Relevant research article summaries

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1. Athey, S.N. et al., 2020, *The Widespread Environmental Footprint of Indigo Denim Microfibers from Blue Jeans*, *Environmental Science Technology Letter*. doi: 10.1021/acs.estlett.0c00498

At any moment, approximately half of the world's population is wearing blue jeans and other denim garments. Microfibers comprised 87–90% of the anthropogenic particles found in sediments from the Canadian Arctic Archipelago, Laurentian Great Lakes, and shallow suburban lakes in southern Ontario. Of all microfibers in sediments, 21–51% were anthropogenically modified cellulose (AC), of which 40–57% were indigo denim microfibers (12–23% of all microfibers analyzed). AC microfibers were also found in rainbow smelt from the Great Lakes. This study found that one pair of used jeans can release $56,000 \pm 4100$ microfibers per wash. Microfibers from jean laundering were consistent in chemical composition and morphology with those found in the environment. Researchers concluded that blue jeans, the world's single most popular garment, are an indicator of the widespread burden of anthropogenic pollution by adding significantly to the environmental accumulation of microfibers from temperate to Arctic regions.

2. Wikswo, M. et al., 2020, *Characterizing Norovirus Transmission from Outbreak Data, United States*, *Emerging Infectious Diseases*, 26(8): 1818–1825.

Researchers estimated the basic (R_0) and effective (R_e) reproduction numbers for 7094 norovirus outbreaks reported to the National Outbreak Reporting System (NORS) during 2009–2017 and used regression models to assess whether transmission varied by outbreak setting. The median R_0 was 2.75, and median R_e was 1.29. Long-term care and assisted living facilities had an R_0 of 3.35, but R_0 did not differ substantially for outbreaks in other settings, except for outbreaks in schools, colleges, and universities, which had an R_0 of 2.92. Seasonally, R_0 was lowest (3.11) in summer and peaked in fall and winter. Overall, there was little variability in transmission across different outbreak settings in the United States.

3. Matrajt, L. and Leung, T., 2020, *Evaluating the Effectiveness of Social Distancing Interventions to Delay or Flatten the Epidemic Curve of Coronavirus Disease*, *Emerging Infectious Diseases*, 26(8): 1740–17485.

A mathematical model was used to investigate the effectiveness of social distancing interventions in a mid-sized city. Interventions reduced contacts of adults >60 years of age, adults 20–59 years of age, and children <19 years of age for 6 weeks.

Results suggested interventions started earlier in the epidemic delayed the epidemic curve and interventions started later flattened the epidemic curve. Researchers noted that, while social distancing interventions were in place, most new cases, hospitalizations, and deaths were averted, even with modest reductions in contact among adults. However, when interventions ended, the epidemic rebounded. Models suggested that social distancing can provide crucial time to increase health care capacity but must occur in conjunction with testing and contact tracing of all suspected cases to mitigate virus transmission.

4. Xiao, F. et al., 2020, *Infectious SARS-CoV-2 in Feces of Patient with Severe COVID-19*, *Emerging Infectious Diseases*, 26(8): 1920–1922.

Severe acute respiratory syndrome coronavirus 2 was isolated from feces of a patient in China with coronavirus disease who died. Confirmation of infectious virus in feces affirms the potential for fecal–oral or fecal–respiratory transmission and warrants further study.

5. Liu, Y. et al., 2020, *Survival of toxigenic Escherichia coli on Chamomile, Peppermint, Green, Black, Ginger, and Cinnamon Teas during Storage and Brewing*, *Journal of Food Safety*, 40(5): e12831.

Persistence of toxigenic *E. coli* on dried chamomile, peppermint, ginger, cinnamon, black, and green teas stored under 4, 10, and 25°C was determined. The *E. coli* survival rate in ginger and cinnamon teas decreased below 0 on Day 5. In the other tested teas, *E. coli* survivability showed a downward trend over time, but never dropped to 0. Chamomile tea retained the greatest population of viable *E. coli*. *E. coli* die-off was higher at 25°C compared with lower temperatures. The *E. coli* population was reduced to below 2 Log CFU/g after 1 minute at 80°C. *E. coli* survival at 60°C was higher than that at 70°C in all tested teas. The data indicated that if *E. coli* survives after storage, it may also survive and grow after the brewing process, especially if performed using temperatures <80°C.

6. Lau, W.W. et al., 2020, *Evaluating Scenarios toward Zero Plastic Pollution*, *Science*, 369(6510): 1455–1461.

To estimate the effectiveness of interventions to reduce plastic pollution, researchers modeled stocks and flows of municipal solid waste and four sources of microplastics through the global plastic system for five scenarios between 2016 and 2040. Implementing all feasible interventions reduced plastic pollution by 40% from 2016 rates and 78% relative to “business as

usual" in 2040. Even with immediate and concerted action, 710 million metric tons of plastic waste cumulatively entered aquatic and terrestrial ecosystems. To avoid a massive build-up of plastic in the environment, coordinated global action is urgently needed to reduce plastic consumption; increase rates of reuse, waste collection, and recycling; expand safe disposal systems; and accelerate innovation in the plastic value chain.

