The Toxic Effects of Spent Crankcase Oil Exposures; Systematic Review and Meta-analysis.

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The study sought to execute a systematic review and meta-analysis to describe the toxicological implications associated with exposures of humans and laboratory animals to Spent Crankcase Oil (SCO). Databases like PubMed, Scopus, Science Direct, Google Scholar, Web of Science, and PlosOne were searched systematically. Statistical analysis and forest plots were done with RevMan 5.3 software. Results revealed that Spent Crankcase Oil exposure caused a significant reduction in the body weight, and red blood cell count of animal models, while a significant elevation of aspartate aminotransferase (AST), alkaline phosphatase (ALP), and creatinine concentration were recorded in both animal and human occupational exposure studies. Oxidative stress, heavy metals bioaccumulation, immunotoxicity, genotoxic, and carcinogenic effects were also in the list of findings.

Abstract Reference

PP05

BACKGROUND

The poor disposal of spent crankcase oil on lands, gutters, and waterways, in every state in Nigeria, other African countries and many parts of the World, is quickly becoming an issue requiring public health concern. Minimal attention to upholding regulatory guidelines controlling disposal has not helped the situation either. Over 80 million litres of crankcase oil disposed of from mechanic workshops, industries, power stations; and commercial houses find its way into drains and ground surfaces in the cities [1]. Spent crankcase oil (SCO) also known as used mineral-based crankcase oil, is used to describe the brown-to-black oily liquid often changed from the engines of a car after prolonged use. Spent crankcase oil contains aliphatic hydrocarbons, PAHs (also found in the virgin oil), metals like aluminium, chromium, copper, iron, lead, manganese, molybdenum, nickel, silicon and tin, added to the spent crankcase oil as the engines undergo wears and tears.

Studies have attributed the toxicity potential of SCO to additives present in the oil, accumulated with use. During usage, high temperatures and friction cause changes such as oxidation, nitration, and polymers breakdown in the component chemicals. The use of SCO as fuel for incineration by some industries and for domestic purposes, has led to the production of certain harmful compounds, which could be dispersed into the atmosphere as toxicants. Reports have also presented the gradual release of SCO into storm water runoffs in developed cities with heavy car usage. During rainfall and flooding, water contaminated with SCO makes its way into streams, rivers, and lakes. Water-Soluble Fractions (WSF) of spent engine oil enter into water bodies as runoffs during rainfall. Also, aided by gravity the oil moves through the soil to groundwater sources such as wells, and through lateral spreading combined with capillary forces and differences in soil type, pollution of drinking water sourced from these places becomes inevitable. Human exposure to contaminants in SCO exists. These could be through occupational exposures of automobile mechanics and factory workers where the oil is used to aid incineration. The general population may be exposed while checking oil levels in cars or self-servicing vehicles. SCO use as a lubricant for machine parts, or as traditional medicinal antidotes for poisons, use as acaricides, and also for warding off reptiles in some African culture, maybe routes of human exposure.

The eco-toxicological effects of SCO have also been captured by several studies.

METHODS

The review and meta-analysis was developed following the procedures stated by the Preferred Reporting Items for Systematic reviews and Meta-analyses (PRISMA) and the recommendations for the reporting of systematic reviews and meta-analyses of animal experiments.

Databases like PubMed, Scopus, Science Direct, Google Scholar, Web of Science, and PlosOne, were searched following a procedure to obtain experimental studies on organisms that assessed the toxic effects of spent crankcase oil (SCO) and human epidemiological exposure studies from 1960 to January 31st, 2020, without language or publication dates restrictions.

After identical records were screened, two authors, (AF and BG) each examined the studies to consider their suitability for inclusion. The screening took place in a two-step process; title and abstract examination, resulting in the elimination of publications that were not needed. The second step used a full-text screening process. Data was extracted under the following items; first author's last name and year, experimental model, spent crankcase oil formulation, dosage/ route of exposure, observed health effects, tissue/organ examined, sample size, methodological instrumentation, duration of exposure, major findings in comparison to untreated controls.

