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STATISTICAL ANALYSIS OF ENVIRONMENTAL IMPACTS FROM BALLPOINT PEN USAGE AND DISPOSAL

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Abstract

The widespread use of ballpoint pens (BPPs) has emerged as a notable source of plastic pollution, yet their environmental impacts remain largely overlooked. This study presents a statistical analysis of BPP usage and disposal patterns in India, considering variations across age groups, professional activities, and the effects of the COVID-19 pandemic. Data were collected over a two-year period with an additional four months during the lockdown, revealing an average individual consumption of approximately one BPP per week. The distribution of usage followed a positively skewed and leptokurtic pattern, with peak consumption observed among students aged 12–25, particularly at 17 years. Professional use patterns varied significantly: journalists, scriptwriters, and electricians reported higher pen turnover, while IT professionals and professors exhibited reduced dependence due to increasing reliance on digital tools. The pandemic led to a marked reduction in student pen use, but professional consumption remained largely unaffected. Extrapolation of survey data indicated that India disposes of approximately 49.92 billion BPPs annually, corresponding to 5.49 million tonnes of plastic waste. The associated carbon footprint was estimated at 4.83 MTCE per ton of plastic, resulting in 2.65 million tonnes of CO₂e emissions per year. Improper disposal of BPPs exacerbates environmental risks: their composite design hinders recycling, leading to landfill accumulation, microplastic generation, leaching of toxic substances, and release of hazardous gases during incineration. Notably, 97% of users replaced rather than refilled pens, reinforcing single-use practices. Survey responses indicated increasing awareness of alternatives, with 90% of participants supporting fountain pens (FPs) as an eco-friendly option. Adoption of FPs could reduce plastic waste by over 60%. This study highlights the underestimated environmental burden of BPPs and emphasizes the importance of promoting sustainable writing instruments, encouraging refill practices, and advancing technological transitions toward digital documentation to mitigate future impacts.

Key words: ballpoint pen, fountain pen, Indian survey, plastic disposal, statistical analysis, waste management

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