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*Research article*

# Rare dizziness, syncope, loss of consciousness, seizure, and risk of falling after vaccination

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**Abstract:** Some individuals experience dizziness, syncope (temporary loss of consciousness caused by a fall in blood pressure), seizure, and similar rare adverse events after vaccination. Sudden impacts to alertness, consciousness, ability to talk, vision, or balance may pose rare risks for some vaccinees for a few days post vaccination. Herein, the Vaccine Adverse Event Reporting System (VAERS) database is examined for relevant adverse events. These adverse events exhibit a consistent pattern of onset soon after vaccination consistent with other reported reactogenicity adverse events. The onset of these adverse events soon after vaccination provides supportive evidence to reject the hypothesis that the majority of these adverse events represent background occurrences unrelated to vaccination. The immediate onset timing of these adverse events represent a pattern that warrants further study. The observed onset pattern for multiple unrelated vaccines are consistent with the possible etiology of innate immune responses to vaccination as causative for these observed adverse events. Cautionary avoidance of some activities immediately following vaccination may reduce accidental injuries.

**Keywords:** histamine; mRNA vaccines; COVID-19 vaccine; dizziness; syncope; seizure

**Abbreviations:** COVID-19: coronavirus disease 2019; HPV: human papillomavirus; mRNA: messenger ribonucleic acid; SARS-CoV-2: severe acute respiratory syndrome coronavirus 2; TDAP: tetanus, diphtheria, and pertussis; VAERS: Vaccine Adverse Event Reporting System

## 1. Introduction

Multiple vaccines have been associated with rare undesirable rare adverse events. Recent development of messenger ribonucleic acid (mRNA) and adenoviral vaccines for Severe Acute respiratory syndrome coronavirus 2 (SARS-CoV-2) are associated with higher frequencies of adverse events than seen previously for all other vaccines combined [1]. A small subset of these adverse events affecting alertness, balance, vision, and consciousness have the potential for accidental injuries when they occur without warning. The etiology for these increased frequencies of adverse events associated with coronavirus disease 2019 (COVID-19) and other vaccines remain unknown.

Some vaccinees (vaccinated individuals) experience vasovagal reaction (VVR) shortly after vaccination. VVR can lead to dizziness, presyncope (near fainting), and reflex syncope (fainting/loss of consciousness). Immunization stress-response (ISRR) has been proposed by the World Health Organization (WHO) to include VVR. VVRs are reported to be more common in adolescents and young adults [2]. Syncope was the most common adverse event for 209215 vaccinees aged 6 through 17 [3]. Syncope was also the most common immediate adverse event reported by an Australian retrospective study [4]. Some cases of COVID-19 vaccine-associated syncope can occur after the typical 10–15 minutes waiting period [5,6]. A study in Saudi Arabia reports adverse events per 10000 COVID-19 vaccine doses for dizziness (17.8), headache (9.7), nausea (7.1), and syncope (3.2) [7]. A case study of 20 million Malaysian reports a small increase risk of venous thromboembolism, arrhythmia, and convulsion/seizure for BNT162b2 vaccinees [8]. Seizures following SARS-CoV-2 vaccination are reported to occur as exceedingly rare events with 2.73 per million for mRNA-1273 (Moderna) and 1.02 per million for BNT162b2 (Pfizer-BioNTech) [9]. A retrospective study of 418 people with epilepsy reported a 6.2% increase in seizure frequency the month following vaccination [10]. Also, inclusion of varicella to the combination measles-mumps-rubella vaccine increases the risk of febrile seizure [11]; perhaps through increased reactogenicity due to combining these four vaccines.

The Vaccine Adverse Event Reporting System (VAERS) is the established database set up to monitor adverse events following vaccination in the United States. Herein, adverse events relevant to alertness, balance, vision, consciousness, falling, and head injury were characterized from VAERS reports from 1990 until Oct 21, 2022 for all vaccines with a focus on the vaccines with the highest reactogenicity levels. The majority of these adverse events occur within the first few days following vaccination, with the highest frequency within 24 hours of vaccination. This immediate onset timing pattern warrants additional studies. Individual vaccine subcomponents, including adjuvants, likely contribute to the reactogenicity level observed for each vaccine. Consistency of adverse event timing patterns and normalized frequency patterns of adverse events across unrelated vaccines support the hypothesis that reported reactogenicity adverse events are associated with and correlate with the level of innate immune responses to vaccination.

