

# Chronic sub-clinical systemic metabolic acidosis (CSSMA) – fact or fiction?

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## Participant Assessment

For each question choose one correct answer or select the combination of correct statements where applicable.

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### Question 1

**Chronic sub-clinical systemic metabolic acidosis is:**

- 1.1 The same as what is traditionally known as 'acidosis'.
  - 1.2 When blood pH is less than pH 7.35.
  - 1.3 When blood pH despite compensation, remains close to the lower limit of 'normal'.
  - 1.4 When blood pH is greater than pH 7.45.
  - 1.5 None of the above.
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### Question 2

**The contemporary 'Westernised' diet:**

- 2.1 Is acidogenic as it contains too much animal protein (meat and dairy products).
  - 2.2 Is incompatible with the human genome designed to consume a more alkaline (ancestral) diet.
  - 2.3 Contains too little alkalising minerals (potassium, bicarbonate, magnesium and calcium) found traditionally in fruits and vegetables.
  - 2.4 Has a high (more positive) PRAL compared to the low or negative PRAL ancestral diet.
  - 2.5 All of the above.
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### Question 3

**Choose the correct statement(s) about urine pH:**

- 3.1 Increases in response to a low PRAL, alkaline diet and decreases in response to a high protein (high PRAL) diet.
  - 3.2 Decreases in response to a low PRAL, alkaline diet and increases in response to a high protein (high PRAL) diet.
  - 3.3 Is a convenient and reliable reflection of dietary acid load and increases in response to alkaline mineral supplementation confirming their systemic alkalising action.
  - 3.4 Combination of statements 1 & 3.
  - 3.5 Combination of statements 2 & 3.
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**Question 4****Choose the correct combination of statements about CSSMA and bone health:**

1. Acid-Ash hypothesis states that skeletal demineralisation occurs in response to CSSMA i.e. release of skeletal alkaline mineral reserves as a form of buffering response.
2. An acidogenic diet leads to increased urine calcium loss and increase in markers of bone resorption such as N-telopeptide.
3. An acidic diet negatively affects bone density by depleting vitamin D levels.
4. Alkalisiation with supplemental potassium citrate and bicarbonate leads to reduced calcium loss, bone turnover markers and increased bone mass.
5. Consuming >9 servings of fruit and vegetables daily has been shown to increase urine pH, reduce calcium loss and has a favourable impact on bone turnover markers.

- 4.1 Combination of 1,3,4,5
  - 4.2 Combination of 1,2,3,5
  - 4.3 Combination of 2,3,4,5
  - 4.4 Combination of 1,2,4,5
  - 4.5 Combination of all statements (all are correct)
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**Question 5****Choose the correct combination of statements about CSSMA and its impact on kidney function:**

1. Kidneys assist with acid base balance by excreting acid, neutralising acid, and excreting anions.
2. CSSMA negatively affects kidney function by increasing endothelin-1, angiotensin II and aldosterone, and ammonia, a by-product of acid neutralisation which leads to kidney injury.
3. High dietary acid load and NEAP are associated with the progression of CKD to ESRD and high PRAL with increased risk of incident CKD.
4. Renal acid base balance deteriorates with decline in kidney function.
5. Systemic alkalisiation with bicarbonate or a low protein high fruit and vegetable diet has been shown to slow progression of CKD, reduce risk of ESRD and improve GFR.
6. Higher levels of serum bicarbonate are associated with a better outcome and survival in CKD.

- 5.1 Combination of 3,4,5,6
  - 5.2 Combination of 1,2,5,6
  - 5.3 Combination of 1,3,4,5
  - 5.4 Combination of 2,3,4,6
  - 5.5 Combination of all (all statements are correct)
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**Question 6****Choose the correct combination of statements about CSSMA and kidney stones:**

1. A high PRAL increases the risk of stone formation by 5.5 times.
2. When the body compensates the acidogenic diet, it results in increased calcium and oxalate excretion in the urine and reduced urine citrate.
3. Potassium citrate prevents recurrence of kidney stones, and citrate salts reduce size of stones and prevent more from forming.

