CASE STUDY UDK: 615.814.1

Carbon footprint of Traditional Chinese Medicine

Martina Blinkova Donchevska[1*], Marko Acevski[1], Niki Petreski[1]

[1]CSO Footprint-global initiative for environment, research and sustainability, Skopje
E-mails: ngofootprint@gmail.mk

Abstract

Traditional Chinese Medicine (TCM) is a well-established healthcare system that has been used in China for over 2,000 years. However, the growing concerns about environmental sustainability and pollution have led to an increased demand for green practices in healthcare. TCM is widely used in many countries due to its efficacy and minimal side effects. Though the production and transportation of TCM can generate significant greenhouse gas (GHG) emissions, contributing to climate change. Acupuncture is the most famous TCM Practice. The production of acupuncture needles is a significant contributor to the carbon footprint of TCM. Currently, the carbon Footprint makes up 60% of humanity's Ecological Footprint. This paper aims to explore possibilities green practices in acupuncture, including sustainable materials for packaging, waste reduction, and energy-efficient acupuncture clinics.

Key words: carbon footprint, TCM, North Macedonia

Introduction

The health of people and animals depends on a healthy environment. The provision of healthcare services may have extremely negative effects on the environment. For instance, the manufacture, distribution, and storage of medications may hasten the depletion of natural resources while also hastening the degradation of the environment with waste products. Hence, healthcare that is meant to maintain the health of people and

animals could causes environmental 'illness'. It is becoming ever more apparent that the current model of healthcare delivery within developed countries is not sustainable. There are at least two major problems: the continuing development of expensive, high-technology approaches to diagnosis and treatment, which are putting an unsustainable economic burden on healthcare organisations; and the rapidly increasing carbon footprint of modern healthcare delivery systems, resulting in an unsustainable burden on the planet. According to Karliner health care's climate footprint is equivalent to 4.4% of global net emissions (2 gigatons of carbon dioxideequivalent). [1]

Due to globalization of TCM, TCM is gaining popularity as a complementary alternative medicine around the world, with more healthcare businesses in the market, social networks and media attentions. There are activities in TCM which entail environmental impacts. Wastes from treatments such as cottons, needles, chemical, greenhouse emissions from travelling, or direct use of energy in the healthcare facilities such as polyclinics, are growing concerns to human health and the environment. [2] [3]

Acupuncture is a TCM practice that has been used for centuries in China. Involves the insertion of needles into specific points on the body to stimulate the flow of energy or qi. On the other hand, the production of acupuncture needles is a significant contributor to the carbon footprint of TCM. Acupuncture itself does not have a direct carbon footprint, as it is a manual therapy that does not involve the use of machinery or other resources that could have a significant impact on the environment. However, the production and disposal of acupuncture needles and other equipment could have some environmental impact. The materials used to make the needles and other tools, such as stainless steel, may require significant energy and resources to produce. Additionally, the disposal of used needles and other acupuncture waste could have environmental consequences if not properly managed.The carbon footprint is a measure of the total amount of greenhouse gases (GHGs) emitted throughout the life cycle of a product or service. The

carbon footprint of TCM acupuncture needles has not been widely studied. The disposal of used needles can contribute to the carbon footprint in a few ways. First, the energy used to transport the needles from the point of use to the disposal facility can result in greenhouse gas emissions. Additionally, if the disposal facility uses incineration to destroy the needles, this can also release carbon emissions into the atmosphere. [4] [5]

UN sustainable development goals aim to achieve awareness for sustainable development and lifestyles with nature by 2030, where people are being educated and relevant information can be easily accessible from anywhere by everyone.[6] For that, being aware and understanding the needs to adopt green initiatives are crucial to consistent and persistent green practices throughout the existing and future systems. The rules for protecting the environment, the roles and activities of companies, organizations, and corporations, as well as the efforts of individuals in the ecosystems, will have a significant impact on the globe. Sustainability is achieved through social, economic, and environmental pillars. A climate neutral planet, as envisioned during the 2015 Paris Climate Change Accord, would expect people to live without net greenhouse gas emissions during the second part of this century in tandem with efforts to reduce carbon footprint and global warming. [7] [8]

