Characterization of Exposure Potential during Activities on Synthetic Turf Fields with Recycled Tire Crumb Rubber Infill

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CDC ATSDR

Background

- **FRAP Exposure Characterization Component**
  - Estimate *nature, duration, and frequency* of exposure for those who regularly use synthetic turf fields containing tire crumb
    - Gather human activity data for synthetic field users
    - Develop and apply methods for measuring exposure
    - Collect field environment measurements relevant for exposure through inhalation, dermal, and ingestion pathways
    - Take personal exposure measurements
    - Conduct studies in warmer months, if possible

Background and Purpose

- **The literature review and data gaps analysis identified several exposure-specific data gaps.**
  - Limited research on human exposure assessment
  - Limited characterization of dermal and ingestion exposure pathways
  - Limited biomonitoring studies
  - Small sample sizes
  - No epidemiological studies

- **Purpose: Characterize exposures or how people are exposed to chemical compounds found in recycled tire crumb rubber based on their activities on synthetic turf fields**

Research Activity Aims

- In order to characterize potential exposure patterns, ATSDR and EPA are conducting a pilot-scale exposure characterization study and an exposure measurements sub-study.
  - Aim 1: Collect human activity data for synthetic turf field users that will reduce the reliance of default exposure factor assumptions in exposure and risk assessment.
  - Aim 2: Conduct an exposure measurement sub-study for people using synthetic turf fields with tire crumb rubber infill, to improve understanding of potential exposures, particularly for the dermal and ingestion exposure pathways.

Exposure Characterization Research Activities

- Bioaccessibility of tire crumb constituents
- Athlete micro-activity data gathering from publicly available video
- Exposure pathway modeling (using literature data and data from the Tire Crumb Rubber Characterization Study)

Pilot Measurement Field Study

- Field user activity questionnaires
- Video recording during play/practice on fields
- Exposure measurements during play/practice on fields

Exposure Characterization Study Implementation

Apr 2016	• Research protocol approved, including review at 4 federal agencies and external peer review
July 2016	• CDC IRB approval received
June 2017	• CDC IRB continuation approval received
July 2017	• Pre-pilot testing complete
August 2017	• SOPS and QAPPS complete
August 2017	• OMB approval received; Participant recruitment and sampling initiated

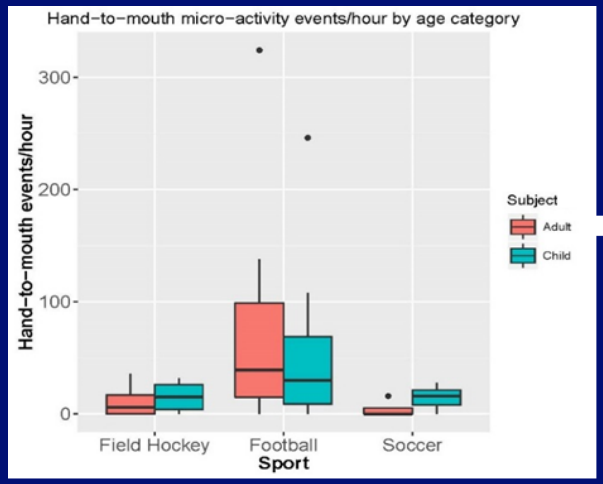
Exposure Characterization Methods

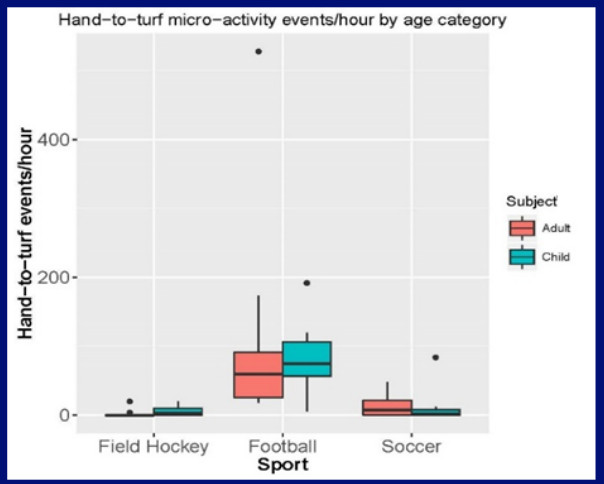
- **Extant public video**
  - 30 hours for adults/children for soccer, football, field hockey
  - Extract frequency for exposure-related contacts
- **Bioaccessibility**
  - *In vitro* bioaccessibility testing of metals and SVOCs in 82 tire crumb rubber samples using artificial bio-fluids
    - Saliva, gastric fluid, and sweat
  - Estimate oral and dermal bioavailability using bioaccessibility testing data
- **Exposure Characterization Questionnaire**
  - Administer an activity-based questionnaire to participants (must be >7 years of age)
- **Field Measurement Study Age groups and sporting types**
  - Adults, adolescents, youth, and children (must be >7 years of age)
  - Based on participating fields activity schedules (soccer, football)
- **Video exposure characterization participants during active play**

