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Effect of Cucumber Supplementation on Blood Pressure (BP) and Anthropometric Indices in the Older Adults in Nnewi, Anambra State, Nigeria

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ABSTRACT: Hypertension and obesity are becoming common among the older adults and this increases the risk of several non-communicable diseases such as cardiovascular diseases and diabetes mellitus. Dietary supplementation with vegetables rich in antioxidant-rich compounds and minerals may have a beneficial effect on the blood pressure (BP) and anthropometric indices. Consequently, the objective of this paper was to determine the impact of cucumber supplementation on blood pressure (BP) and anthropometric indices in healthy older adults in Nnewi, Anambra State, Nigeria with Thirty (30) participants who received 400 g ±10 g of fresh whole cucumbers every day for a total of four (4) weeks (28 days) and were required to eat the entire cucumber every day before their daily breakfast. Results showed the mean SBP (P=0.004) and DBP (P=0.001) levels were significantly decreased whereas, BMI (p=0.088), WC (p=0.097) and WHR (p=0.136) did not differ significantly after cucumber supplementation compared to baseline levels. This study has shown the BP lowering effect (hypotensive effect) of *Cucumis sativus* (cucumber) consumption in older adults and could be of importance in the prevention and therapeutic management of hypertension.

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Anthropometric indices continue to be important measurements especially in predicting obesity and various diseases it causes. The fact that these measurements are very simple to apply and provide

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clinicians with important information especially in identifying cardiometabolic diseases cannot be overlooked (Pazarlı, 2022). The use of these indices without the need for complex measurements or laboratory tests gives rapid results on the risks of chronic diseases (Pazarlı, 2022). Anthropometric indices—which include measurements of human body composition and physical dimensions—are crucial for comprehending the health and well-being of individuals. These indices are useful instruments for evaluating general health problems and nutritional status (Khurana *et al*., 2024). Body mass index, waist circumference, waist-to-height ratio, and hip circumference are accurate anthropometric parameters to identify obesity (Hewage *et al*., 2023). The body mass index (BMI) is an index usually used for determining whether a person has excess weight or not. It is the measure that considers the weight and height of an individual and is defined as an individual's weight in kilograms divided by the square of his/her height in meter (kg/m^2). A person is considered to be overweight or obese based on BMI value, but this index may not correspond to the same mark of fatness in different people. BMI is a traditional indicator and is not a sensitive index as it cannot recognize the fat distribution, high-fat percentage, and the increment of the muscles (Hall and Cole, 2006). There are other anthropometric measures that capture obesity more precisely than the BMI index. Waist circumference, hip circumference, and waist-hip ratio are few indices that can be used as an alternative to BMI. These indices can reflect abdominal adipose, a superior measure for the risk of various NCDs, including cardiovascular diseases (Hewage *et al*., 2023). Non-communicable diseases (NCDs) are linked to excessive adiposity and anthropometric indices can be used to identify those at risk (Hewage *et al*., 2023). Previous study shows that obesity, hypertension, high-risk WC, and high-risk WHR are significant risks for developing NCDs and multi-morbidity among the older adults (Bramhankar *et al*., 2021; Okwara *et al*., 2021). Central obesity is an independent and alterable risk factor for the occurrence of multimorbidity in middle-aged and elderly populations (Geng *et al*., 2022). Inappropriate dietary intake, lack of physical exercise, tobacco and alcohol consumption, high body mass index, and obesity are the factors that affect the health of individuals and increases the risk of NCDs (Yadav and Arokiasamy, 2014). On the other hand, blood pressure (BP) is a measure of the force that the heart uses to pump blood around the body (National Health Service (NHS), 2022). The following are modifiable risk factors that raise the chance of having high blood pressure (hypertension): unhealthy diets (rich in saturated and Trans fats, excessive salt consumption, etc.), inadequate consumption of fruits and vegetables, absence of physical activity, alcohol and tobacco use, and being overweight or obese. Hypertension is an important modifiable chronic NCD (Moussouni *et al*., 2022), whose prevalence is on the rise in Nigeria (Ogungbe *et al*., 2024; Nwevo *et al*., 2024), due to changes in dietary pattern, sedentary life styles and urbanization. Higher levels of BP, BMI and WHR have been documented recently among older people (Ogbodo *et al*., 2024). Dietary supplementation with vegetables and fruits rich in phytochemicals, minerals and inorganic elements known for their medicinal values which can impact the human health positively may play pivotal role in moderating blood pressure and anthropometric indices in older adults. Cucumber has been shown to have therapeutic potentials that can impact human health positively (Ezeodili *et al*., 2017; Ogbodo *et al*., 2017; Ogbodo *et al*., 2024), hence, the objective of this paper was to determine the impact of cucumber supplementation on blood pressure (BP) and anthropometric indices in healthy older adults in Nnewi, Anambra State, Nigeria.

