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LETTER

Commercial clothes dryers: a source of microfiber emissions to air

Lisa M Erdle[1,*], Victoria Fulfer[1], Lucinda Anderson[1,2], Win Cowger[3,4] and Marcus Eriksen[1]

[1] The 5 Gyres Institute, Los Angeles, CA, United States of America
[2] Brown University, Providence, RI 02912, United States of America
[3] Moore Institute for Plastic Pollution Research, Long Beach, CA, United States of America
[4] University of California, Riverside, CA, United States of America
[*] Author to whom any correspondence should be addressed.

E-mail: lisa@5gyres.org

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Abstract

Background. Microfibers from textiles are a major source of microplastic pollution, yet emissions from dryers are poorly studied. *Objectives*. This study quantifies microfiber emissions from commercial dryers and explores deposition around laundromats. *Methods*. We conducted atmospheric sampling using passive samplers at ten laundromats in San Francisco and quantified microfiber emissions from dryer vent lint at two locations. *Results*. Microfiber deposition rates were significantly higher downwind of dryer exhausts, and lint samples indicated emissions of 8–47 million microfibers per week per laundromat. City-wide emissions may reach 1.1 quadrillion microfibers annually. *Conclusions*. Commercial dryers are an overlooked source of airborne microfiber pollution. Mitigation strategies, including filtration, should target this source.

1. Introduction

Plastics, and microplastics in particular, have become ubiquitous pollutants in the environment. Among microplastics, microfibers—thin fibers <5mm, often shed from textiles—are increasingly detected in the environment, including stormwater (Zhu *et al* 2021), the marine environment (Michishita *et al* 2023), remote terrestrial environments (Allen *et al* 2019, Napper *et al* 2020), and the human body such as in lungs (Prata *et al* 2020). Atmospheric transport is often cited as a key pathway for this dispersal (Evangeliou *et al* 2020), yet a comprehensive accounting of all microfiber sources remains incomplete. A better understanding of the magnitude and sources for microfiber emissions is critical to informing policies and driving effective mitigation for microfibers (Chen *et al* 2024).

Although microfiber emissions and solutions have gained attention in recent years (McIlwraith 2019, Napper *et al* 2020, Geyer *et al* 2022), emissions from dryers, wear, and non-textile sources remain under-studied. Recent studies show that emissions from tumble drying (Tao *et al* 2022) and regular wear (De Falco *et al* 2020) may equal to or exceed microfiber release from washing machines. Vented domestic dryers have been identified as significant sources of microfibers (Kapp and Miller 2020), yet commercial dryers, which process high volumes of textiles, remain unexamined. Laundry facilities could represent a significant point source of microfibers.

Airborne microfiber emissions are particularly relevant for human health exposure due to their potential to enter the respiratory system. Recent studies have detected microfibers in human lung tissue (Chen *et al* 2022, Jenner *et al* 2022), placenta (Ragusa *et al* 2021), and even the brain, where fibers may reach the brain's olfactory bulb via the nasal passage (Amato-Lourenço *et al* 2024). This raises concerns about chronic exposure through inhalation. Microfibers may also carry hazardous chemicals, such as dyes, flame retardants, and heavy metals (Lacasse and Baumann 2004, Athey *et al* 2022). As cities seek to improve air quality and control microplastic emissions, identifying local airborne sources of microfibers becomes increasingly important for public health and the environment.

San Francisco Bay provides a well-documented case for studying sources and pathways of microfiber pollution. Zhu *et al* (2021) found anthropogenic microfibers—including dyed cellulose and synthetic polymers—in every environmental compartment sampled, including surface water, wastewater, sediment, biota, and stormwater. Stormwater contained approximately 140 times more anthropogenic micro debris (mostly microfibers) compared to treated effluent, pointing to diffuse sources of microfibers and a priority for emissions reductions (Zhu *et al* 2021). Yet, studies have not addressed microfiber emissions to air in San Francisco or links to specific sources.

This study focuses on vented commercial dryers in laundromats as potential sources of airborne microfiber emissions using passive samplers to investigate local deposition and dryer vent capture devices. Dryers are typically classified as vented (gas or electric) or ventless (condenser or heat pump). Vented remains the most common in the U.S., are the standard in laundromats, and are the focus of this study. Although laundromats have been suggested as a point source of microfiber emissions, we could not find any studies that investigate microfiber emissions from commercial laundry facilities or laundromats. Our objectives were threefold: (1) to determine whether laundromats contribute to microfiber pollution via airborne emissions, (2) to evaluate microfiber release through dryer vents in commercial laundries, and (3) to provide recommendations for possible mitigation strategies. Investigating airborne microfiber emissions from dryers, our findings aim to inform future research, guide targeted interventions, and support policies that reduce microfiber emissions from textiles.