4. Citrate in the urine helps to prevent calcium oxalate stone formation. When urine citrate is low (like in CSSMA) the risk of stone formation is higher.
5. Alkalisating the urine with a high fruit and vegetable diet or supplementing with citrate prevents formation of oxalate, cystine, and uric acid stones.
6. CSSMA is only responsible for the formation of calcium oxalate stones.

- 6.1 Combination of 3,4,5,6
  - 6.2 Combination of 2,3,4,5
  - 6.3 Combination of 1,4,5,6
  - 6.4 Combination of 1,2,3,4
  - 6.5 Combination of all (all statements are correct)
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#### Question 7

**Choose the correct combination of statements about CSSMA and gout:**

1. The most important risk factor for the development of uric acid kidney stones is high urine pH.
2. A more alkaline urine facilitates the elimination of uric acid from the body.
3. Gout sufferers typically have more acidic urine, a urine pH of less than 5.5 is particularly a risk for the formation of uric acid kidney stones.
4. Increasing urine pH to 6.2-6.8 using potassium citrate is advised as a therapeutic intervention for uric acid stones.
5. Supplemental sodium citrate is the treatment of choice for dissolving uric acid stones.

- 7.1 Combination of 2,3,4
  - 7.2 Combination of 1,2,3
  - 7.3 Combination of 3,4,5
  - 7.4 Combination of 1,4,5
  - 7.5 Combination of all (all statements are correct)
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#### Question 8

**Choose the correct statement(s) about CSSMA, insulin resistance and type 2 diabetes:**

- 8.1 High PRAL and NEAP scores are positively associated with development of incident type 2 diabetes and HOMA-IR scores.
  - 8.2 CSSMA may lead to decreased glucose uptake by muscles and disrupt insulin signalling pathways or binding of insulin to insulin receptors.
  - 8.3 CSSMA leads to lower fasting insulin levels.
  - 8.4 Combination of 1 & 3
  - 8.5 Combination of 1 & 2
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#### Question 9

**Choose the correct combination of statements about CSSMA and metabolic syndrome:**

1. There is an established association between insulin resistance, low urine pH and gout.
2. Metabolic syndrome is a condition comprising: obesity, insulin resistance, gout and osteoporosis.

3. Metabolic syndrome, NAFLD and insulin resistance sufferers typically have lower urine pH.
4. NAFLD is also associated with low urine pH and those with NAFLD typically have high dietary acid loads.
5. Uric acid kidney stone development is a renal manifestation of metabolic syndrome.
6. NAFLD odds increase by 1.32 for every 40mEq/day increase in NEAP.

- 9.1 Combination of 1,3,4,5
  - 9.2 Combination of 1,2,5,6
  - 9.3 Combination of 3,4,5,6
  - 9.4 Combination of 2,3,5,6
  - 9.5 Combination of all (all statements are correct)
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### Question 10

**Choose the correct combination of statements about CSSMA and hypertension:**

1. PRAL, NEAP and animal protein to potassium ratio is positively associated with higher blood pressure and the risk thereof.
2. Hypertension and CSSMA are further related since CSSMA features such as increased urinary calcium excretion and sodium chloride consumption are themselves also associated with hypertension.
3. Research confirms that CSSMA is linked with raised diastolic pressure only.
4. Data from a large observational study confirmed that those with higher NEAP scores had a 33% higher risk of hypertension than those who did not.
5. CSSMA may lead to hypertension as it is known to promote cortisol and aldosterone release from the adrenals via stimulation of the pituitary and ACTH.

- 10.1 Combination of 1,4,5
  - 10.2 Combination of 2,3,4
  - 10.3 Combination of 1,2,5
  - 10.4 Combination of 1,2,3
  - 10.5 Combination of all (all statements are correct)
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### Question 11

**Choose the correct statement(s) on the influence of CSSMA on the musculoskeletal system:**

1. Data from three trials of supplemental alkaline minerals report improvements in chronic back pain, osteoarthritis of the hands and rheumatoid arthritis.
2. In athletes CSSMA caused by a high protein diet may compound the additional acidogenic burden induced by exercise which may compromise performance and recovery time, supplemental bicarbonate improves recovery and repeated exercise performance.
3. An alkaline diet (potassium rich) is reported to support the preservation of muscle mass in older patients.
4. Even slight changes in extracellular pH may significantly impact on metabolism and biosynthesis of chondrocytes.
5. One trial reports improvement in ankylosing spondylitis in response to the alkaline diet.

