

# Differences in Concussion Diagnosis by Sex and Age Group in a General Population.

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## Background

- Concussions are a type of traumatic brain injury that can affect brain function and are most commonly caused by falls and contact sports.
- Studies focused on college-aged athletes have found female athletes have a significantly higher risk of concussion diagnosis than their male counterparts. However, little is known about these differences with respect to the general population.<sup>1-3</sup>
- According to a 2019 systematic review, research examining sex differences in concussion risk is a relatively new area of study and it is important to study this outside of the sports concussion domain.<sup>4</sup>

## Objective

- The objective of this study was to evaluate if the sex trend in concussion diagnosis seen in college-aged athletes exists in a general population.

## Methods

### Study Design and Patients

- This study employed a retrospective observational cohort design within the MarketScan® Commercial and Medicare Databases, using data from January 1, 2018 through December 31, 2020.
- Patients were included in the current study if they had continuous enrollment in the database from January 1, 2018 - December 31, 2019 and were between the ages of 14-65 on January 1, 2018.

### Outcomes

- Prevalent concussion during the time period of interest was identified as any ICD-10 diagnosis code for concussion in the inpatient or outpatient setting.
- As a secondary outcome, a subset of patients with at least 12 months of follow-up after the first concussion were examined to determine what proportion of those patients had claims evidence of concussion at least 30 days after the index concussion.

### Statistical Analyses

- Patients were identified in the MarketScan data using MarketScan Treatment Pathways, an online analytic platform.
  - Treatment Pathways allows users to identify cohorts of interest using claims data (Figures 1 and 2).
  - Patients were stratified by sex, as well as age group (14-17 (high school aged), 18-23 (college aged), and 24-65 years (post-college aged)).
- Demographic characteristics among those with concussion during the study period and the total study population were described using Treatment Pathways reports.
- Prevalence of concussion was calculated and compared statistically across sexes within each age-group.
- Among those with concussion and continuous enrollment 12 months following the index concussion, the proportion with evidence of concussion ≥30 days after the index concussion was calculated and compared statistically (Figure 3).

## Results

### Demographic Information

- Of the approximately 9.4 million patients included in this study, 8.1% were between the ages of 14-17, 12.4% were between the ages of 18-23, and 79.5% were between the ages of 24-65. 48.7% were male, 47.8% lived in the South, and 87.8% lived in an urban county (Table 1).
- A total of 66,098 had a claim associated with concussion diagnosis during the study period. Over half (56%) of the patients with concussion diagnosis were female (Table 1).

