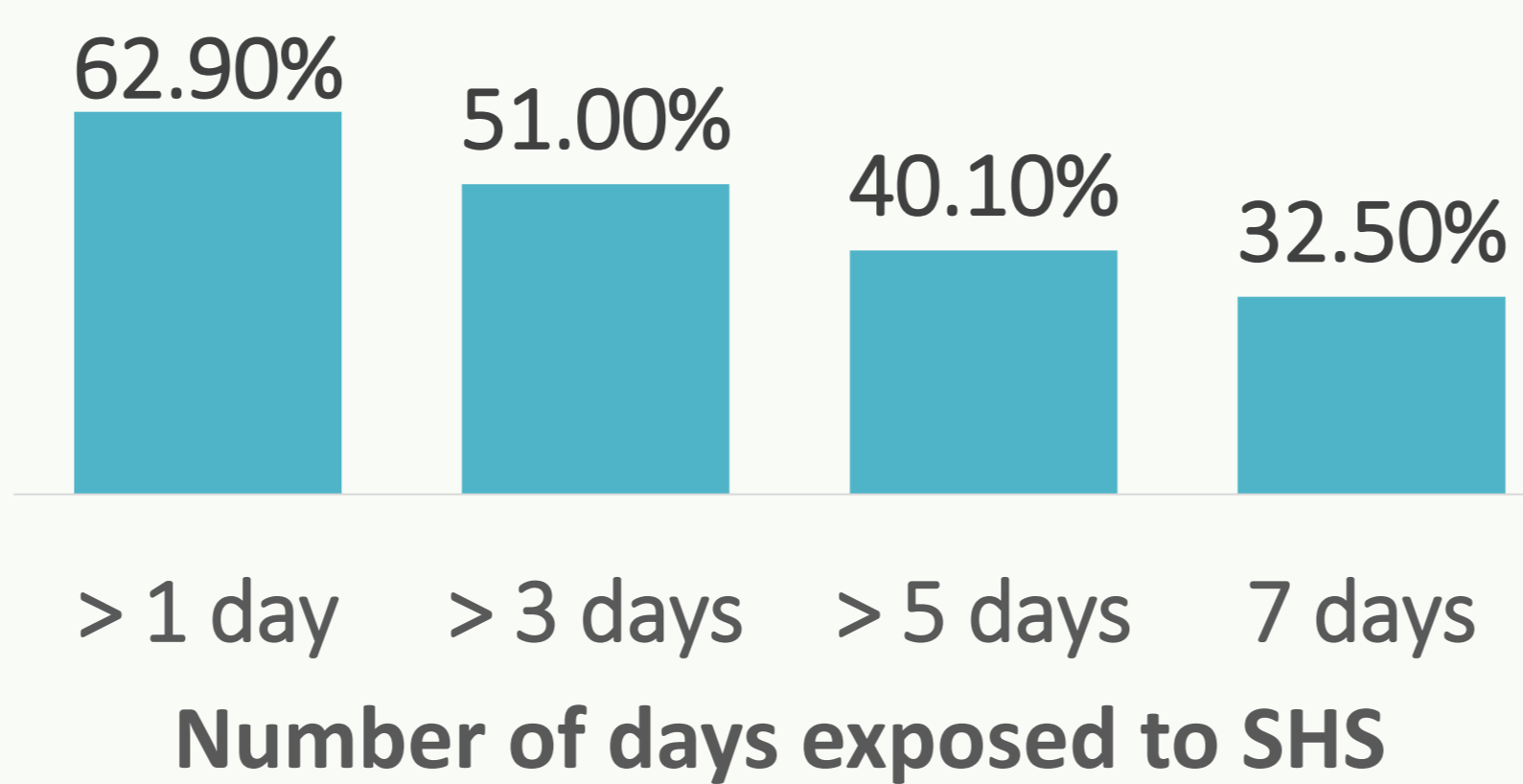




Introduction

Lung cancer is the current leading cause of cancer incidence and mortality worldwide, with cigarette smoke serving as the chief risk factor for development of lung cancer. Cigarette smoke can be categorised as **first-hand (FHS)**, **second-hand (SHS)** or third-hand smoke, with the potency of each varying based on the quantity and quality of exposure. SHS has been categorised as a group 1 carcinogen by the International Agency for Research on Cancer, and has been suggested to affect many other organs, besides the lungs. Globally, almost 1 in 3 people are considered to be passive smokers due to domestic or public smoke exposure (**Figure 1**)

Figure 1: Global prevalence of SHS exposure in any place [1] (based on 142 surveyed countries)



Methods and Materials

In April 2022, general practitioners from the Olomouc district (~230,000 patients) were invited to share lung cancer case reports in never-smokers, from the last 10 years. Selected cases were screened with follow-up questions to identify potential lung cancer risk factors (family history, environmental and occupational). Cases with second-hand smoke exposure presenting as the only risk factor were selected. A structured, but non-exhaustive literature search (PubMed, MEDLINE, Scopus and Web of science) was carried out using search terms relating to the project theme.