2. Methods

2.1. Atmospheric sampling

Atmospheric deposition sampling was conducted at ten laundromats in the San Francisco Bay Area, California, USA (figure 1). This region was selected due to its robust dataset on microplastic pollution across environmental compartments (Zhu *et al* 2021). Sites were selected to represent varying urban densities and environmental conditions around San Francisco Bay.

2.1.1. Atmospheric deposition

Atmospheric deposition sampling was conducted using passive air samplers. Passive samplers consisted of sampling devices with adhesive tape to capture deposited particles. Each sampling device consisted of a 4.5 cm diameter double-sided tape circle ($A \approx 15.9$ cm^2) affixed to a 5 cm diameter transparency sheet. The design was adapted from Hamilton *et al* (2021) and modified to resemble artificial leaves to limit any potential tampering with sample devices. Sampling devices were assembled in a clean cabinet, then placed in pre-cleaned glass petri dishes (washed and triple rinsed with RO water) until deployment to minimize contamination. The protective double-sided tape liner was removed after samplers were installed.

At each laundromat, three upwind ($n = 3$) and three downwind samples ($n = 3$) were collected. Samples were collected at all ten sites, including in San Francisco, Oakland, Moraga, San Pablo, Vallejo, Napa, Sonoma, Novato, and San Anselmo (figure 1). Samplers were affixed to nearby structures at approximately 1.2 m above ground (chest height) and spaced within 1 m^2. Samples were exposed for approximately 24 h in a period of consistent wind direction. Passive samplers captured total ambient deposition; attribution to dryer exhaust relied on contrasts between paired upwind and downwind placements. This approach assumes that, in the absence of dryer emissions, background microfiber deposition rates and velocities are comparable between the paired locations. The samplers remained either upwind or downwind of dryer exhaust throughout sampling. Additionally, wind direction and speed were monitored at each site at deployment and collection (details in Supporting Information). Two field blanks (one for each upwind and downwind group) were included at every site, totaling 20 blanks deployed.

One sample site (Site 1, Downtown San Francisco) had the downwind samples tampered with, so only the upwind sample ($n = 3$) and blank were collected and analyzed at that site.

2.1.2. Microfiber identification

Suspected anthropogenic microfibers were quantified under a Nikon SMZ1270 stereo microscope. Adhesive tape and transparencies were first transferred to the microscope using clean tweezers. Each identified microfiber was photographed, measured for total length, fiber morphology (see more in Supporting Information), and categorized by color.

To identify material type, a subset of microfibers was analyzed by Raman spectroscopy using an Xplora Plus (Horiba Scientific) equipped with LabSpec6 software. Approximately 10% of each color category was analyzed