Figure 1. Pathway to Identify Eligible Patients in the Study Period

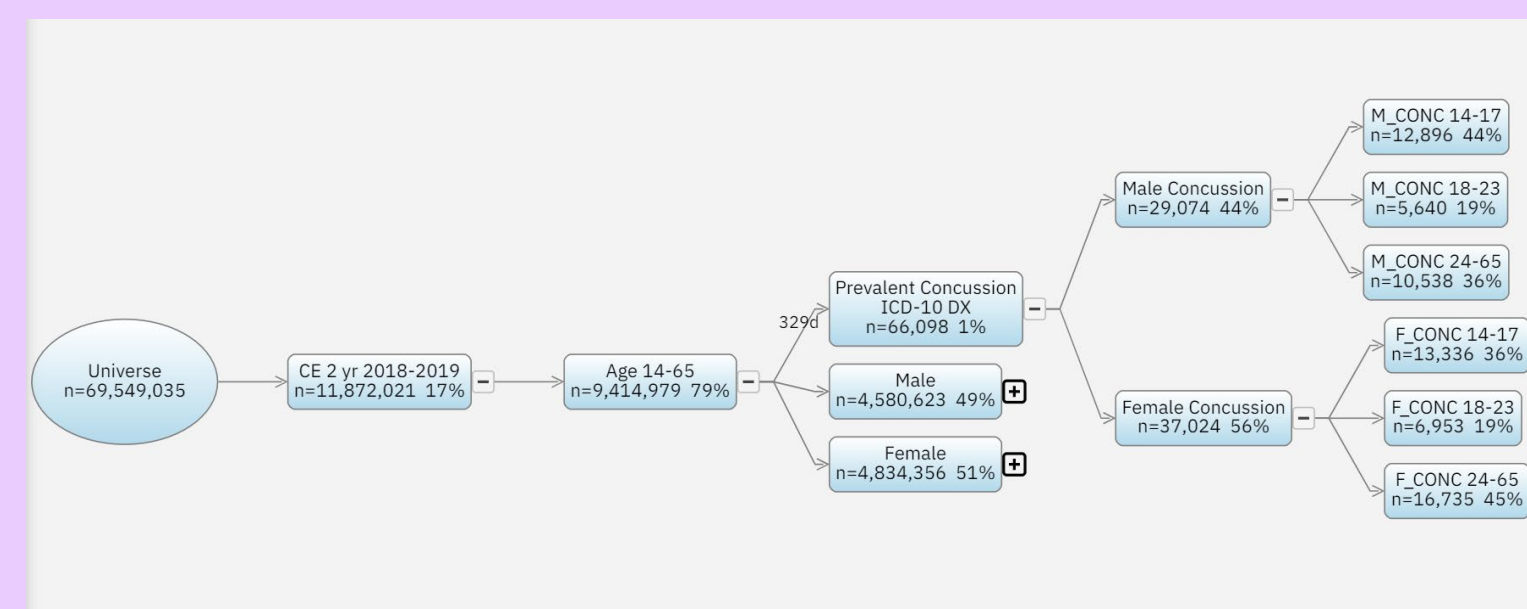


Figure 2. Pathway to Identify Patients with Concussion between 2018-2019

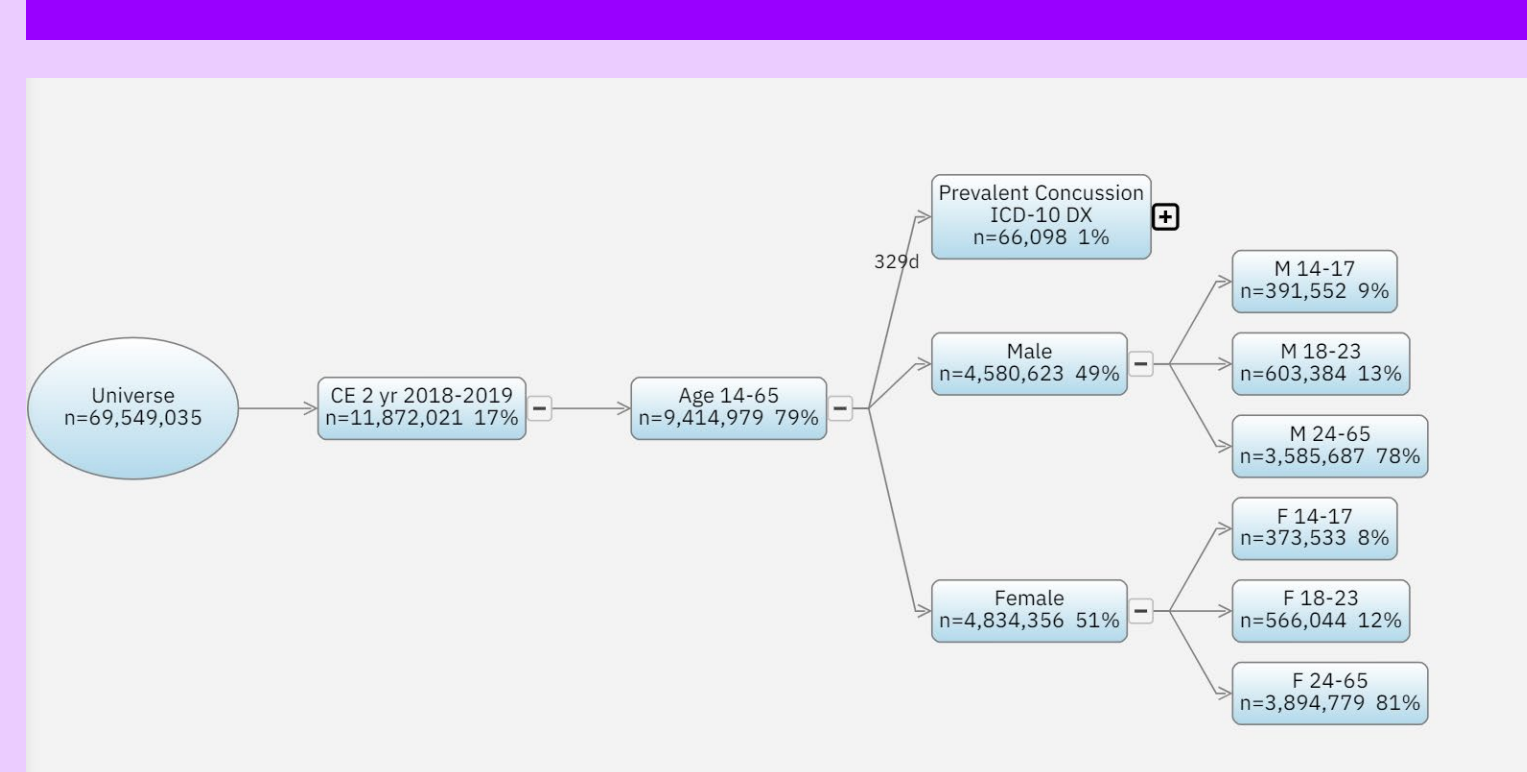


Figure 3. Pathway to Identify Concussion Diagnosis ≥ 30 Days After Index Concussion

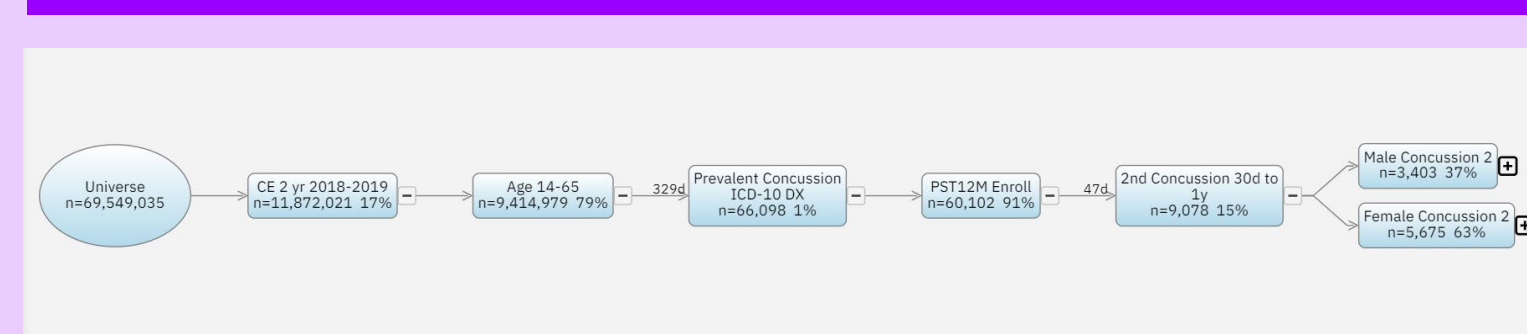


Table 1. Demographic Characteristics

	Concussion (N=66,098)	Total population (N=9,414,979)
<b>Age Category</b>		
14-17	26,232 (39.7%)	765,085 (8.1%)
18-23	12,593 (19.1%)	1,169,428 (12.4%)
24-65	27,273 (41.3%)	7,480,466 (79.5%)
<b>Sex</b>		
Male	29,074 (44.0%)	4,580,623 (48.7%)
Female	37,024 (56.0%)	4,834,356 (51.3%)
<b>Geographic Region</b>		
Northeast	11,352 (17.2%)	1,326,134 (14.1%)
Midwest	16,469 (24.9%)	2,094,974 (22.3%)
South	26,591 (40.2%)	4,503,122 (47.8%)
West	11,444 (17.3%)	1,454,988 (15.5%)
Unknown/Missing	242 (0.4%)	35,761 (0.4%)
<b>Urbanicity</b>		
Urban	58,804 (89.0%)	8,270,618 (87.8%)
Rural	7,006 (10.6%)	1,106,068 (11.7%)
Unknown/Missing	288 (0.4%)	38,293 (0.4%)

