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Athletes' Selected Micro-Activities on Turf Fields: Utilizing Extant Videography for Quantification of Events During Soccer, American Football, and Field Hockey Play

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Background

- Concerns regarding potential exposure to toxicants from the fields athletes play on have been raised (both synthetic and natural fields).
- Previous research has shown that micro-activities (i.e., hand-to-mouth and skin-to-surface contacts) are important factors in people's exposures to chemicals in outdoor settings.
- However, no published data have been identified for exposure-related micro-activities of athletes engaged in various sports on synthetic turf fields.
- The objective of this study was to quantify the frequency of micro-activity events/hour by athletes playing on synthetic and natural fields using publicly available videos (soccer, American football, & field hockey).
- Micro-activities of interest include:
 - Hand-to-mouth contact
 - Object-to-mouth contact
 - Hand-to-turf contact
 - Body-to-turf contact

Methodology

Extant video collection and coding:

- Social Media (YouTube) was systematically mined for extant videos.
- EPA technicians randomly searched and found publicly available videos of children ($n = 30$) and adults ($n = 30$) playing soccer, field hockey, or football, on natural or synthetic turf fields (indoor/outdoor).
- Videos selected and examined were required to have high-quality resolution to allow a researcher to observe, code, and record selected micro-activity events of athletes for a minimum of 15-minutes (soccer/field hockey) or 10-minutes (football).
- Frequencies for micro-activities were normalized to event[s] per hour.
- EPA technicians coded the videotapes for playing field characteristics and player demographics (Table 1).
- Videotapes with < 8 activities were coded twice.
- 3 technicians trained together/individually for 3 days each.
- Technicians tested (3x) for consistency in recording/coding.
- Random cross-checking of each technician's video coding.

Analysis:

R Studio with R version 3.1.2 (2014-10-31).

Descriptive Statistics:

- Means, SDs, Ranges.
 - Demographic frequencies.
 - Micro-activity frequencies.
- ### Inferential Statistics:
- Differences b/w gender, age, sport type for micro-activities.
 - T-tests and ANOVAs.

Table 1: Characteristics of athletes & field conditions

Characteristics	Attributes	Number	Percentage
Subject	Child	30	50.0%
	Adult	30	50.0%
Sex	Male ^a	38	63.3%
	Female	22	36.7%
Mouthguard	Yes	32	53.3%
	No	28	46.7%
Gloves	Yes ^b	22	36.7%
	No	38	63.3%
Field Location	Indoor	19	31.7%
	Outdoor	41	68.3%
Field Type	Natural	6	17.6%
	Synthetic	28	82.4%

^a Males were only sex observed playing football on selected videos.

^b For athletes that wore gloves, 18.2% ($n = 4$) wore only one glove.

Results

- Results of independent t-tests showed no significant differences in frequencies of micro-activity events depending on type of field:
 - Natural vs. Synthetic
 - Indoor vs. Outdoor
- Results of independent t-tests determining if age (child/adult) influenced event frequency, showed no significant differences per micro-activity by age.
- ANOVA results indicated that athletes (children and adults combined) had significant differences ($p < .001$) in frequencies of micro-activity behavior (hand-to-mouth, hand-to-object, hand-to-turf, and body-to-turf), influenced by sport (Figure 1).
- Tukey *post-hoc* analysis indicated that football had significantly more hand-to-mouth, object-to-mouth, hand-to-turf, and body-to-turf micro-activity events/hour than either field hockey or soccer (which did not differ from each other).

Micro-activity events/hour for children by sport type

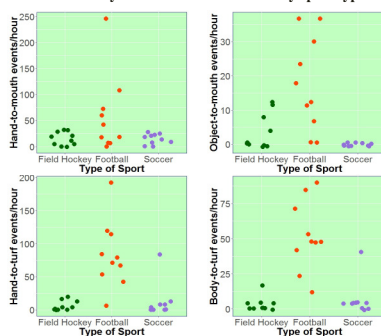


Figure 2: ANOVA: micro-activity event/hour for children by sport type

- After stratifying for age, ANOVA results indicated that children had significant differences ($p < .001$) in frequencies of micro-activity behavior depending on the sport for object-to-mouth, hand-to-turf, and body-to-turf; however hand-to-mouth frequencies were not significantly different depending on type of sport ($p = .058$) (Figure 2).
- Adults had significant differences in frequencies of micro-activity behavior depending on the sport for hand-to-mouth ($p = .021$), object-to-mouth ($p = .020$), hand-to-turf ($p = .024$), and body-to-turf ($p = .005$) (Figure 3).

