study that, there was a significant change in the systemic blood pressure (systolic, diastolic, pulse pressure and mean arterial), immediately after water ingestion in middle as well as in old age group individuals separately. However, these changes in BP were not significantly different when the effect was compared among these group individuals. In the same manner there was a significant change in the systemic blood pressure (systolic, diastolic, pulse pressure and mean arterial) immediately after water ingestion in young as well as in old age group individuals separately. However, these changes in BP were not significantly different when the effect was compared among these group individuals.

The present study results clearly indicate the similar findings that the SBP, DBP, PP and MAP were increased immediately after water ingestion in all the three age group individuals. However, these changes in systemic BP were not significantly different when this effect was

compared among these group individuals. These findings may suggest that the systemic blood pressure changes observed after acute water ingestion may be due to the momentary changes in pressor response in all the three age group individuals despite of changes in vascular architecture due to aging.

## CONCLUSION

The present study concludes with the following important findings, which will bear a significant importance regarding the blood pressure changes in relation to water ingestion in different age group individuals.

- It was observed that there was increase in systemic blood pressure immediately after water ingestion in all the three age group individuals, irrespective of age.
- It was also observed that the increase in systemic blood pressure was not significantly different, when the effect was compared between younger, middle and old age group individuals, even though there was increase in blood pressure after water ingestion in each group individually.

Thus, the present study can be concluded with the findings that, the systemic blood pressure have a propensity to increase immediately after water ingestion in different age group individuals i.e. young, middle and old age group individual.



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