Figure 4. Prevalence of Concussion, 2018-2019

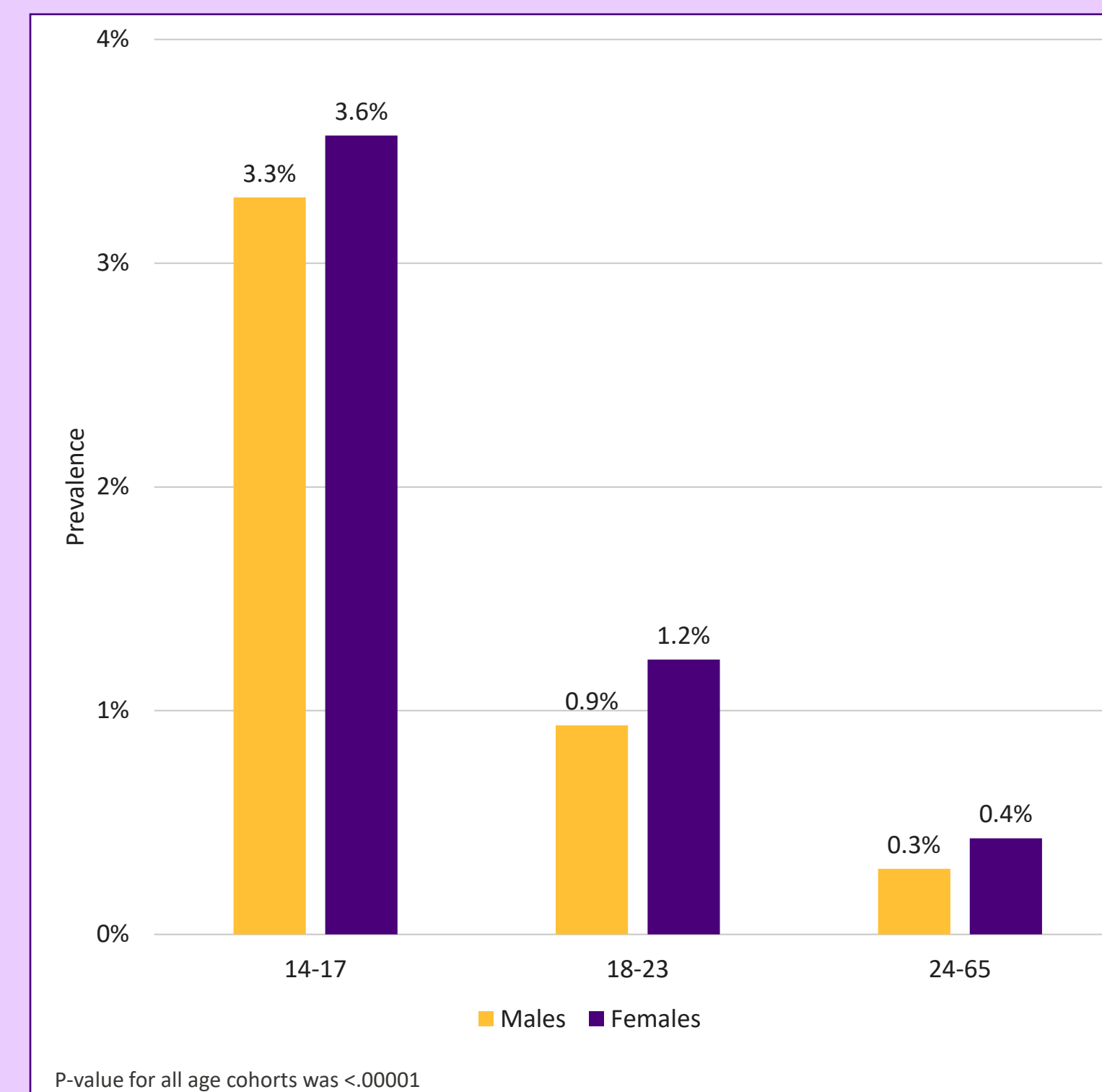
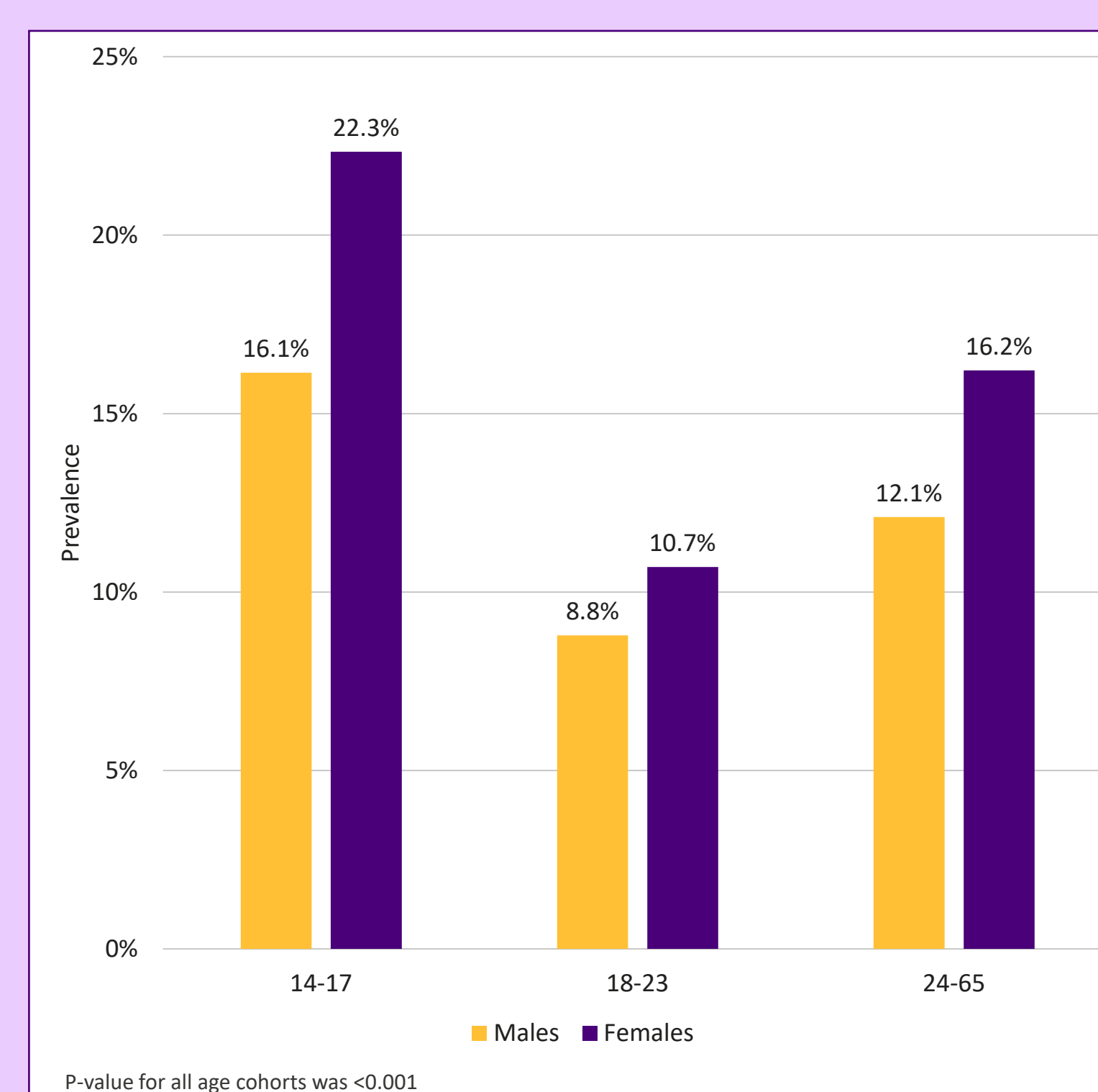