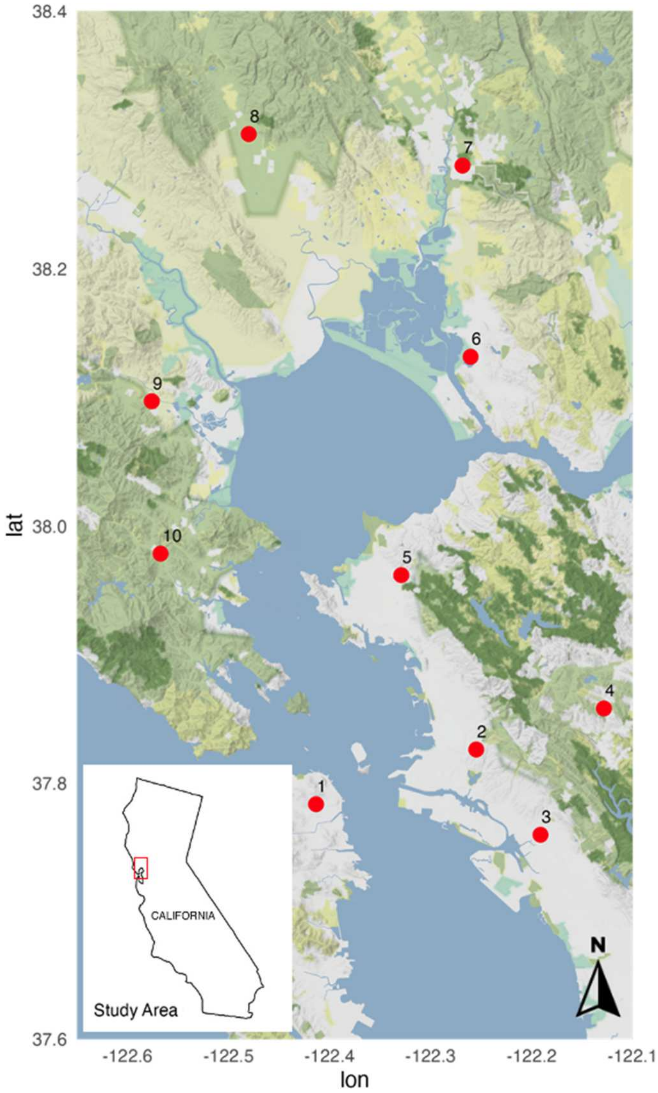

Figure 1. Sites sampled in the San Francisco Bay Area, California, USA. 1: San Francisco, 2–3: Oakland, 4: Moraga, 5: San Pablo, 6: Vallejo, 7: Napa, 8: Sonoma, 9: Novato, 10: San Anselmo.

by Raman, a sub-sampling strategy shown to be representative of overall fiber composition in previous studies (De Frond *et al* 2023). A minimum one particle was analyzed where $n < 10$. Additional operational details are available in the Supporting Information. A total of 149 particles were analyzed for material type by Raman spectroscopy. Spectra were matched to the Bio-Rad and SLoPP/SLoPP-E libraries (Munno *et al* 2020). For comparability with other studies, we included spectroscopy matches in the Supporting Information (table S3).

Following Raman spectroscopy, particles were classified by polymer (e.g., polyethylene, acrylic) where possible using the same classification method as Zhu *et al* (2021). Dyed microfibers with a 'cotton' or 'cellulosic' match (e.g., blue cotton, red cellulose) were classified as 'anthropogenic cellulosic.' Where the base material could not be identified, or we obtained the signal of a dye, we categorized particles as 'unknown,' or 'anthropogenic unknown,' respectively. Cellulosic particles with no clear anthropogenic modification (i.e., no dye) were classified as 'cellulose unknown.' Particles that could not be matched in the library were classified as 'unknown.' Examples of fibers can be seen in figure S1 (see Supporting Information),

2.1.3. Quality assurance/quality control (QA/QC)

Field blanks were processed in the same manner as samples to account for procedural contamination. One field blank was processed for every three samples, carried through all collection and processing steps from deployment to quantification. Microfiber counts in each blank were subtracted from corresponding counts in samples by color category (e.g., blue, black, clear). This correction was applied to all reported data. In one instance, the blank contained a higher count compared to the sample, and this was treated as a zero.

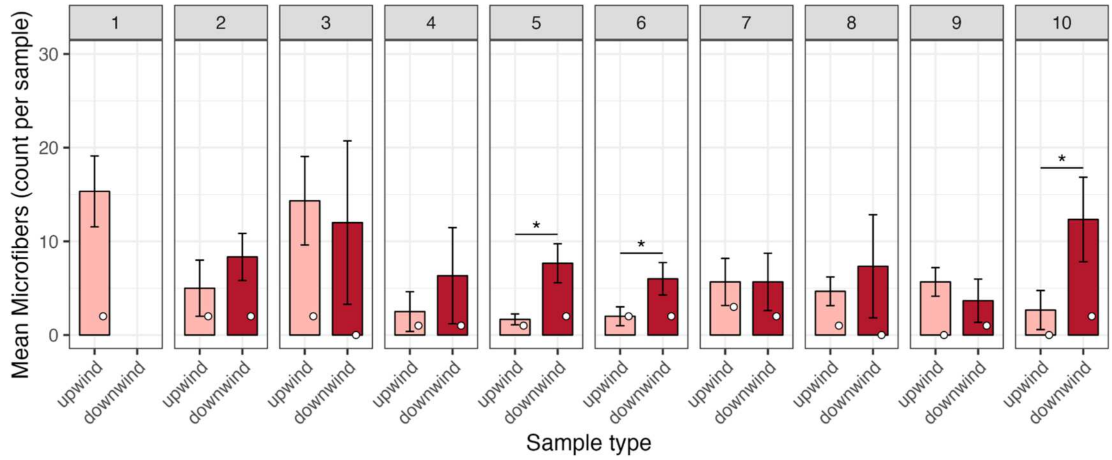

Figure 2. Microfiber counts for each site (1–10) broken down by upwind and downwind samples. Bars represent the mean, and error bars represent the standard deviation. The microfiber counts in the respective blanks are represented by dots. Samples could not be retrieved from the downwind at Site 1, thus only upwind values are displayed for this site. Asterisks show significant differences between upwind and downwind (* $p < 0.05$).

2.1.4. Statistical analysis

Statistical analyses were performed using R version 4.2.1 (R Core Team 2022) using RStudio. A two-way ANOVA was used to evaluate the effects of site and position (upwind versus downwind) on blank-corrected microfiber counts. Blanks were reported and presented in figures to ensure transparency in count reporting, following some best practices for processing and reporting blanks (Munno *et al* 2023). The deposition rate in the number of particles/m^2/day was calculated by taking the count for each sample (on a passive sampler with an area of 15.9 cm^2, measured in count/sample/day) and multiplying that value by 628.9.