MATERIALS AND METHODS

Study Design: Thirty participants were selected using simple random sampling technique and they were supplemented with cucumber (*Cucumis sativus*). Prior to the start of the supplementation study, the participants were advised to refrain from eating cucumber and other vegetables of a similar kind as well as other supplements for a period of two weeks. Daily fresh cucumber purchases were made from vendors at Nkwo Market in Nnewi. The weights of the cucumbers were then determined using an electronic weighing scale (Peace Sky) model PH-2015A made in China. Cucumbers that weighed 400 g ±10 g were meticulously selected. For a total of four (4) weeks (28 days), each participant received about 400 g of freshly whole cucumbers every day. The participants were required to eat the entire cucumber every day before their daily breakfast using the oral method of administration. The cucumbers were appropriately wrapped, delivered to each participant on a daily basis, and kept in good hygienic condition. To guarantee compliance, cucumbers were delivered to each participant each day prior to breakfast, observing the participants finish the entire cucumber. Blood pressure (BP) readings (systolic and diastolic BP) and anthropometric indices (body mass index (BMI), Waist circumference (WC) and waist-to-hip ratio (WHR) measurement were taken at baseline (day 0) and post-research (29^{th} day).

Inclusion Criteria: Apparently healthy older adult male and female individuals (45-75 years) were recruited for this study.

Exclusion Criteria: Individuals with known conditions such as Diabetes mellitus, kidney disease, cardiovascular diseases (heart disease), pregnant women, lactating mothers, alcohol abusers, smokers and those on any kind of supplementation were excluded from the present study.

Ethical Approval: Ethical clearance for the study was sought and obtained from Nnamdi Azikiwe University Teaching Hospital Ethics Committee (NAUTH/CS/66/VOL. 16/VER. 3/07/2023/07).

Participants' informed consent: Prior to the start of the study, the participants' written informed consent was sought and obtained.

Anthropometric indices measurements: Body mass index (BMI) was calculated using the equation 1:

$$BMI = \frac{Weight\ (kg)}{Height^2(m^2)} \quad (1)$$ (WHO, 1995).

A measuring tape was fastened to a piece of wood to determine height, and an electronic weighing scale (Peace Sky model PH-2015A made in China, which can measure up to 180kg of weight) was used to determine weight. BMI of 25 and 30 kg/m^2 was used to classify overweight and generalized obesity, respectively. Waist circumference was measured with the participant in the standing position, at the midpoint between the upper margin of the iliac crest and the lower margin of the last rib, using a metric tape (cm).

The hip circumference in turn was determined with the patient in the standing position as the greatest distance between the major trochanters. The waist/hip ratio was calculated by dividing the waist circumference (in cm) by the hip circumference (in cm).

Blood Pressure Measurement: After a 10-minute rest period, the subject's systemic blood pressure was measured using an automatic digital blood pressure monitor (Kris-Aloy Mercurial Sphygmomanometer made in China) and a Kris-Aloy Dual Head Stethoscope (Mercury Barometer method) with the subject seated. Systolic and diastolic rates were used to express blood pressure. Hypertension was defined as systolic blood pressure ≥ 140mmHg and/or diastolic blood pressure ≥90mmHg.

