

Methyl-sulphonyl-methane (MSM) and Musculoskeletal health – a review for clinicians

Participant Assessment

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

Question 1

Choose the correct combination of statements about MSM:

- 1.1 MSM stands for methylsulphuricmethanol which is an organo-sulphur compound derived from DMSO.
- 1.2 MSM is metabolite of and derived from the parent compound known as DMSO.
- 1.3 MSM has a similar molecular structure as DMSO except it has two double bonded oxygen atoms.
- 1.4 The chemical formula for MSM is $(CH_2)_3SO_2$.
- 1.5 MSM and DMSO have very low molecular weight.
- 1.6 MSM and DMSO are both naturally occurring substances.

1. Combination of 1,2,3,4
 2. Combination of 1,2,4,5
 3. Combination of 1,3,4,5
 4. Combination of 2,3,5,6
 5. Combination of all (all statements are correct)
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Question 2

Choose the correct combination of statements about the sulphur cycle:

- 1.1 Dimethyl sulphide gas (DMS) is produced and released into the atmosphere when marine algae consume sulphur in the oceans.
- 1.2 Photochemical oxidation is when DMS gas is converted to DMSO and MSM in the atmosphere by interacting with UV light, ozone and nitrate.
- 1.3 MSM is delivered from the atmosphere back to the earth and soil via precipitation.
- 1.4 Bioaccumulation is when MSM levels build up in plants which absorb it from soil.
- 1.5 Plants use up MSM and release sulphide by plant respiration or directly into soil when they die and decay returning it to the soil.
- 1.6 Sulphide from plants is oxidised into sulphate and incorporated into minerals which through erosion ends up back in the oceans, completing the sulphur cycle.

1. Combination of 1,2,4,5
 2. Combination of 2,3,4,6
 3. Combination of 1,2,3,4
 4. Combination of 3,4,5,6
 5. Combination of all (all statements are correct)
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Question 3

Choose the correct combination of statements about MSM in humans:

- 3.1 In humans, small amounts of MSM can be absorbed from foods, or produced from ingested DMSO, a healthy gut microbiome can also produce small amounts from various precursors.
- 3.2 Supplemental MSM can be detected in the blood within 15min of ingestion.

- 3.3 Supplemental MSM can be detected in the blood within 90min of ingestion.
- 3.4 Serum MSM levels increase significantly after taking 3 grams/day for at least 2 weeks and reach peak levels after 4 weeks.
- 3.5 MSM is poorly excreted, only small amounts are excreted in stool, suggesting it builds up in the body indefinitely.
- 3.6 Due to its low molecular weight, MSM has the ability to easily penetrate cell membranes, and distribute into soft tissue.

1. Combination of 1,3,4,6
 2. Combination of 1,2,4,6
 3. Combination of 3,4,5,6
 4. Combination of 1,3,5,6
 5. Combination of all (all statements are correct)
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Question 4

Choose the correct combination of statements about the mode of action of MSM:

- 4.1 MSM plays a role in the maintenance and support of connective tissue, due to its sulphur content.
- 4.2 Sulphur is important for cross-linking of proteins in the extracellular matrix, for the formation of strong, but flexible, disulphide bonds and necessary for healthy cartilage formation.
- 4.3 MSM also has antifungal and anti-helminthic properties.
- 4.4 MSM is works as an anti-inflammatory and antioxidant at a transcriptional and subcellular level.
- 4.5 MSM modulates cortisol levels and thus has the ability to regulate the inflammatory response.
- 4.6 Its anti-inflammatory effect is attributable mainly to the down regulation of NF- κ B (resulting in lower levels of IL-1, IL-6 and TNF- α , iNOS and Cox-2) and reduced expression of NLRP3.

1. Combination of 1,2,5,6
 2. Combination of 1,2,3,5
 3. Combination of 1,3,4,6
 4. Combination of 1,2,4,6
 5. Combination of all (All statements are correct)
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Question 5

MSM produced commercially for pharmaceutical use:

- 5.1 Has to be produced from DMSO using hydrogen peroxide as the amounts found in plants is too little to extract feasibly.
- 5.2 Is extracted from the wood of trees as the primary source of MSM.
- 5.3 Preferably undergoes multiple stages of distillation to remove excess water when producing pure MSM.
- 5.4 From DMSO has been shown to exert a similar anti-inflammatory effect to that of MSM extracted from plants.
- 5.5 By crystallisation, results in the production of 99.9% pure MSM.