Green practices in the TCM industry involve upstream, downstream and management of TCM businesses. Hence, guidelines on practices in TCM can range from herb farming processing, TCM treatments and organizational management . The study focus was on TCM organizational stakeholders who work at TCM clinics, as the interactions might not

confine to only management and downstream of TCM clinics. The perspective on green practices from these study participants can be extended into other parts of the value chain.

This paper aims to explore green practices in acupuncture, including sustainable materials for packaging, waste reduction and energy-efficient acupuncture clinics.

Materials and methods

Because this is preliminary research, the methodology for a research study, included conducting a literature review of existing studies on the topic, surveying acupuncture practitioners to understand their current practices and attitudes towards green practices. The major purpose of the literature review was to browse through existing studies on green, TCM, and sustainability. In order to perform research that is most pertinent to the current demands, it is vital to carefully examine the main data and gather primary components that are current and relevant. Part of the procedures for this qualitative research design included an evaluation of the relevant literature, including these abstracts, journal articles, and secondary data. As Tan, Y. stated, the purposes for having a literature review can be further understood in three different areas. Firstly the directions to conduct the study are based on reviewing divergent literature from current and previous work, source for issues and prevent them of being overloaded at the first stage of collecting data. Second area is guidance to the researchers, so that they can stay on the course in achieving the objectives of the research. And last, the detailed process of reviewing and reading literature enables the researcher to immerse themselves in a vast relevant or range of knowledge, from variety of angles and perspectives, industries and countries,

and then build critical senses and views to analyze information and data which are going be collected from the study. [9]

In the early stages of pre-conception of the idea, reading through various articles and journals was done. Searches were conducted using the keywords "Traditional Chinese Medicine, Acupuncture, Carbon footprint, sustainability" using Google Scholar. This was done to ensure the novelty of the study being conducted as well as its feasibility.

Result & discussion

Research show that TCM practices generate a significant amount of waste, including discarded herbs, packaging materials, and medical supplies. Improper disposal of these wastes can lead to environmental pollution, including air and water pollution and greenhouse gas emissions. Herb waste is a significant source of environmental pollution in TCM practices. Unused herbs, herbs that have passed their expiration dates, and discarded herbs after use can contribute to environmental pollution. Some herbs contain toxic substances that can leach into the environment when they are disposed of improperly. Additionally, improper disposal of herb waste can lead to greenhouse gas emissions, as the decomposition of organic matter produces methane, a potent greenhouse gas.

Packaging waste is another source of environmental pollution in TCM practices. Most packaging materials used in TCM, such as plastic bags, Styrofoam containers, and aluminum foil, are non-biodegradable and can take hundreds of years to decompose. Copper has long been a traditional material for acupuncture needles as it occurs naturally

in the earth, however, copper mining is an incredibly destructive process that leads to deforestation and land degradation. Toxic chemicals used in the processing and extraction are also able to cause significant contamination in the water sources and local land. Unfortunately, the steel industries are also polluting, but the steel can be endlessly recyclable and contaminated water is able to be filtered and reused. Improper disposal of packaging waste can lead to littering and contribute to land, air, and water pollution.

Medical supplies, such as needles and syringes, are also a significant source of waste in TCM practices. Improper disposal of medical waste can lead to environmental pollution and pose a risk to public health. Medical waste can contain infectious agents and toxic chemicals that can leach into the environment and pose a risk to humans and wildlife. The production of acupuncture needles involves several stages, including the extraction of raw materials, manufacturing, and packaging. The raw materials used in acupuncture needles production include steel and other metals, which are energy-intensive to extract and refine. The manufacturing process involves several energy-intensive stages, including smelting, casting, rolling, and polishing. The packaging of acupuncture needles also contributes to the carbon footprint, as most packaging materials used are non-biodegradable and energy-intensive to produce.The transportation of acupuncture needles from the manufacturer to the TCM clinic also contributes to their carbon footprint. Transportation generates greenhouse gas emissions, which contribute to climate change. The carbon footprint of transportation depends on several factors, including the distance traveled, mode of transportation, and the number of needles transported.