2.2. Dryer vent emissions

Lint samples were collected from laundromat dryer exhausts to determine microfiber emissions. Pre-weighed 100 μm nylon mesh bags were secured on the exhaust vents with rubber clamps. Sampling occurred at two laundromats for seven consecutive days, with nylon mesh bags installed in the morning, and changed daily. Nylon mesh bags with lint were carefully rolled from the opening and stored in reusable silicone bags. Following collection, nylon bags and lint were dried in a desiccator, and then weighed. The weight of lint for each sample was determined by taking the weight for the full nylon bag and subtracting the weight of the empty bag. To estimate the weekly lint capture, we used the average daily weight. Subsamples were further analyzed to estimate microfiber counts. Completing count and weight for microfiber estimations are preferred, since extrapolations between weight and count can lead to results that are misleading and off by orders of magnitude (Balasaraswathi and Rathinamoorthy 2021).

To estimate microfiber count, 1 mg subsamples were taken from dried lint. Across three days for Laundromat 1 and three days for Laundromat 2, three subsamples of lint, approximately 1 mg each, were taken to determine count. The number of microfibers in each subsample were counted manually under the microscope using tweezers and double-sided tape on a transparency sheet with a grid, to prevent double counting or missing a fiber. With microfiber counts from each subsample, we estimated a count of microfibers per mg of sample.

3. Results

3.1. Atmospheric deposition

Anthropogenic microfibers were found at all ten sampling locations (figure 2). A 2-factor ANOVA, testing for differences in the count of microfibers found a significant difference between sites ($p = 0.00027$, $\eta_p^2 = 0.437$), with 43.7% of the variance attributed to differences between sites. Sample position (upwind versus downwind) was also significant ($p = 0.0149$, $\eta_p^2 = 0.074$), though the effect size was small, explaining only 7.4% of the variance. Overall, downwind samples typically contained higher concentrations of microfibers than upwind samples (4.7 ± 5.0 particles/sample/day (mean $\pm$ SD, $n = 30$) for upwind passive samplers compared to 6.4 ± 4.8 particles/sample/day (mean $\pm$ SD, $n = 27$) for downwind), although significant differences were only detected at three of the nine sites (figure 2). Sites with significantly higher microfiber counts in downwind samples were Site 5 ($p = 0.049$), Site 6 ($p = 0.025$), and Site 10 ($p = 0.030$).

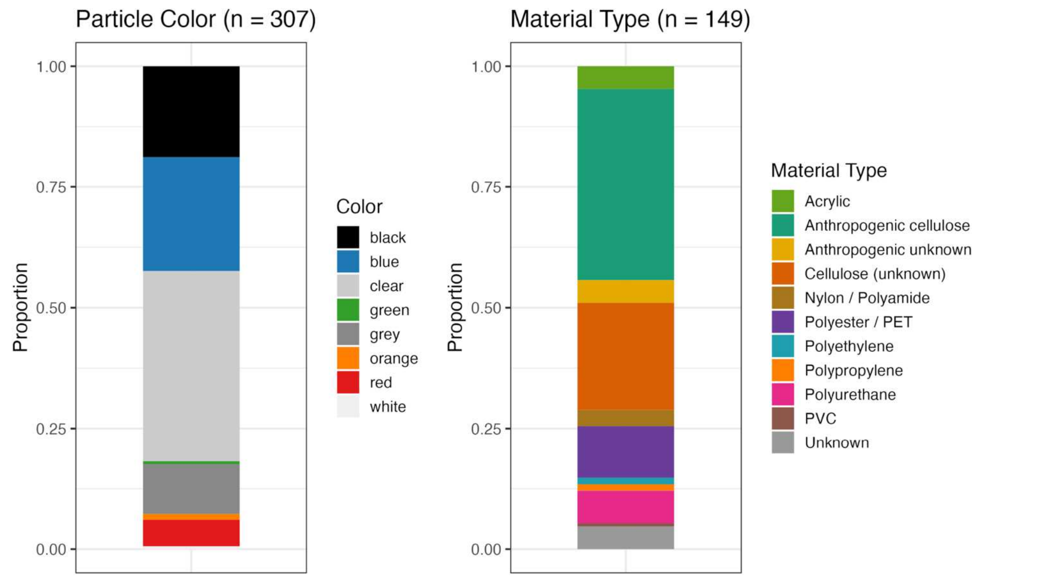

Figure 3. Microfiber color (left) of suspected anthropogenic microfibers ($n = 307$). Material type (right) was analyzed for a subset of microfibers ($n = 149$).