Micro-activity events/hour by sport type (adults & children combined)

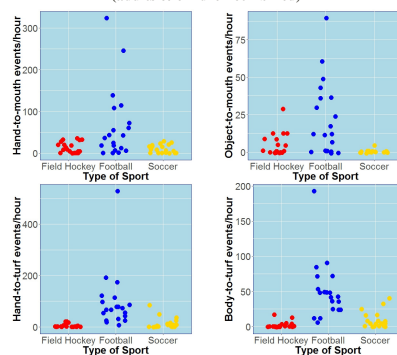


Figure 1: ANOVA: micro-activity event/hour by sport type (All ages)

Micro-activity events/hour for adults by sport type

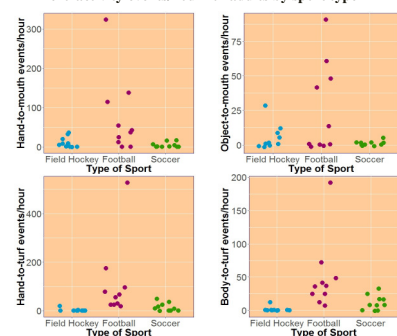


Figure 3: ANOVA: micro-activity event/hour for adults by sport type

Results

- Athletes wearing gloves ($n = 22$, 10.45 ± 16.68) had significantly fewer hand-to-mouth events than those not wearing gloves ($n = 38$, 40.32 ± 67.22); $t(44.40) = 2.60$, $p = .012$ (Figure 4).
- No significant difference in the hand-to-turf events between those wearing gloves ($n = 22$, 59.45 ± 118.36) and those not wearing gloves ($n = 38$, 25.00 ± 34.13); $t(23.04) = 1.33$, $p = .195$ (Figure 4).

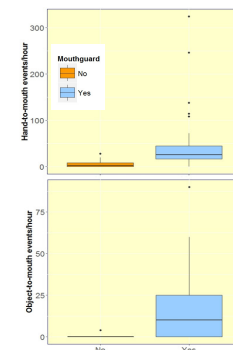


Figure 5: Mouthguard use and micro-activity events/hour t-test results

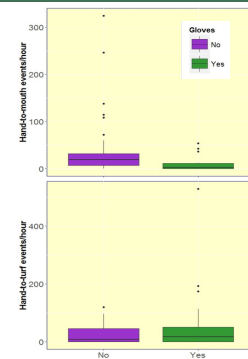


Figure 4: Glove usage and micro-activity events/hour t-test results

- Players who wore mouthguards ($n = 32$, 50.13 ± 70.55) had significantly more hand-to-mouth events than those who did not wear mouthguards ($n = 28$, 5.64 ± 7.74); $t(31.85) = 3.54$, $p = .001$ (Figure 5).
- Independent t-test results also showed significant differences in object-to-mouth events between those who wore mouthguards ($n = 32$, 16.06 ± 21.06) and those who did not ($n = 28$, 0.14 ± 0.76); $t(31.09) = 4.27$, $p < .001$ (Figure 5).

Discussion

- Results suggests that the type of sport played may have greater impact on exposure to chemicals than age or field type.
- Extant videography was shown to be a successful method of data collection and analysis of athlete micro-activity behavior:
 - Type of field (either indoor/outdoor or natural/synthetic) does not effect micro-activity frequency.
 - Age of participant does not effect micro-activity frequency.
 - Mouthguard use, glove use, and type of sport had significant influences over micro-activity events.
- Based on study observations, future analysis should consider:
 - Accounting for temporal trends in player or sport.
 - Measurement and analysis of player positions for effects.

Disclaimer: Although this work was reviewed by U.S. EPA and approved for publication, it may not necessarily reflect official Agency policy. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

This research was designed in response to concerns about tire crumb infill on synthetic-turf athletic fields. The U.S. EPA, the CDC and Consumer Product Safety Commission created the tri-agency research project: Federal Research Action Plan on Recycled Tire Crumb Used on Playing Fields and Playgrounds.