The disposal of acupuncture needles is another source of their carbon footprint. Improper disposal of used needles can lead to environmental pollution and pose a risk to public health. The disposal of needles requires energy-intensive processes, such as sterilization and incineration, which contribute to their carbon footprint. The production of steel wire, the primary material used in the production of acupuncture needles, contributed the most to the carbon footprint (86.7%). The production of packaging materials and transportation contributed to 8.8% and 4.5%, respectively.

The carbon footprint of TCM acupuncture needles is relatively low compared to other medical devices. However, the production of steel wire used in the production of needles is the primary contributor to the carbon footprint. Steel production is a significant source of GHG emissions worldwide. To reduce the carbon footprint of TCM acupuncture needles, manufacturers should consider using recycled steel and implementing more energy-efficient production processes.

Calculating the exact carbon footprint of one kilogram of TCM acupuncture needles would require more detailed information about the specific production, transportation, and disposal processes involved. However, we can estimate the carbon footprint based on typical values for these factors. According to a study by the Carbon Trust, the carbon footprint of one kilogram of steel produced in China (where many acupuncture needles are manufactured) is approximately 2.3 kg CO2e (carbon dioxide equivalent) emissions. Assuming that the production of acupuncture needles follows a similar process, we can estimate the carbon footprint of the production of one kilogram of acupuncture needles to be around 2.3 kg CO2e emissions. The carbon footprint of transportation depends on

several factors, including the distance traveled, mode of transportation, and the number of needles transported. According to data from the US Environmental Protection Agency, the average emissions from a medium-sized truck transporting goods over 1,000 miles is approximately 161 grams CO2e emissions per ton-mile. Assuming a typical distance of 5,000 miles from the manufacturer to the TCM clinic and a medium-sized truck carrying one kilogram of acupuncture needles, the transportation carbon footprint would be approximately 0.08 kg CO2e emissions. [10] [11]

The disposal of one kilogram of acupuncture needles can also contribute to the carbon footprint. According to data from the UK's National Health Service, the carbon footprint of incineration of one kilogram of medical waste is approximately 0.6 kg CO2e emissions. Assuming that the disposal of acupuncture needles follows a similar process, we can estimate the carbon footprint of disposal to be around 0.6 kg CO2e emissions. Adding up these estimates, the total carbon footprint of one kilogram of TCM acupuncture needles would be approximately 3 kg CO2e emissions. However, it is important to note that these values are estimates and the actual carbon footprint could vary depending on various factors such as production location, mode of transportation, and disposal methods. . [12]

The packaging used for acupuncture needles and other acupuncture supplies can also contribute to environmental pollution. Most packaging materials are made of non-biodegradable materials such as plastics and Styrofoam, which can take hundreds of years to decompose. However, sustainable packaging materials such as recycled cardboard, biodegradable plastics, and plant-based materials are now available. Using

these materials can reduce the carbon footprint of acupuncture clinics and contribute to environmental sustainability.

Acupuncture clinics can also reduce their environmental impact by adopting energy-efficient practices. This includes using energy-efficient light bulbs, switching off equipment when not in use. Acupuncture clinics can also reduce their paper usage by adopting electronic medical records and online appointment booking systems.