Six samples had the same particle counts in the samples as the blanks. One sample had a greater number of particles in the blank compared to the sample. In this case, the count was adjusted to zero. No particles were detected in four of the 19 blanks. Blank correction values, along with raw count data for blanks, samples, and all other raw data, are reported in the Supplementary Information.

Blank-corrected microfiber concentrations at each site ranged from 0.3 ± 0.6 particles/sample/day (mean ± SD, Site 6) to 13.3 ± 3.8 particles/sample/day (mean ± SD, Site 1). Both sites were for samples from the upwind sample positions. Converted to m^2, this translates to 207 ± 358 particles/m^2/day (mean ± SD) at Site 6 and 8,364 ± 2,390 particles/m^2/day (mean ± SD) at Site 1. Across all sites, the microfiber concentration was 5.5 ± 4.9 particles/sample/day (mean ± SD), or 3,459 ± 3,088 particles/m^2/day (mean ± SD).

Microfiber lengths ranged from 83 μm–7286 μm, although no significant differences were observed between site or sample position. Microfiber lengths for upwind samples measured 1094 μm ± 1274 μm (mean ± SD) and for downwind samples were 1280 μm ± 1082 μm (mean ± SD). Approximately 1% of fibers measured were >5000 μm. The most prevalent microfiber colors were clear (39%), blue (24%) and black (19%). Other colors included red, green, orange, and grey (figure 3).

A subset of microfibers ($n = 149$) was analyzed by Raman spectroscopy for material identification (figure 3). Overall, the most common material types were anthropogenic cellulose (40%) and cellulose unknown (22%). The most abundant confirmed polymers were polyester/PET (11%), polyurethane (7%), and acrylic (5%). Other polymers included nylon/polyamide (4%), PE, (1%), PP (1%) and PVC (1%).

3.2. Dryer vent emissions

The amount of lint captured via dryer vent exhaust from Laundromat 1 ($n = 7$) was 2.27 ±1.16 g lint/day (mean ± SD), and for Laundromat 2 ($n = 7$) was 1.31 ±0.77 g lint/day (mean ± SD) (figure 4). Since lint contains microfibers and other materials, we also aimed to calculate the count of microfibers in a known sample mass. The average microfiber count per mg of lint analyzed was 877 ± 381 microfibers per mg (mean ± SD) for Laundromat 1 ($n = 9$) and 1625 ± 734 microfibers per mg (mean ± SD) for Laundromat 2 ($n = 9$) (figure 5). The average count was 1251 ± 685 microfibers per mg (mean ± SD).

4. Discussion

4.1. Anthropogenic microfibers in atmospheric deposition

Our study provides some of the first empirical evidence that commercial laundromats are a source of airborne microfiber pollution. We found higher microfiber concentrations in downwind samples compared to upwind at multiple sites, suggesting localized emissions from dryer exhaust. Although differences were only statistically significant at three sites, most showed a directional trend with higher microfiber counts in downwind samples. This suggests that laundromats contribute to microfiber deposition in their immediate surroundings.

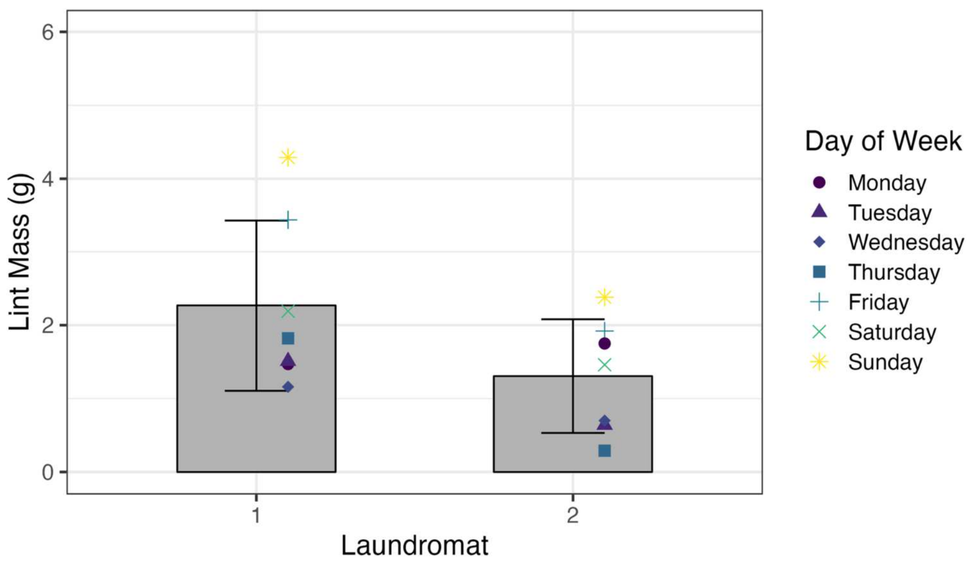

Figure 4. Mean weight (g) ($n = 7$) of lint captured via dryer vent exhaust over 24 h. Error bars represent standard deviation.