Case 1 – Female (24 years old)

- May 2021 Presented with painful resistance (20mm) in left sternocleidomastoid region. Normal physical examination. Elevated CRP (63.2 mg/L). Ultrasound (US) showed enlarged lymph nodes. Prescribed co-amoxiclav.
- July 2021 **Cervical lymphadenopathy (15mm). New onset heartburn with cough. CRP (18.2 mg/L)**
- Sept 2021 Extirpation of nodes. Biopsy revealed metastatic mucinous adenocarcinoma. PET-CT showed accumulation in lungs, liver and spleen. Patient diagnosed with bronchogenic mucinous adenocarcinoma with metastases.
- Oct 2021 **Treated with Alectinib.**

Case 2 – Female (34 years old)

- Apr 2015 Presented with Cough, evening wheezing, diarrhoea and fever. Normal physical examination. Elevated CRP (12.2 mg/L). Prescribed inhaled salbutamol, levocetirizine and nifuroxazide. Cough persisted despite escalation to budesonide. Bilateral lung murmurs. X-ray and CT showed sharply demarcated mass in right middle lung.
- Aug 2015 **PET-CT showed accumulation (10mm) in the right middle lung lobe.**
- Sept 2015 Video-assisted thoracoscopic lobectomy with histology (poorly differentiated carcinoma with sarcomatoid features, without metastasis)

Patient History:

Never-smoker with history of domestic SHS exposure until age 10 (**father smoked 20 cigarettes/day inside the house**). 10 years occupational exposure to SHS. No family history of cancer. No other risk factors detected. Extirpation of benign breast fibroadenoma.

Patient History:

Never-smoker with history of domestic SHS exposure (**father smoked 15 cigarettes/day inside the house**). No occupational SHS exposure. No family history of cancer. Premature birth (30 weeks). Stable small thyroid nodule.

Discussion

The selected case reports identified 2 young females with histologically uncommon types of lung cancer, in the absence of any risk factors besides SHS exposure (domestic +/- occupational). Our literature search indicated SHS exposure is more likely to affect women and children, with one cross sectional study (192 countries) showing up to 40% of children being exposed to SHS in countries with high smoking prevalence [2][3]. Furthermore, middle-income countries and low socio-economic status were also associated with increased SHS exposure.