7. Hrubec, T.C. et al., 2020, *Altered Toxicological Endpoints in Humans with Quaternary Ammonium Compound Exposure*, British Medical Journal. doi: 10.1101/2020.07.15.20154963

Quaternary Ammonium Compounds (QACs) are ubiquitously used in medical settings, restaurants, and homes as cleaners and disinfectants. They are also used on food and in personal care products as preservatives. Chronic QAC toxicity was recently identified in mice and resulted in developmental and reproductive deficits and altered immune function. Cell-based studies show that QACs increase inflammation, disrupt cholesterol synthesis, and decrease mitochondria function. Testing of the blood of 43 random volunteers found QAC in 80% of study participants and were associated with decreased mitochondrial function and an increase in inflammatory cytokines in a dose-dependent manner. Cholesterol synthesis pathway intermediaries were generally increased, indicating disruption in cholesterol homeostasis. This is the first study to demonstrate that chronic exposure to QACs results in measurable concentrations in human blood, and it showed significant correlations between QAC level and meaningful biomarkers related to health.

8. Ribeiro, F. et al., 2020, *Quantitative Analysis of Selected Plastics in High-Commercial-Value Australian Seafood by Pyrolysis Gas Chromatography Mass Spectrometry*, Environmental Science & Technology, 54: 9408–9417.

Microplastic contamination of the marine environment is widespread, but the extent to which the marine food web is contaminated is not yet known. Pyrolysis gas chromatography mass spectrometry was used in this study for the identification and quantification of polystyrene, polyethylene, polyvinyl chloride, polypropylene, and poly(methyl methacrylate) in the edible portion of five different seafood organisms: oysters, prawns, squid, crabs, and sardines. Polyvinyl chloride was detected in all samples and polyethylene at the highest total concentration of between 0.04 and 2.4 mg/g of tissue. Sardines contained the highest total plastic mass concentration (0.3 mg/g tissue) and squid the lowest (0.04 mg/g tissue). Findings showed that the total concentration of plastics is highly variable among species and that microplastic concentration differs between organisms of the same species.

9. Li, L., et al., 2020, *Effective Uptake of Submicrometre Plastics by Crop Plants via a Crack-Entry Mode*, Nature Sustainability, 3: 929–937.

Most microplastics are emitted, either directly or via the degradation of plastics, to the terrestrial environment and accumulate in large amounts in soils, representing a potential threat to terrestrial ecosystems. Researchers analysed the uptake of different microplastics by wheat and lettuce from treated wastewater in

hydroponic cultures and in sand matrices or a sandy soil. Results provided evidence in support of submicrometre- and micrometre-sized polystyrene and polymethylmethacrylate particles penetrating the stele of both species using the crack-entry mode at sites of lateral root emergence. This crack-entry pathway and features of the polymeric particles lead to the efficient uptake of submicrometre plastic. The plastic particles were subsequently transported from the roots to the shoots. Higher transpiration rates enhanced the uptake of plastic particles, showing that the transpirational pull was the main driving force of their movement. Study findings shed light on the modes of plastic particle interaction with plants and have implications for crops grown in fields contaminated with wastewater treatment discharges or sewage sludges.

10. Schullehner, J. et al., 2020, *Exposure to Manganese in Drinking Water during Childhood and Association with Attention-Deficit Hyperactivity Disorder: A Nationwide Cohort Study*, Environmental Health Perspectives, 128(9): 097004-1.

In a nationwide population-based registry study in Denmark, researchers followed a cohort of 643,401 children born 1992–2007 for clinical diagnoses of ADHD. Mn measurements from 82,574 drinking water samples were used to estimate longitudinal exposure during the first 5 years of life. Study found that exposure to increasing levels of Mn in drinking water was associated with an increased risk of ADHD-Inattentive subtype, but not ADHD-Combined subtype. After adjusting for age, birth year, and SES, females exposed to high levels of Mn (i.e., >100 µg/L) at least once during their first 5 years of life had an HR for ADHD-Inattentive subtype of 1.51 and males of 1.20 when compared with same-sex individuals exposed to <5 µg/L. When modeling exposure as a time-weighted average, sex differences were no longer present.

11. Tian, H. et al., 2020, *A Comprehensive Quantification of Global Nitrous Oxide Sources and Sinks*, Nature, 586: 248–256.