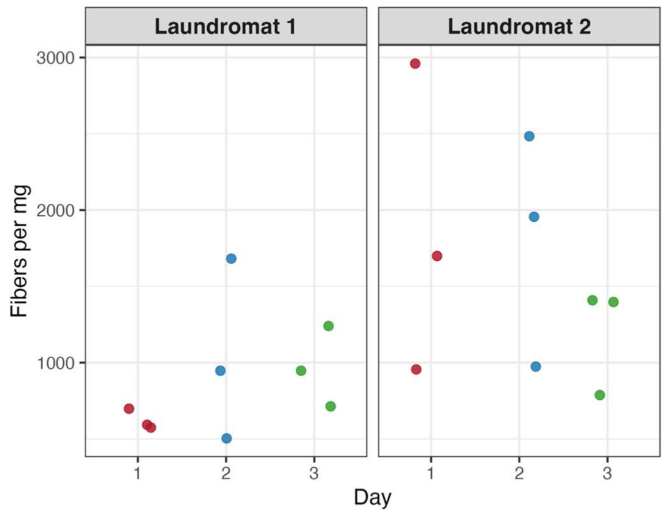

Figure 5. Count of microfibers per mg lint captured via dryer vent exhaust, by day and laundromat.

Cellulosic fibers were the most common material type in our samples, consistent with previous findings in San Francisco and globally. Our samples contained both natural and synthetic microfibers, but the majority were cellulosic. Approximately 60% of fibers were dyed, indicating anthropogenic modification. This aligns with findings from stormwater in San Francisco (Zhu *et al* 2021) and reflects broader global patterns (Athey and Erdle 2021). Approximately half of fibers in our study were 0.355–0.999 mm, consistent to microfiber lengths reported by Sutton *et al* (2016) and Zhu *et al* (2021), which could suggest common microfibers sources in our samples with microfibers found in stormwater and across other environmental compartments.

The high proportion of cellulosic materials may be due to textile construction, since cellulosic fibers often exhibit high shedding rates compared to synthetics. Shedding rates can be twice as high for cotton compared to polyester (Zambrano *et al* 2019), attributed to cotton's staple fiber, where individual fibers are spun together to form yarns. Due to their length, these fibers shed more easily during washing and drying compared to long filament fibers (Allen *et al* 2024). Spun yarn in some cases can be used for synthetics, such as soft garments (e.g., sweaters, socks), blends with natural fibers (e.g., cotton-polyester garments), and geotextiles (Ruppenicker *et al* 1989, Kothari 2008), although it is consistently used for cotton. The propensity of cotton to shed may help explain the large proportion of cellulosic fibers in our samples and other studies in San Francisco, despite the dominance of synthetic fibers in global textile production. It is estimated that in 2023, synthetics accounted for more than 65% of all fibers produced (Textile Exchange 2025), although only 30% of the fibers we identified were synthetic.

The presence of microfibers in all passive samplers, including upwind, aligns with a growing understanding that airborne microfiber pollution is widespread, especially in cities (Dris *et al* 2016, Li *et al* 2020). Still, the transport dynamics of microfibers are poorly understood. Li *et al* (2020) observed higher microfiber concentrations at 1.5 m above the ground compared to 18 m, suggesting fibers originate from ground-level sources and likely re-suspend. Smaller particles may resuspend more easily (Li *et al* 2020), increasing potential for inhalation for smaller size fractions. Furthermore, because passive samplers were deployed for ~24 h, spanning Saturday - Sunday, the deposition measured may represent an overestimation of typical emissions. Lint data revealed higher counts on weekends (Friday - Sunday), suggesting greater use during peak periods (see section, below).