Preliminary Example Result for Athletes' Exposure-Related Activities

Activity Events per Hour - Differences Between Sports

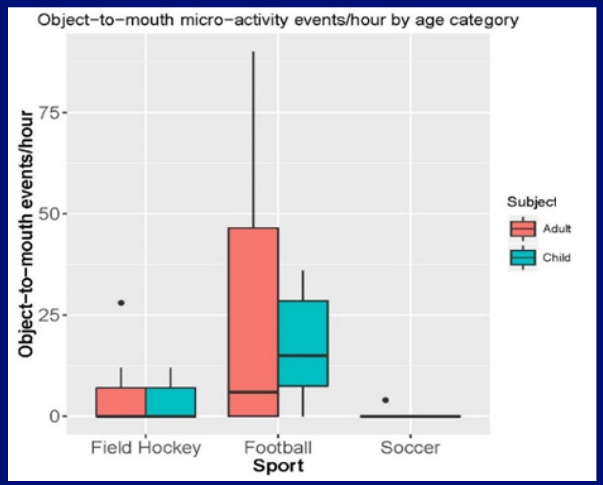
Hand-to-Mouth

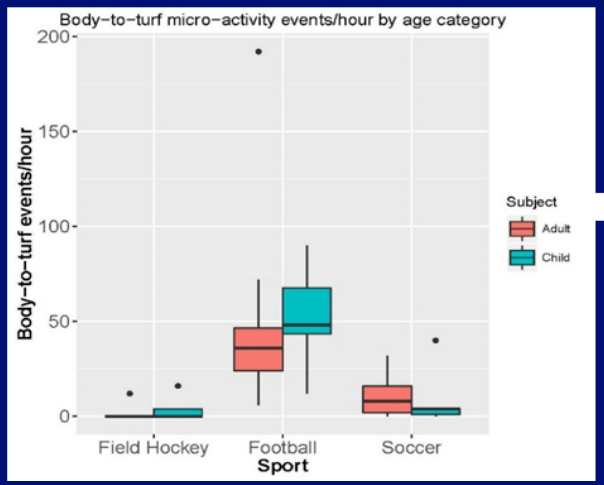




Hand-to - Turf

Object-to-Mouth





Body–to-Turf

See ISES 2017 Poster: Hibbert, Morgan, Grissom, Utile. *Athletes' Selected Micro-Activities on Turf Fields: Utilizing Extant Videography for Quantification of Events During Soccer, American Football, and Field Hockey Play*

Bioaccessibility Testing Methods

Preparation of artificial biofluids

- Saliva, sweat, sebum, and gastric fluid

Dissolution of tire crumb rubber in artificial biofluids

- Aqueous extract for metals
- Organic extract for SVOCs

Analytical measurements of metals and SVOCs in extracts

- Metals (except for mercury): acid digestion (EPA 3010), ICP-MS (EPA 6020)
- Mercury: acid digestion and cold vapor atomic absorption (EPA 7470)
- SVOCs: GC/MS (EPA 8270)

Calculation of the in vitro percent bioaccessibility

- Calculate the bioaccessible amount of each analyte in each biofluid
- Divide the bioaccessible amount by the concentration of the corresponding analyte in the tire crumb sample and multiply by 100

Exposure Measurements Sub-Study Methods

- Subset of exposure characterization participants
  - Target sample size of 45
  - Three participating fields
  - Two activity types

Personal samples

- Passive Air VOCs (continuous during play)
- Post-activity dermal wipe sample collection
  - Dermal SVOCs
  - Dermal metals