The VAERS database is a resource for researchers to detect patterns that warrant further study. VAERS is known to report and store co-occurring health events with no proof of causation. Mechanical incidents (e.g., car accident) may have no causality relationship with recent vaccination. An indirect relationship occurs when the mechanical operator experiences a vaccine associated adverse events negatively impacting consciousness or vision. Immediate onset patterns for rare adverse events affecting consciousness, ability to talk, vertigo, dizziness, vertigo, etc. are observed

for vaccines with high reactogenicity levels. The inclusion of cautionary warnings may be warranted for driving, operating mechanical equipment, risk of falling, etc. for 24 to 48 hours post vaccination for high reactogenicity level vaccines. Syncope and consciousness adverse events are also known to be associated with elevated histamine levels [12,13].

The observed immediate onset patterns of loss of consciousness/syncope and seizure all warrant additional study. Inclusion of cautionary warnings may be warranted. The immediate onset pattern possibly implicates elevated histamine levels and possibly additional molecules released by innate immune responses to vaccination.

## 2. Materials and methods

### *2.1. VAERS data mining*

The VAERS database was data mined for data on the following reported adverse events: Altered state of consciousness, aphasia (loss of ability to understand or express speech), confusional state, depressed level of consciousness, dizziness, fall, head injury, hypotension, loss of consciousness, muscle twitching, pallor, presyncope, seizure, somnolence, syncope, tremor, unresponsive to stimuli, vertigo, vision blurred, and visual impairment; dizziness, pallor, vision blurred, and muscle twitching may precede syncope onset. The downloaded data include all adverse events reported from 1990 to Oct 21, 2022. The Ruby program, named vaers_slice.rb [1], was used to tally selected reported vaccine adverse events by vaccine and day of onset. The vaers_slice.rb program takes as input a list of one or more adverse events to characterize; these adverse events are summarized from the yearly VAERS Symptoms, Vax, and Data files from 1990 to 2022. The output from vaers_slice.rb consists of five reports: summaries by vaccine, summaries by age of onset of symptoms, summaries by day of onset of symptoms, and two summaries of additional symptoms reported (selected symptoms and all other symptoms). Microsoft Excel was used create figures.

## 3. Results

All of the VAERS adverse events from 1990 to Oct 21, 2022 are summarized in the Supplemental data: Table S1 (all 20 adverse events combined), Table S2 (Altered state of consciousness), Table S3 (Aphasia), Table S4 (Confusional state), Table S5 (Depressed level of consciousness), Table S6 (Dizziness), Table S7 (Fall), Table S8 (Head Injury), Table S9 (Hypotension), Table S10 (Loss of consciousness), Table S11 (Muscle twitching), Table S12 (Pallor), Table S13 (Presyncope), Table S14 (Seizure), Table S15 (Somnolence), Table S16 (Syncope), Table S17 (Tremor), Table S18 (Unresponsive to stimuli), Table S19 (Vertigo), Table S20 (Vision blurred), and Table S21 (Visual impairment). Individual and combined symptoms reports from vaers_slice.rb are included in the Supplemental data (Tables S1–S21). The time to onset for selected adverse events are illustrated in Figures 1 and 2. The co-occurrences of pairs of examined adverse events is illustrated in Table 1. The gender ratio (female/male) of examined adverse events for COVID-19 vaccines is illustrated in Table 2. Vaccinees' age for presyncope and syncope adverse events are illustrated in Figures 3 and 4, respectively.