In addition to dryers, other non-laundry sources of microfibers, including wear and waste-related products, may also contribute to airborne microfibers. Fibers from cigarette butts (Belzagui *et al* 2021), wet wipes (Ó Briain *et al* 2020), and regular wear of clothing (De Falco *et al* 2020) are found in the environment and may contribute to ambient microfiber loads. Our detection of microfibers in upwind samples suggests contributions from these and other background sources. Although sample sizes were limited, Sites 1–3, located in highly urbanized areas, had high microfiber deposition rates in upwind and downwind samples. This is consistent with broader research showing higher microfiber deposition in urban settings (Wright *et al* 2020), although the deposition rates we observed were high compared to other studies. Across all sites, the average microfiber deposition rate was 3,459 $\pm$ 3,144 particles/m^2/day (mean $\pm$ SD), with a maximum of 8,364 $\pm$ 2,390 particles/m^2/day (mean $\pm$ SD) — orders of magnitude greater than remote locations in Ireland (80 particles/m^2/day; Roblin *et al* 2020), Paris, France (110 $\pm$ 96 particles/m^2/day; Dris *et al* 2017), and Dongguan, China (175–313 particles/m^2/day; Cai *et al* 2017). Our use of double-sided adhesive tape for passive sampling may have resulted in higher particle counts compared to other sampling methods. Still, elevated rates suggest that sampling near commercial dryers could represent local hotspots for microfiber deposition. Many previously studied cities, where atmospheric deposition rates were lower, have lower reliance on vented dryers; for example, dryers are less common in China, Ireland, and France compared to the United States. Future studies could explore whether cities with widespread dryer use show systematically higher atmospheric microfiber deposition compared to cities where line drying or ventless dryers are more common.

Despite multiple potential sources, this study confirms commercial dryers as a point source of microfiber emissions. The higher microfiber counts observed in downwind samples, combined with quantifiable emissions from dryer vent exhaust demonstrates that commercial dryers contribute to airborne microfiber pollution. This emission pathway is especially relevant in urban areas, where atmospheric deposition may be an important pathway for environmental emissions.

4.2. Microfiber emissions from dryer exhaust

Dryer vent exhaust samples revealed that commercial dryers from laundromats emit a substantial number of microfibers. We captured 15.9 g of lint from Laundromat 1 and 9.1 g of lint from Laundromat 2 over the course of a week. Based on the ranges of 503–2960 microfibers per mg lint, this would equate to 8–47 million microfibers for Laundromat 1 and 4.6–27 million microfibers for Laundromat 2. If we estimate for 1 year, for the laundromats in our study, annually this would be 415 million–2.4 billion microfibers (Laundromat 1) and 239 million–7.2 billion microfibers (Laundromat 2). These results support previous findings that dryers release microfibers to air at rates that can rival washing machines (Kapp and Miller 2020, Tao *et al* 2022) and highlight the importance of commercial dryer emissions as a microfiber source — a source typically absent from current discussions on solutions.

The variation between laundromats may reflect differences in building infrastructure (e.g., vent length, dryer types, primary lint trap design), usage patterns, and cleaning frequency. Although we did not monitor these factors, they likely contribute to variability in emissions. Lint mass varied by sampling day, with higher lint volumes observed on weekends, likely due to greater laundry volume. While domestic laundry studies have shown differences in emissions based on machine type (Hartline *et al* 2016, Erdle *et al* 2021), similar comparative data are lacking for dryers. Cummins *et al* (2023) found that microfiber pathways can vary for condenser versus vented dryers since lint from condenser dryers may get washed down the drain, but the diversity of vented dryer systems, including commercial settings, remains underexplored. Future studies should investigate how operational factors — such as number of loads, machine type, and airflow — as well as usage patterns affect emissions.

Our mesh collection system (100 μm) captured microfibers, although it likely underestimated smaller fibers and particles. Previous research suggests that reducing mesh size — to, for example, 40 μm — can increase capture efficiency in dryers up to 35% (Lant *et al* 2022). Future work should evaluate the performance of primary and secondary lint traps across both household and commercial settings and assess whether integration into commercial systems is feasible and effective. If effective, filtration could yield significant reductions in airborne emissions and tackle a major microfiber source.

Although challenging to directly link the microfiber counts observed in dryer vent exhaust to atmospheric deposition rates measured at our passive samplers, these two sources are likely connected. These emissions, dispersed by wind, could be a primary source of airborne microfibers locally and in the region. Future research should explore the relationship between dryer emissions and local atmospheric microfiber deposition, including mass balance approaches that account for dispersion to better understand microfiber pathways and environmental fate.

5. Implications for policy

Our findings suggest that microfiber emissions from commercial dryers are nontrivial, which align with Kapp and Miller (2020) and Tao *et al* (2022), confirming dryers as a substantial microfiber source. If the average mass of lint and microfiber counts observed in our two laundromats are representative, scaled to the estimated 148 laundromats operating in San Francisco (Lindqwister 2023), annual emissions could be 35 trillion–1.1 quadrillion microfibers in San Francisco, which is and potentially on par with, or greater than, emissions from domestic laundering (Erdle *et al* 2021, Geyer *et al* 2022). Yet, these emissions are currently unregulated and unaccounted for in microfiber mitigation strategies.