- 11.1 Combination of 1,2,3,4
- 11.2 Combination of 2,3,4,5
- 11.3 Combination of 1,3,4,5
- 11.4 Combination of 1,2,4,5
- 11.5 Combination of all (all statements are correct)

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**12. There is an association between CSSMA and cortisol because:**

1. Several of the potential conditions occurring due to CSSMA are also known to occur as a result of elevated cortisol levels.
2. Glucocorticoids naturally increase in acidosis to facilitate the elimination of H<sup>+</sup>.
3. High cortisol is also associated with metabolic syndrome and features thereof including hypertension and uric acid kidney stones.
4. Alkalisating the diet or switching to a lactovegetarian diet has been shown to lead to a reduction in serum and urine free cortisol levels and lead to calcium retention.
5. High cortisol is also associated with modified adiposity, insulin resistance and higher odds of type 2 diabetes.

12.1 Combination of 1,3,4,5

12.2 Combination of 2,3,4,5

12.3 Combination of 1,2,4,5

12.4 Combination of 1,2,3,4

12.5 Combination of all (all statements are correct)

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**Question 13****CSSMA can be addressed using the following dietary modifications:**

1. Use PRAL charts to gauge the influence of individual food groups on dietary acid load.
2. Reduce all citrus fruits as they are very acidic and have high PRAL.
3. Significantly increase intake of fruit and vegetables to 9 or more servings per day.
4. Assist with the compensation of the acidogenic diet by adding more bicarbonate rich plant foods.
5. Reduce salt (NaCl) and replace fizzy drinks with alkaline water.
6. Increase alkalisating foods such as dairy products and milk.

13.1 Combination of 3,4,5,6

13.2 Combination of 1,3,4,5

13.3 Combination of 2,4,5,6

13.4 Combination of 1,4,5,6

13.5 Combination of all (all statements are correct)

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**Question 14****Choose the correct statements about research on alkaline mineral supplementation:**

1. Alkalisating mineral supplements include magnesium sulphate and sodium chloride.
2. The most clinically proven alkalisating minerals include potassium citrate, potassium bicarbonate, sodium bicarbonate, calcium citrate and magnesium citrate.
3. Alkalisating minerals include those in the form of citrate and bicarbonate salts.
4. Alkaline mineral supplementation in trials resulted in increased urine and serum pH.
5. Alkaline mineral supplements led to significant improvements in pain in chronic back pain sufferers, those with OA of the hands and rheumatoid arthritis.
6. Potassium chloride is the form of potassium which has the most supporting data for its use in CSSMA and related conditions.

- 14.1 Combination of 1,4,5,6
  - 14.2 Combination of 1,2,3,4
  - 14.3 Combination of 3,4,5,6
  - 14.4 Combination of 2,3,4,5
  - 14.5 Combination of all (all statements are correct)
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**Question 15**

**Choose the correct statements regarding the clinical relevance of CSSMA:**

- 15.1 Alkalisating the diet and or supplementation with alkalisating minerals may be beneficial in those with or at risk of reduced bone mineral density.
- 15.2 Urine pH is a scientifically accepted reflection of dietary acid load and increases in response to alkalisating the diet or supplementing with alkaline minerals.
- 15.3 Those with metabolic syndrome or features thereof may benefit by alkalisating their diet or taking supplemental alkaline minerals.
- 15.4 Clinical evidence exists for the improvement in bone mineral density, kidney function, kidney stones, gout, and arthritis through alkalisating the diet or supplementing with alkaline minerals.
- 15.5 The major cause of CSSMA is the contemporary acidogenic 'Westernised' diet comprising high animal protein, grains, salt and other EDNP foods.
- 15.6 Lowering dietary PRAL by increasing fruit and vegetables and decreasing animal protein or supplementing with minerals such as bicarbonate or citrate salts are effective ways to address CSSMA.

- 15.1 Combination of 1,2,3,4
  - 15.2 Combination of 1,4,5,6
  - 15.3 Combination of 3,4,5,6
  - 15.4 Combination of 2,3,4,5
  - 15.5 Combination of all (all statements are correct)
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