1. Combination of 1,3,4
 2. Combination of 2,3,4
 3. Combination of 3,4,5
 4. Combination of 2,4,5
 5. Combination of all (all statements are correct)
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Question 6

Choose the correct combination of statements about the use of MSM in arthritis:

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- 6.1 Human trials confirm MSM's ability to reduce pain, stiffness and swelling in patients with osteoarthritis.
- 6.2 Human trials confirm MSM's ability to improve range of motion and physical functioning in osteoarthritis.
- 6.3 At present the evidence for MSM in OA is only derived from animal trials.
- 6.4 Evidence from both OA and RA models of inflammation also suggest MSM's potential cartilage preservation action.
- 6.5 Human Grade II OA chondrocytes treated with concentrations of MSM similar to human doses had reduced mRNA expression of TNF- α & IL-1.
- 6.6 The addition of MSM to glucosamine and chondroitin had no improved benefit over glucosamine and chondroitin alone in terms of OA pain.

1. Combination of 1,2,4,5
2. Combination of 1,2,3,4
3. Combination of 1,2,5,6
4. Combination of 1,3,5,6
5. Combination of all (all statements are correct)

Question 7

Choose the correct combination of statements about the use of MSM in the context of exercise recovery:

- 7.1 Evidence confirms the use of MSM to promote exercise recovery when used pre-exercise i.e. when used in a preventative role.
- 7.2 MSM improves exercise recovery by increasing Vo2 Max in athletes.
- 7.3 Trials confirm that MSM use leads to reduced post exercise muscle soreness and joint pain and improves recovery from exercise.
- 7.4 As an antioxidant, MSM dampens the inflammatory response, reduces oxidative stress and increases antioxidant capacity in response to exercise.
- 7.5 MSM use has also shown to increase markers of exercise recovery, decrease markers of muscle damage and increase glutathione levels post exercise.
- 7.6 MSM increases cortisol levels in athletes thus, has an anti-inflammatory effect.

1. Combination of 1,2,5,6
2. Combination of 2,3,5,6
3. Combination of 1,3,4,5
4. Combination of 3,4,5,6
5. Combination of all (all statements are correct)

Question 8

Choose the correct combination of statements with respect to dosing of MSM in the various contexts:

- 8.1 It is recommended that those requiring higher doses of MSM start treatment with 2 grams daily and gradually increase the dose to the prescribed level, ideally splitting the daily dose.
- 8.2 In OA trials applying MSM, the therapeutic dose ranged from 3.3 – 6 grams daily in the form of split dosages.
- 8.3 According to Prof. Stanley Jacob most of his patients benefited from 2-8 mg of MSM per day.
- 8.4 When used to promote exercise recovery, MSM should be used at a dose of 3 grams daily for an average of 20 days pre-exercise.
- 8.5 When using 3 grams daily, research confirms it takes on average 20 days for serum MSM levels to reach their peak.
- 8.6 Most trials on exercise recovery used 300mg of MSM daily.

1. Combination of 1,2,3,6
2. Combination of 1,2,4,5
3. Combination of 2,3,5,6

3. Combination of 3,4,5,6
 4. Combination of 1,2,3,4
 5. Combination of all (all statements are correct)
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Question 9

Choose the correct combination of statements about the safety and tolerability of MSM:

- 9.1 Toxicity data from animal studies suggests the safety of MSM even in mega doses of 1.5g/kg for extended periods (equivalent of 105 grams/day in a 70kg human) and the LD50 is set at >20grams/kg.
- 9.2 The USA FDA has endorsed the MSM from one major producer with a GRAS status.
- 9.3 Use in pregnancy is presumed safe based on animal studies applying high doses (1g/kg for 21 days), this also reported by Jacob *et al.* who in his experience, concurs based on clinical experience.
- 9.4 MSM has no known drug interactions but concurrent use with blood thinners should be done with caution based on DMSO's ability to inhibit platelet aggregation.
- 9.5 In human OA trials doses of 3-6 grams daily for 12 weeks report no serious adverse events and no negative impact on blood safety markers.
- 9.6 Possible side effects are usually temporary, mild and include GIT discomfort, frequent stools and headache and usually only at high doses introduced suddenly or without splitting the daily dose.

1. Combination of 2,4,5,6
 2. Combination of 1,2,5,6
 3. Combination of 3,4,5,6
 4. Combination of 1,3,5,6
 5. Combination of all (all statements are correct)
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Question 10

Choose the correct combination of statements on definitions and related terminology you have learnt in this CME: (Hint – you may need to look some of these up)

- 10.1 MSM is an organo-sulphur compound comprising two methyl groups, one sulphur and two double bonded oxygen atoms.
- 10.2 'ROS' stands for reactive oxygen species.
- 10.3 'LD50' is the amount of a material, given all at once, which causes the death of 50% (one half) of a group of test animals i.e. a measure of the short-term toxicity/poisoning potential.
- 10.4 'NF- κ B' (inhibited by MSM) is a pro-inflammatory signalling pathway leading to transcription of cytokines.
- 10.5 'WOMAC' stands for Western Oregon Medical Assessment Chart.
- 10.6 'TNF- α ' stands for Trauma Neurological Factor Alpha.

1. Combination of 1,2,4,5
 2. Combination of 2,3,4,6
 3. Combination of 3,4,5,6
 4. Combination of 1,2,3,4
 5. Combination of all (all are correct)
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