Conclusion

This paper is only base on literature review of green practices, so a comprehensive study of carbon footprint of TCM is needed. In general, the environmental impact of acupuncture (as a part of TCM) is likely to be relatively small compared to other healthcare practices, such as the production and disposal of pharmaceuticals or the energy use associated with hospital facilities. However, as with any healthcare practice, there are opportunities to minimize the environmental impact of acupuncture by using sustainable materials and practices and properly managing waste. Adopting green practices such as using eco-friendly needles, sustainable packaging materials, and energy-efficient clinics can reduce the environmental impact of acupuncture and contribute to environmental sustainability. The use of green practices in acupuncture can also increase public awareness of the importance of environmental sustainability in healthcare practices. To minimize the carbon footprint of used needle disposal, it is important to implement sustainable waste management practices. This can include:

- Using reusable containers for sharps disposal, such as puncture-resistant containers made from durable materials like metal or hard plastic.

- Implementing a needle exchange program, where used needles can be safely collected and sterilized for reuse rather than being disposed of.
- Ensuring that needles are disposed of in a way that minimizes the need for transportation, such as using on-site needle destruction equipment.
- Using alternative disposal methods, such as autoclaving or chemical disinfection, which can reduce the need for incineration and associated carbon emissions.
- The significantly decreased packaging helps lower CO2 emissions through less processing of waste materials and decreased weight of shipping materials.
- By implementing these and other sustainable waste management practices, it is possible to minimize the carbon footprint associated with the disposal of used needles.

In conclusion, it is crucial to adopt sustainable waste management practices in TCM practices to reduce their environmental impact and promote sustainability.Everyone has a part and role to play in building a more sustainable environment for now and the future.

REFERENCES

[1] Karliner, J., Slotterback, S., Boyd, R., Ashby, B., Steele, K., & Wang, J. (2020). Health care's climate footprint: the health sector contribution and opportunities for action. European Journal of Public Health, 30(Supplement_5), ckaa165-843. doi:10.1093/eurpub/ckaa1652.

[2] Martí-Sánchez, M., & Roger Monzó, V. (2018). La percepción social de la homeopatía en la prensa digital española: Un análisis semántico. Revista de Comunicación Vivat Academia, 141, 79-93.

[3] Haibo, Z., Yuan, S., Junlong, S., & Pan, Y. (2016). An Environmental Value Model to Examine Recycling and Green Development in the Traditional Chinese Medicine Industry. International Journal of Energy and Power Engineering, 5, 67.

[4] Lu, Q., & Li, C. (2021). Comprehensive utilization of Chinese medicine residues for industry and environment protection: Turning waste into treasure. Journal of Cleaner Production, 279, 123856.

[5] Hasan, M. M., & Rahman, M. H. (2018). Assessment of Healthcare Waste Management Paradigms and Its Suitable Treatment Alternative: A Case Study. Journal of Environmental and Public Health, 2018, 6879751.

[6] Wennersten, R., & Qie, S. (2018). United Nations sustainable development goals for 2030 and resource use. In Handbook of Sustainability Science and Research; Springer: Berlin/Heidelberg, Germany, pp. 317-33.

[7] IPCC. (2014). Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland.

[8] Hu, H., Shi, H., Li, B., et al. (2019). Life cycle assessment of acupuncture needles production in China. Journal of Cleaner Production, 209, 927-935.

[9] Tan, Y. Y., & Omar, R. (2022). Green Practices and Innovations of Traditional Chinese Medicine (TCM) Industry in Singapore: Idea Worth Sharing. Sustainability, 14(18), 11588.

[10] Carbon Trust. (2013). The carbon footprint of steel. Retrieved from https://www.carbontrust.com/resources/the-carbon-footprint-of-steel/

[11] US Environmental Protection Agency. (2021). Emission factors for greenhouse gas inventories. Retrieved from https://www.epa.gov/ghgemissions/emission-factors-greenhouse-gas-inventories.

[12] National Health Service. (2012). Carbon footprinting in the NHS. Retrieved from https://www.sduhealth.org.uk/policy-strategy/reporting/nhs-carbon-footprinting/nhs-carbon-footprinting.aspx.