Statistical Analysis: The SPSS statistical tool, version 26.0, was used to analyze the data collected for this study. Paired t-test was used to compare the data acquired before (pre) and after (post) cucumber supplementation. Results were expressed as mean± SD. At $p<0.05$, statistical significance was assumed.

RESULTS AND DISCUSSION

The mean systolic blood pressure was significantly decreased 4weeks after cucumber supplementation in the older adults compared to the baseline value (126.87±4.03 Vs 130.20±5.01; p=0.004). Similarly, the mean diastolic blood pressure was significantly decreased 4weeks after cucumber supplementation in the older adults compared to the baseline value (83.73±3.75 Vs 87.40±3.68; p=0.000). However, the mean body mass index as well as the mean waist circumference and mean waist-to-hip ratio did not differ significantly after 4weeks of cucumber supplementation in the older adults when compared to their baseline values (p=0.088; 0.136) respectively. (Table 1).

The mean systolic blood pressure was significantly decreased 4weeks after cucumber supplementation in the older adult females compared to their baseline value (125.20±6.46 Vs 129.07±4.25; p=0.002). Similarly, the mean diastolic blood pressure was significantly decreased 4weeks after cucumber supplementation in the older adult females compared to their baseline values (83.60±4.82 Vs 87.33±3.83; p=0.000).

owever, the mean body mass index as well as the mean waist circumference and mean waist-to-hip ratio did not differ significantly after 4weeks of cucumber supplementation in the older adult females when compared to their baseline values (p=0.175; 0.242) respectively. (Table 2).

The mean diastolic blood pressure was significantly decreased 4weeks after cucumber supplementation in the older adult males compared to their baseline values (83.87±3.94 Vs 87.47±2.64; p=0.001).

However, the mean systolic blood pressure, body mass index as well as the mean waist circumference and mean waist-to-hip ratio did not differ significantly after 4weeks of cucumber supplementation in the older adult males when compared to their baseline values (p=0.158; 0.313 and 0.360) respectively. (Table 3).

Table 1: Levels of systolic blood pressure (SBP), diastolic blood pressure (DBP), body mass index (BMI), waist circumference (WC) and waist-to-hip ratio (WHR) in the older adults before and after cucumber supplementation (Mean ± SD; n=30).

Parameters	Before cucumber supplementation (n=30)	After cucumber supplementation (n=30)	t-value	*P*-value
SBP (mmHg)	130.20±15.01	126.87±14.03	3.172	0.004*
DBP (mmHg)	87.40±7.68	83.73±7.75	6.479	0.000*
BMI (Kg/m^2)	29.21±4.65	28.73±5.00	1.766	0.088
WC (cm)	98.60±8.78	96.58±8.67	1.713	0.097
WHR	0.88±0.06	0.90±0.05	1.535	0.136

**P-value is statistically significant at <0.05*.

Table 2: Levels of systolic blood pressure (SBP), diastolic blood pressure (DBP), body mass index (BMI), waist circumference (WC) and waist-to-hip ratio (WHR) in the older adult females before and after cucumber supplementation (Mean ± SD; n=15).

Parameters	Before cucumber supplementation (n=15)	After cucumber supplementation (n=15)	t-value	*P*-value
SBP (mmHg)	129.07±12.25	125.20±10.46	3.851	0.002*
DBP (mmHg)	87.33±8.83	83.60±7.82	5.332	0.000*
BMI (Kg/m^2)	29.70±5.23	29.02±5.70	1.429	0.175
WC (Cm)	99.58±8.86	98.01±8.96	0.831	0.420
WHR	0.87±0.07	0.89±0.05	1.223	0.242

**P-value is statistically significant at <0.05.*

Table 3: Levels of systolic blood pressure (SBP), diastolic blood pressure (DBP), body mass index (BMI), waist circumference (WC) and waist-to-hip ratio (WHR) in the older adult males before and after cucumber supplementation (Mean ± SD; n=15).