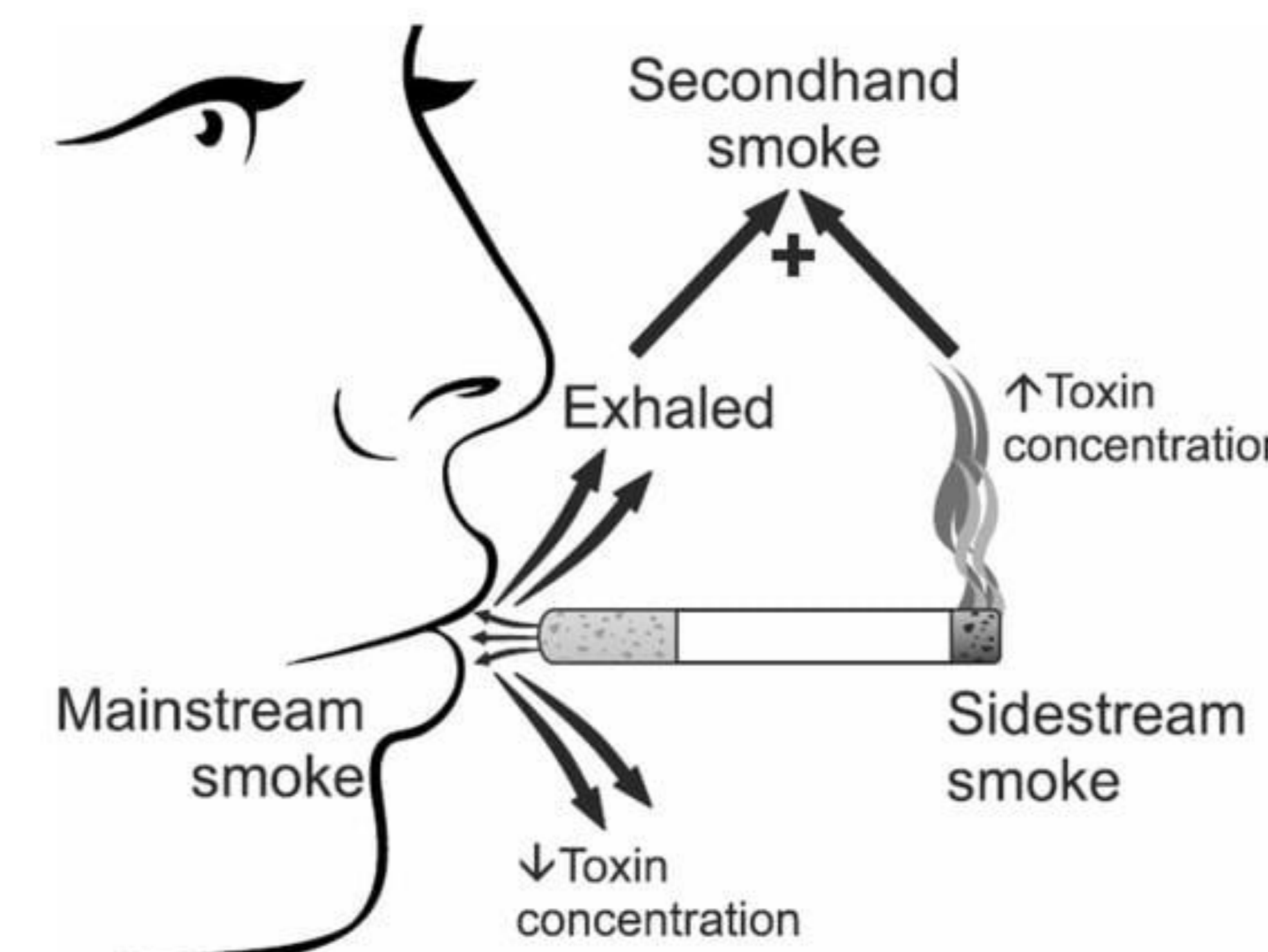
SHS consists mainly of sidestream smoke and partially of mainstream smoke (**Figure 3**). It is composed of more than 7000 chemicals, including 70 known carcinogens, with research showing that many of these carcinogens are emitted at higher concentrations in sidestream smoke (**Figure 2**). SHS presents a myriad of negative health effects including increased risk of cardiovascular disease, decreased fertility and reduced birthweight, head circumference and foetal growth. Most importantly, SHS is associated with increased risk of developing lung, breast, nasopharyngeal, laryngeal and cervical cancer [6].

Figure 2: Table showing fold change in carcinogen concentration between SHS and FHS

Carcinogen	SHS : FHS
Polycyclic aromatic hydrocarbons	10 fold increase
Benzene	10:1
Benzopyrene	4.5:1
N-nitroso-dimethyl alanine	100:1

Source – [4][5]

Figure 3: Composition of SHS and its relation to toxin concentration



Preventative measures including public bans have done well to reduce the rates of public smoking, but may have a negative impact on rates of domestic smoking, where SHS exposure is rife [7]. With the risk of lung cancer correlating to increased years of SHS exposure, additional preventative steps need to be taken to safeguard risk groups including children, who are least able to control domestic SHS exposure. Currently, assessment of SHS exposure is estimated through an interview or questionnaire format – rarely, from lab tests or specific measurements (e.g. serum cotinine). This raises some questions about the true prevalence of SHS exposure.

Conclusion

A significant portion of the global community is regularly exposed to SHS, which offers a plethora of negative health effects and is associated with the development of lung cancer. Improvements need to be made to screening methods, education and legislative measures to protect those most at risk of the harmful effects of SHS. Healthcare workers should routinely pay attention to both past and present SHS exposure, offering regular screening to those considered high risk patients based on a thorough patient history and confirmatory lab investigations.

References

- [1] [https://doi.org/10.1016/S2214-109X\(21\)00365-X](https://doi.org/10.1016/S2214-109X(21)00365-X) - (last accessed 14.04.2023)
- [2] <http://dx.doi.org/10.1136/tobaccocontrol-2015-052692> - (last accessed 14.04.2023)
- [3] <https://doi.org/10.18332/tid/117958> - (last accessed 14.04.2023)
- [4] <https://doi.org/10.3390/ijerph15091981> - (last accessed 14.04.2023)

- [5] Secondhand Smoke Exposure and Cardiovascular Effects: Making Sense of the Evidence.
- [6] [10.31557/APJCP.2019.20.3.971](https://doi.org/10.31557/APJCP.2019.20.3.971) - (last accessed 14.04.2023)
- [7] [10.1002/hep.4276](https://doi.org/10.1002/hep.4276) - (last accessed 14.04.2023)