Figure 5. Proportion of Concussion Patients with Evidence of Concussion ≥30 Days after Index Concussion



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## Results (cont.)

### Prevalent Concussions

- Overall, the prevalence of concussion was 0.7% among males and 0.8% among females (p-value<0.001). Within each age cohort, females were more likely to be diagnosed with concussion than males (p-value<0.001), with prevalence decreasing as age group increased (Figure 4).

### Secondary Concussion Claims

- Among patients with at least 12 months follow-up after index concussion (N=60,102), 11.7% of males and 16.9% of females had a diagnosis code for concussion at least 30 days after the initial concussion (p-value<0.001). Claims evidence of concussion ≥30 days after the initial concussion was more common among females than males in all age groups (p-values<0.001; Figure 5).

## Limitations

- This study is subject to limitations common to all retrospective administrative claims studies.
- Concussion can be difficult to diagnose in any setting, potentially leading to misclassification. Additionally, previous research suggests females may be more likely to report concussion symptoms, which may result in non-differential misclassification and explain sex differences in concussions.<sup>3</sup>
- Most previous research has relied on concussion being diagnosed by athletic trainers (without physician confirmation). By contrast, this study requires a physician diagnosis to ensure patients actually have a medically-defined concussion. Therefore, this study is limited to concussion events in which the patient visited a healthcare provider, so may reflect a more severe concussion population.<sup>1,2</sup>
- It is unknown whether the presence of concussion diagnosis codes at least 30 days after the index code indicates follow-up care after the index concussion, concussion symptoms that have persisted for at least 30 days, or evidence of a second concussion.

## Conclusions

- Results show that the prevalence of concussion differs across sex and age groups in a general population, and that in high-school, college and post-college aged populations females are more likely to have a concussion diagnosis than males.
- This study shows the value of using a general database population to expand previous findings among athletes and suggests further research is needed to better isolate the factors faced by females that result in higher concussion risk.

### References

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### Disclosure

RD and MR are employees of Merative.