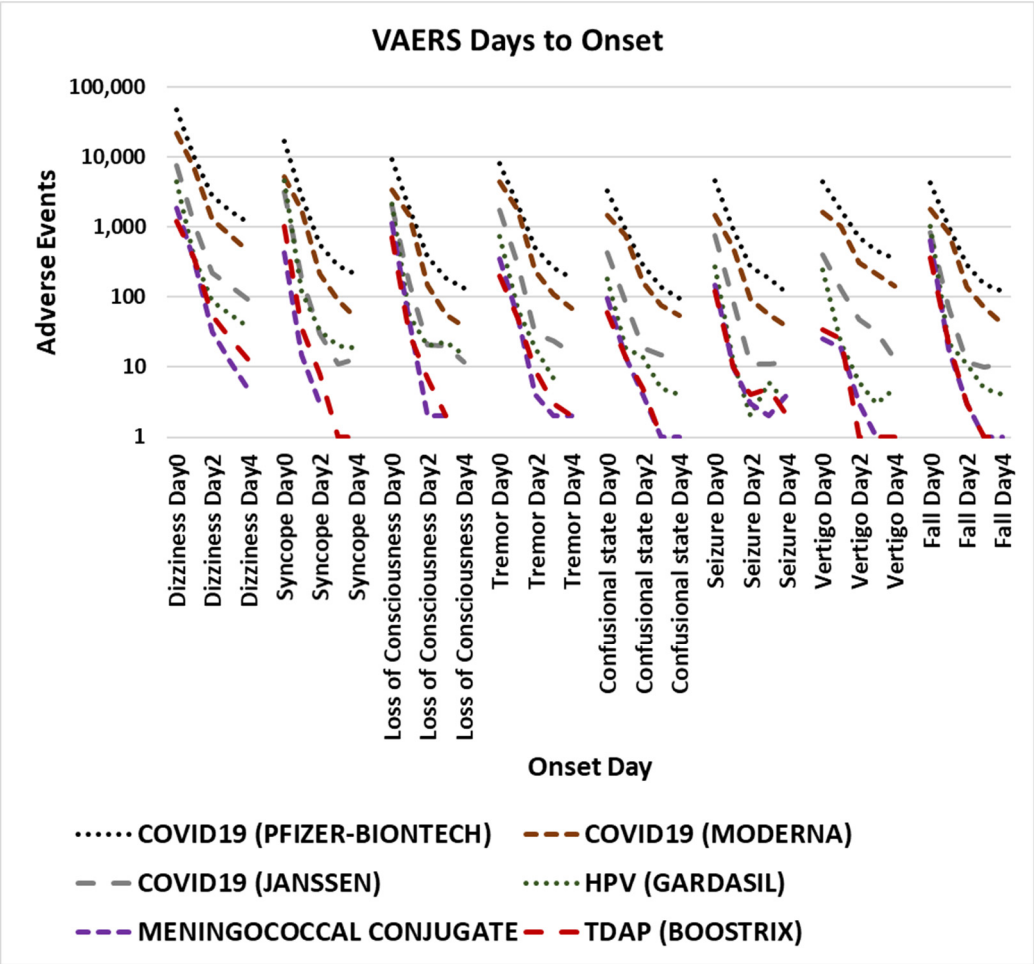


**Figure 1.** Immediate onset of adverse events in VAERS (1990 to Oct. 21, 2022). Vaccines plotted include COVID-19 (Pfizer-BioNTech, Moderna, and Janssen), Human papillomavirus HPV (GARDASIL), Meningococcal conjugate (MENACTRA), and TDAP (tetanus, diphtheria, and pertussis) (BOOSTRIX).