Laundromats often serve families, students, and low-income households in dense cities, which must be considered in implementing mitigation strategies. Despite challenges faced by laundromats (e.g., closing in the face of rising rents), they also function as important community spaces. For example, *Laundry Cares* and *Too Small to Fail*, a partnership with the Laundry Cares Foundation (the charitable arm of the Coin Laundry Association), supports laundromats as literacy and art hubs for children (Hadani and Vey 2020). Laundromats may also have potential as hubs for environmental awareness, offering education on plastic pollution, air quality, and public health.

Governments and innovators rely on scientific data about pollution sources to prioritize solutions and policy interventions. For example, Browne *et al* (2011) linked the presence of microfibers on beaches near sewage outfalls to washing machine effluent, spurring the development of research on quantifying emissions from washing clothing. Filtration devices were developed and tested in the lab (e.g., Napper *et al* 2020, McIlwraith *et al* 2019) and at community scales (Erdle *et al* 2021), demonstrating their effectiveness and informing policies like the Fighting Fibers Act of 2024.

To date, much of the proposed regulation has focused on washing machines, although our results suggest there should be increased attention towards designing or retrofitting dryers with improved lint capture. Our study highlights the potential benefit of such measures at the commercial scale due to high levels of emissions. High-traffic laundromats could be a relatively easy way to concentrate these efforts. Future work should test filtration technologies across dryer types and scales. Given the magnitude of emissions observed here, effective dryer filtration may be an essential tool in broader microfiber pollution prevention.

Our findings expand on emission estimates from the San Francisco Estuary Institute (SFEI), which has estimated that trillions of microplastic particles, including microfibers, enter San Francisco Bay annually (Paterson *et al* 2024). While most research to date has focused on waterborne particles (Zhu *et al* 2021), our results suggest that airborne microfibers from dryers may represent an additional, underexplored pathway. These particles, due to being small and lightweight, may be carried long distances via air. This highlights the need for a more comprehensive understanding of microfiber pathways, including atmospheric transport and subsequent deposition in urban areas.

Textile design changes are also essential. Upstream strategies that reduce fiber shedding, such as textile redesign, have been recommended given the high rates of atmospheric deposition (Napper *et al* 2023). We support these recommendations and propose that dryer filtration may be an effective intervention that complements textile redesign, such as avoiding staple fibers or selecting low-shed materials. Filtration, however, may be an important stop gap or a useful for materials that have spun yarns and exhibit high rates of shedding (e.g., cotton). There is growing evidence that dyes and finishes can impact the persistence of cellulosic microfibers in the environment (Athey *et al* 2020, Zambrano *et al* 2021), and cause biological effects (Carney Almroth *et al* 2021). Increasingly, microfibers (including cellulosic microfibers) are also detected in human tissue such as lungs (Chen *et al* 2022, Jenner *et al* 2022). Filtration on dryers may be an effective intervention point to capture multiple microfiber types.

In conclusion, this study provides evidence that commercial dryers are a source of airborne microfiber pollution. Our results show significant differences in atmospheric deposition of microfibers downwind from laundromats compared to upwind. Analysis of lint samples from dryer exhaust also estimate that emissions from a single facility is in the millions of microfibers released each week. These findings identify an overlooked source of microfiber emissions and offer a new target for interventions. Future work is still needed to quantify relative contributions of all sources of microfibers to the environment, however, this work demonstrates that commercial dryers are a major source of microfiber emissions. Addressing these emissions through improved filtration systems, monitoring programs, and inclusive policies will be essential for mitigating microfiber pollution to mitigate risk for environmental and human health.

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Conflict of interest statement

The authors declare no conflicts of interest associated with this manuscript.

Data availability statement

All data that support the findings of this study are included within the article (and any supplementary files).

Data access statement

All data supporting the findings of this study are available in the Supplementary Information.

Ethics statement

This study did not involve human or animal subjects and did not require ethical approval.

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Author contributions

Lisa M Erdle 0000-0003-2942-6884
Conceptualization (equal), Data curation (equal), Formal analysis (equal), Funding acquisition (equal), Investigation (equal), Methodology (equal), Supervision (equal), Validation (equal), Visualization (equal), Writing – original draft (equal), Writing – review & editing (equal)

Victoria Fulfer 0000-0002-8468-4053
Writing – original draft (equal), Writing – review & editing (equal)

Lucinda Anderson 0009-0002-3048-7780
Data curation (equal), Investigation (equal), Writing – original draft (equal), Writing – review & editing (equal)

Win Cowger 0000-0001-9226-3104
Writing – original draft (equal), Writing – review & editing (equal)

Marcus Eriksen 0000-0001-9453-5492
Writing – original draft (equal), Writing – review & editing (equal)

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