Parameters	Before cucumber supplementation (n=15)	After cucumber supplementation (n=15)	t-value	*P*-value
SBP (mmHg)	131.33±17.71	128.53±17.09	1.491	0.158
DBP (mmHg)	87.47±6.64	83.87±7.94	3.937	0.001*
BMI (Kg/m^2)	28.71±4.11	28.44±4.38	1.046	0.313
WC (Cm)	97.38±8.69	95.01±8.27	1.634	0.124
WHR	0.89±0.05	0.90±0.06	0.946	0.360

**P-value is statistically significant at <0.05*.

In the current study, the older adults who received cucumber supplements had significantly lower mean systolic and diastolic blood pressure readings than before the supplementation. In like manner, both SBP and DBP were significantly decreased following 4weeks cucumber supplementation in the female participants while only DBP was significantly decreased in the male participants compared to their baseline values. This shows that the addition of 400 g of cucumber to the diet each day may lower blood pressure due its hypotensive effects. The minerals in cucumbers and their high water content may have acted as a mediating factor in this reduction. Cucumber has been shown to contain numerous minerals, notable among which include Potassium, Calcium, Magnesium, Manganese (Mn), copper, zinc (Zn) and chromium (Imo *et al*., 2018; Imo *et al*., 2020; Okeke *et al*., 2021; Mallick, 2022). The hypotensive effect of cucumber consumption may be due to the water and potassium contents of the cucumber, which attracts sodium to the intracellular system and lowers blood pressure by causing vasodilation (opening the blood vessels) (Dwi *et al*., 2021). Potassium is necessary for the balance of water and electrolytes as well as the regular operation of cells, including nerves (Sunday and Hartline, 2012). Again, the high water content in cucumber also has a diuretic effect which can lower blood pressure. It is also conceivable that the potassium content of the cucumber can reduce renin secretion, which suppresses the Renin-Angiotensin System. Additionally, it can decrease aldosterone release, which reduces water and sodium absorption in the renal tubules. This mechanism causes diuresis to increase, which reduces blood volume and blood pressure. In addition, Manganese, copper, zinc and chromium are reported to be important micro-minerals which are required by certain enzymes by acting as co-factors required for some pathways or biochemical processes (Imo *et al*., 2019)). In line with the current finding, a prior study on the Effect of Cucumber Juice on the Elderly Hypertension in Citalahab Village, Pandeglang District demonstrated that consumption of cucumber juice significantly lowered mean blood pressure in the treatment group compared to the control group (Winata *et al*., 2020). Similar findings were made in the study by (Ismanti *et al*., 2023) entitled "The Effect of Cucumber Juice on Lowering Blood Pressure among Hypertensive Patients," which showed a significant decrease in

blood pressure in the treatment group compared to the control group.

Surprisingly, this study found no appreciable changes in BMI, WC and waist-to-hip ratio in the older adults after 4 weeks of cucumber supplementation compared to their baseline values. Similarly, gender wise comparison also showed no significant mean differences in both BMI, WC and WHR before and after cucumber supplementation. This finding may be an indication that short-term cucumber consumption may not be sufficient to cause noticeable changes in these parameters. In a similar vein, no significant change in BMI after 21 days of consuming 400g of whole cucumbers compared to baseline values were reported after researching the impact of cucumber consumption on serum lipid profile and liver aspartate transaminase and alanine transaminase in apparently healthy undergraduate students (Ezeodili *et al*., 2017). However, the results of previous authors, who evaluated the effects of *Cucumis sativus* seed extract on serum lipids in adult hyperlipidemic patients: a randomized double-blind placebo-controlled clinical trial which showed that Cucumis seed extract resulted in a significant decrease in BMI compared to the control group, are in contrast to the present finding (Soltani *et al*., 2017).

Conclusion: The systolic and diastolic BP were significantly decreased following supplementation than in baseline values. Thus, this study has shown the blood pressure lowering effect (hypotensive effect) of *Cucumis sativus* (cucumber) in older adults. Hence, cucumber consumption could be of importance in the prevention and therapeutic management of hypertension.

DECLEARATIONS

Declaration of Conflict of Interest: The authors declare that no known conflict of interest or personal relationships that could have influence the work reported in this paper.

Declaration of Data Availability: Data are available upon request from the corresponding author.

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