The methodological quality of the included studies was assessed using the items listed in Systematic Review Centre for Laboratory animal Experimentation, SYRCLE's risk of bias tool [17], to accommodate animal studies, and was developed with the Cochrane risk of bias tool using the RevMan 5.3 software. The inverse variance method which featured a random-effects model was used in the meta-analysis. Forest plots were contrived using the RevMan 5.3 software. SMD (Standardized mean difference), an index of the effect size was applied while plotting the forest plot.

RESULTS

PRISMA flow chart of the selection process is given below in Figure 1.

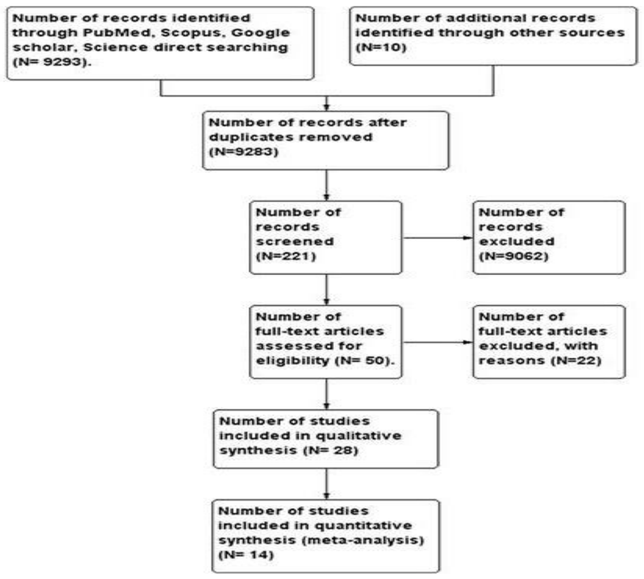

Figure 1: Flow diagram of the selection process.

28 articles were eventually used in the qualitative synthesis, while 14 studies were used for the meta-analysis. The meta-analysis had a total of 1,243 subjects from different human and animal experimental studies.

Five studies included in the review documented changes in body weights on exposure to SCO. On the other hand, eight studies documented the effect of SCO exposure on the mortality of organisms used.

Also, studies presented observations showing the adverse health effects SCO could have on the liver, kidneys, haematopoietic and reproductive systems. Oxidative stress, immunotoxicity, genotoxicity, and carcinogenesis, and heavy metal accumulation in elevated concentrations in the blood and several organs of animals, are also on the list of adverse events associated with SCO exposure following acute and chronic exposures through oral and dermal routes..

The occupational exposure studies included in this review pointed to the hepatotoxic, renal, haematological, blood heavy metal accumulation, and urinary 1-pyrenol excretion effects associated with SCO exposures on automotive repair mechanics and their apprentices.

CONCLUSIONS

The Figure below captures the entirety of effects from exposures to SCO as represented in the various studies used in the review process.

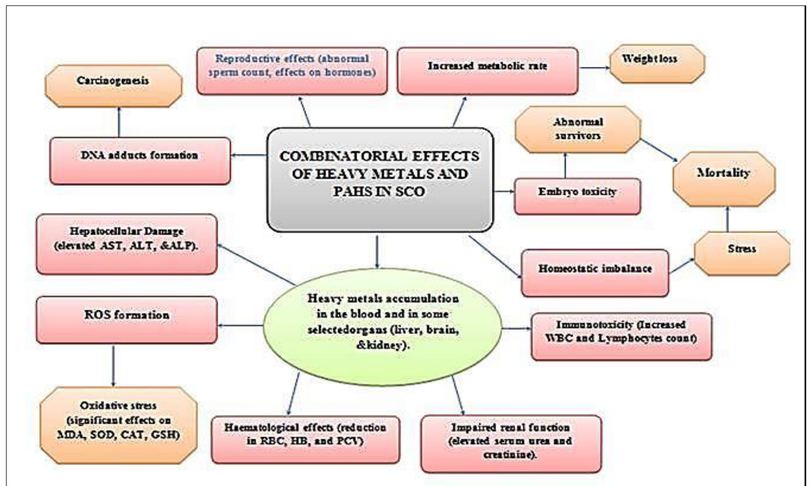

Figure 13: Conceptual framework of the toxic effects of spent crankcase oil exposures.

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MORE INFORMATION / REFERENCES

For more information on the study, please visit: https://doi.org/10.1007/s43188-021-00093-2.

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