Nitrous oxide (N₂O), like carbon dioxide, is a long-lived greenhouse gas that accumulates in the atmosphere. Over the past 150 years, increasing atmospheric N₂O concentrations have contributed to stratospheric ozone depletion and climate change, with the current rate of increase estimated at 2% per decade. Researchers presented a global N₂O inventory that incorporates both natural and anthropogenic sources and accounts for the interaction between nitrogen additions and the biochemical processes that control N₂O emissions. Bottom-up (inventory, statistical extrapolation of flux measurements, process-based land and ocean modelling) and top-down (atmospheric inversion) approaches were used to provide a comprehensive quantification of global N₂O sources and sinks resulting from 21 natural and human sectors between 1980 and 2016. Global N₂O emissions were 17.0 teragrams of nitrogen/year (bottom-up) and 16.9 teragrams of nitrogen/year (top-down) between 2007 and 2016. Global human-induced emissions, which are dominated by nitrogen additions to croplands, increased by 30% over the past four decades to 7.3 teragrams of nitrogen/year. This increase was mainly responsible for the

growth in the atmospheric burden. Study findings point to growing N₂O emissions in emerging economies, particularly Brazil, China, and India.

12. Li, D. et al., 2020, *Microplastic Release from the Degradation of Polypropylene Feeding Bottles during Infant Formula Preparation*, *Nature Food*, 1: 746–754.

Polypropylene-based products are commonly used for food preparation and storage, but their capacity to release microplastics is poorly understood. Researchers investigated the potential exposure of infants to microplastics from consuming formula prepared in polypropylene (PP) infant feeding bottles (IFBs). This study showed that PP IFBs release microplastics with values as high as 16,200,000 particles per litre. Scenario studies showed that PP IFB sterilization and exposure to high-temperature water significantly increase microplastic release. To estimate the potential global exposure to infants up to 12 months old, we surveyed 48 regions, finding values ranging from 14,600 to 4,550,000 particles per capita per day, depending on the region. This study demonstrated that infant exposure to microplastics is higher than was previously recognized due to the prevalence of PP-based products used in formula preparation and highlights an urgent need to assess whether exposure to microplastics at these levels poses a risk to infant health.

13. Goulter, R.M. et al., 2020, *Characterizing Microbial Cross-Contamination on Large Surfaces Using a Traditional “Cloth and Bucket” Disinfection Method*, *Food Protection Trends* 40(6): 392–401.

The use of buckets containing soiled disinfectant solutions for disinfection is regularly practiced in food service and other settings. This study characterized microbial transfer of vegetative bacteria (*Listeria innocua* and *E. coli*), spores (*Bacillus cereus*), and a virus (MS2 bacteriophage), to large surfaces, using a “cloth and bucket” method with a commonly used quaternary-ammonium compound (QAC) disinfectant (with or without 5% soil) and a phosphate-buffered-saline (PBS) control. With disinfectant (with or without soil), there was little

transfer of vegetative bacteria. Transfer occurred readily with the PBS control (4.8 ± 1.0 and 3.3 ± 0.9 log CFU/surface for *Listeria innocua* and *E. coli*, respectively). Spores were transferred efficiently, regardless of whether PBS or QAC was used or whether test was with or without soil. MS2 bacteriophage appeared to be eliminated relatively quickly. When the QAC did not inactivate the organism (regardless of soil load), high microbial loads (>87.9% of initial inoculum) were detected in the bucket solution after wiping experiments. This study suggests that reusable cloth can potentially promote contamination of surfaces, sometimes in the presence of disinfectant.

14. Tan, C. et al., 2020, *Hexavalent Chromium Release in Drinking Water Distribution Systems: New Insights into Zerovalent Chromium in Iron Corrosion Scales*, *Environmental Science & Technology* 54(20): 13036–13045.

When cast iron corrosion pipe is in contact with residual disinfectants, drinking water distribution systems have become potential geogenic sources for hexavalent chromium Cr(VI) release. The presence of bromide in drinking water significantly accelerated Cr(VI) release because of its catalytic effect. Findings from this study point to a previously unknown but important pathway of Cr(VI) formation in drinking water, that is, direct oxidation of Cr(0) by chlorine, and suggest new strategies to control Cr(VI) in drinking water by inhibiting Cr(0) reactivity.

15. Marshall, K.E. et al., 2020, *Lessons Learned from a Decade of Investigations of Shiga Toxin-Producing E. coli Outbreaks Linked to Leafy Greens, US and Canada*, *Emerging Infectious Diseases*, 26(10): 2319–2328.

Leafy greens are the second most common source of foodborne STEC O157 outbreaks after ground beef. During 2009–2018 in the US and Canada, 40 outbreaks, 1212 illnesses and 77 cases of hemolytic uremic syndrome and 8 deaths were identified. More outbreaks were linked to romaine lettuce (54%) than to any other type of leafy green. More outbreaks occurred in the fall (45%) and spring (28%) than in other seasons.