

Are Statistics Misleading Sodium Reduction Benefits?

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Abstract

There is a global movement toward lowering the blood pressure (BP) to prevent cardiovascular disease. Researchers use statistical power test on dietary increased sodium and point to the resulting elevation in BP as proof that salt increases BP. However, while tests show that the increase in BP is not by chance and is the result of increased salt intake and it also shows that this increase is consistent across test subjects, the results do not show that the magnitude of increase in BP is significant enough to warrant concern. Similarly, it is questionable if the reduction in dietary salt culminates in meaningful BP reduction. Statistics mislead when misunderstood. We show that dietary salt changes do not represent significant variation in BP but reduction of salt significantly may increase triglycerides, which may be more harmful.

Keywords: Sodium reduction; Hypertension; Blood pressure; Statistics; Triglycerides

Commentary

Numerous research studies show that increased dietary salt elevates BP [1-11]. However, when reading the amount of increase, it is small in number and percentages relative to what it was before salt increase regardless if the salt was increased moderately or significantly. The BP increase is between 1.5 mm Hg and 4.18 mm Hg in healthy participants and up to 5.8 mm Hg in hypertensive patients (less than 4%) although some minor variations exist among ethnic groups [6,12-16]. Other studies also show that the sodium reduction resulted in non-hypertensive patients amounting to 1% reduction (or 1.2 mm Hg in the case of 120 mm Hg systolic) to 3.5% decrease in hypertensive subjects (up to 5.6 mm Hg in a person of 160 mm Hg systolic with the outcome of 156.4 mm Hg ending systolic) as a result of reduced sodium diet and that sodium reduction also increased cholesterol by 2.5% with 7% increase in triglycerides [6]. In contrast, a review of literature study shows no difference in cholesterol or triglycerides [17]. We speculate that the different outcomes may very well be the results of failing to examine diet other than sodium and failing to assess lipid and glucose metabolic sensitivity to sodium changes in the subjects [18]. There is a possibility that metabolically impaired subjects with diabetes mellitus or pre-diabetes were included in tests since such have not been listed as exclusion criteria by the studies. It is not known if any testing was conducted by any of the experiments about other metabolic variants that can affect both blood pressure and also cholesterol levels of the participants by dietary sodium modifications [19]. Since glucose metabolism is strongly affected by sodium intake, we propose that studies that exclude incorporating glucose metabolic status and impaired lipid metabolism may not provide an adequate measure of response to sodium variations in the diet [20].

Studies show that the connection of the ratio of potassium to sodium has a higher importance to BP variations than sodium modification alone [21-23]. Furthermore systolic BP varies across a range of 100 mm Hg and 139 mmHg [24-27] over the course of a day

for non-hypertensive individuals making it difficult to conclude that the small variation in BP from sodium is not within a normal variable in daily changes of BP. The 39 mm Hg systolic point-range of variations is considered to be normal. This range is large enough to incorporate the small BP increase or decrease caused by dietary salt increase of either small or higher amounts. Additionally, white coat BP effects may also skew BP result [28] and may not do so consistently. A review study looked at the various amounts of potassium to sodium ratio and found that ratio changes can affect BP by as much as 10 ± 2 mmHg when potassium was not increased commensurate with sodium [21]. We did not find any study conducted on humans that specifically studied BP changes in any one individual though a period of time to see how a person responds to increased salt intake and if that varies substantially [29].

We also looked to see if there is a significant difference between dietary salt reduction and changes in blood pressure to see if we find similar results. It is apparent that experiments with sodium are short term, meaning studies increase dietary sodium for subjects for a short period of time (days to weeks) whereas studies on medicine use evaluate the results after years of use [17]. A review study of the literature found that long term (5 years) medicinal reduction of blood pressure yielded 5-6 mm Hg in blood pressure, which is greater reduction than sodium reduced diets achieve in the healthy and about the same as the reduction affected in those with hypertension [30]. Thus it appears that a hypertensive person, who is usually placed on medication for BP benefits about the same as reduced sodium diets provide but is there a reason to reduce sodium in the diet of everyone regardless of health status?

We found another possible weakness in the studies we researched. While all research needs to be conducted in basal conditions to reflect accurate changes, meaning for the same person when tested before increased sodium change one day, the next day the same person would have the same exact BP as the previous day prior to increased sodium, we have not found any control in the studies for this natural variability. There is noted variability in basal conditions even within the same day as the heart is variable in response to environmental changes [31].

While this is explainable by the large natural variability-range considered normal for systolic pressure for each individual (from 100 mm Hg to 139 mm Hg), it may be questionable if ignoring this variability weakens findings that report changes in response to changes in dietary sodium.

Since the normal daily variations in BP are significantly larger in range than the deviations caused by dietary salt changes, one may immediately question if what we see is not part of the large range of normal variations. Hypertensive persons also experience a daily range of BP variations.

While it is understandable that BP increase is of concern, the size of the increase must also be significant. Although there is a direct relation between salt intake and BP change [32], the change is too minor in both directions to be significant. We must therefore ask: is the slight reduction in BP worth the possible trade-of subjects experience by their increase in triglycerides by a much 7% [6,8,13,16] as a result of reduced salt in their diet? Is it a fair and safe exchange to suggest that a hypertensive patient should decrease dietary salt in order to reduce BP by less than 4% and in exchange potentially end up with a 7% increase in triglyceride when medicines provided to the hypertensive achieve the same? Such huge increase in triglycerides may lead to serious diseases [33] whereas a less than 4% decrease in BP does not lead to a healthier life.

Recommendation

We suggest a re-interpretation of research methods and findings in the relation of dietary salt intake and BP since the negative effects of the possible 7% increase in triglycerides provide worse health outcome than the benefit of less than 4% decrease in BP provides. The important outcome should not be how many subjects have their BP increase due to additional dietary salt, which is what the power test evaluates, but how much that increase is and what is its significance—a test currently not evaluated by statistics. It is also questionable if dietary salt reductions should be applied across the whole population as a preventive measure. Significant gaps exist in current research to state with certainty that reducing dietary sodium across the board decreases heart disease yet to come. Fear of increased dietary salt has permeated the entire medical community. The misunderstood statistical results suggesting serious increase in BP is not warranted based on current research. Further research is recommended to set the records straight and to relax the diagnostic process and modify the dietary recommendations of the physicians.

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