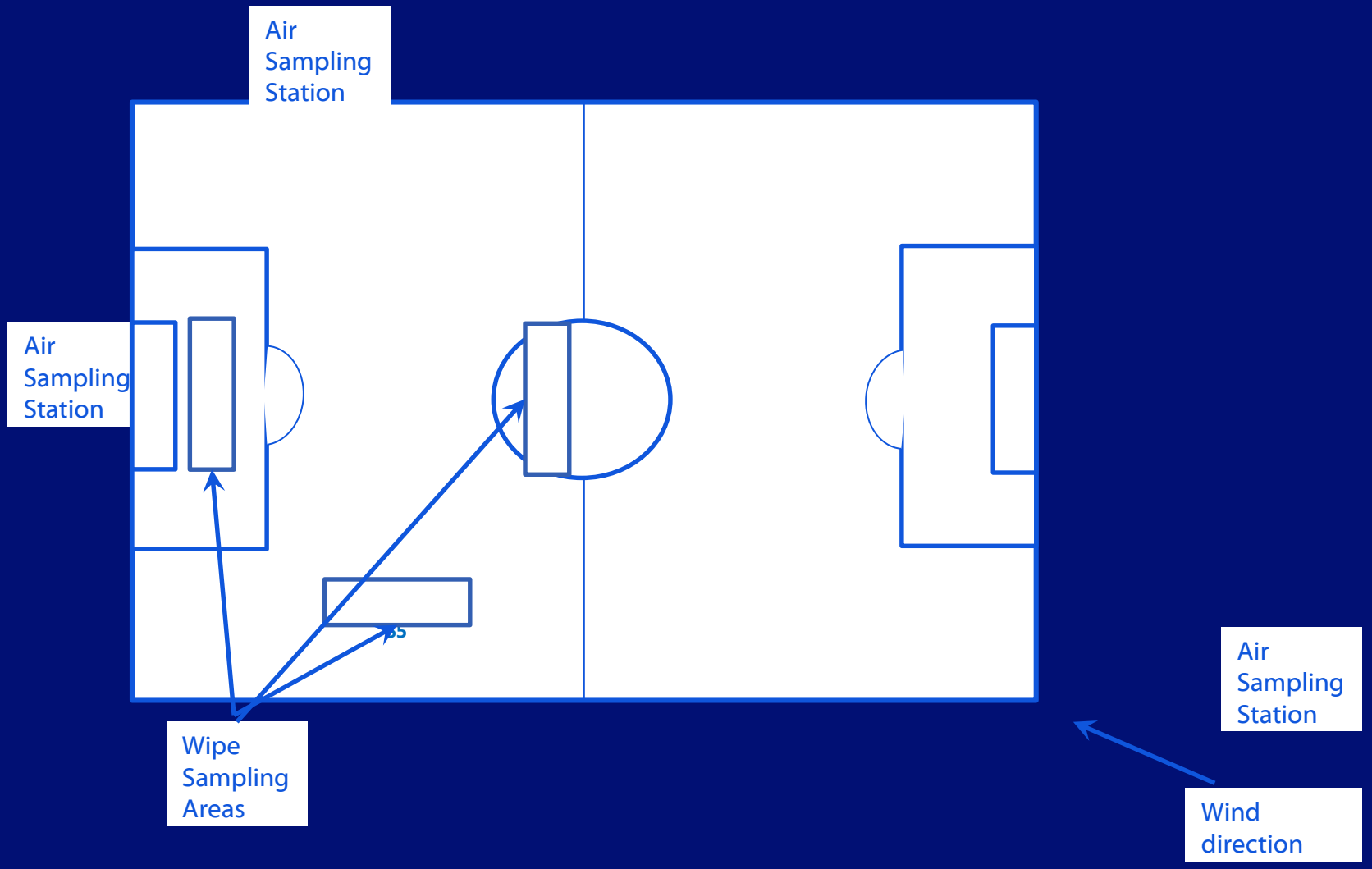
Biological samples

- Pre and post-activity sample collection
- Blood metals
- Serum metals
- Urine analytes TBD

Facility samples

- Air VOCs and SVOCs
- Air particle/metals
- Surface wipe metals
- Surface wipe SVOCs
- Surface drag sled SVOCs
- Dust characterization
- Dust metals
- Dust SVOCs

Field Measurements Example Set-Up



Exposure Measurements – Field Environment

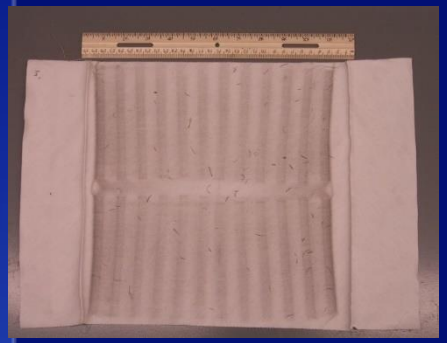
Air Samples

- Next to field and upwind sites
- Total suspended particulates
- Metals
- SVOCs
- VOCs (active + passive)

Field Surface Wet Wipe Samples

- Metals - Ghost Wipes
- SVOCs – Cotton twill with 1:1 isopropanol/water

Exposure Measurements Field Environment



Drag Sled Samples

- For 'transferrable' SVOC residues
- Standardized weight/pressure

Field Dust Samples

- Metals and SVOCs
- On-field sieving of surface tire crumb
- 150 µm sieve

Exposure Measurements Personal Samples

Passive Air VOC Samples

- Radiello passive samplers with Carbopack X

Dermal Wipe Samples

- Hands – total surface
- Arms & Legs using defined area templates
- Metals using Ghost wipes
- SVOCs twill wipes w 1:1 isopropanol/water

Urine and Blood Samples

- Pre- and Post-Activity samples
- Analytes to be determined

Study Status

- **Field and participant recruitment initiated August 5, 2017**
- **Sample collection initiated September 11, 2017**
  - Exposure characterization participants (as of October 10, 2017)
    - Questionnaire n=32
    - Exposure measurements sub-study n=25
    - Video n=17
- **Final report anticipated to be released in 2018**

Study Challenges

- **Logistical challenges**
  - Field locations and access to fields
  - Field facilities (electrical outlets, bathrooms, etc.)
  - Practice schedules
  - Equipment transport
  - Weather
- **Recruitment challenges**
  - Recruitment timeline
  - Access to potential participants
  - Willingness to participate in all aspects of the exposure measurements sub-study
- **Method challenges**
  - Method complexity/simplicity
  - Efficiency of method implementation
  - Low detection limits needed
  - Urine and blood collection

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Questions?