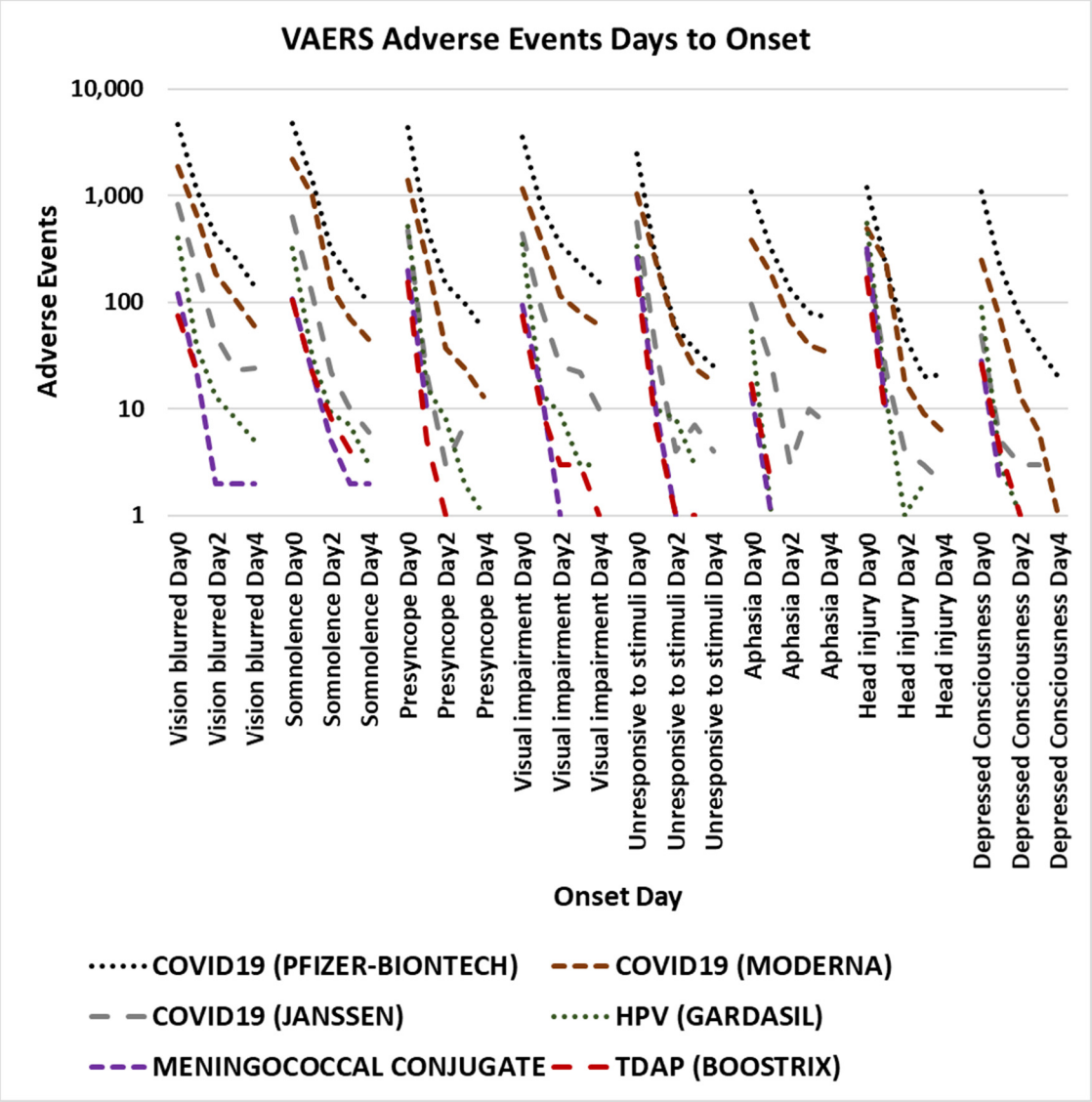


**Figure 2.** Immediate onset of adverse events in VAERS (1990 to Oct 21, 2022). Vaccines plotted include COVID-19 (Pfizer-BioNTech, Moderna, and Janssen), Human papillomavirus HPV (GARDASIL), Meningococcal conjugate (MENACTRA), and TDAP (tetanus, diphtheria, and pertussis) (BOOSTRIX).

**Table 1.** Co-occurrences of pairs of examined adverse events reports from VAERS (1990 to Oct. 21, 2022); these represent counts of pairs of adverse events that are both reported by vaccinees.

| Adverse event | Confusional state | Dizziness | Fall | Head injury | Hypotension | Loss of consciousness | Seizure | Syncope | Unresponsive to stimuli | Vertigo |
|---|---|---|---|---|---|---|---|---|---|---|
| Altered state of consciousness | 74 | 368 | 131 | 20 | 73 | 148 | 178 | 189 | 80 | 36 |
| Aphasia | 476 | 760 | 176 | 24 | 61 | 215 | 201 | 154 | 172 | 114 |
| Confusional state | | 3346 | 857 | 187 | 457 | 930 | 514 | 1256 | 662 | 389 |
| Depressed level of consciousness | 168 | 652 | 194 | 32 | 143 | 232 | 195 | 348 | 161 | 68 |
| Dizziness | 3346 | | 4642 | 1267 | 3659 | 8308 | 1776 | 13735 | 2223 | 7575 |
| Fall | 857 | 4642 | | 2886 | 524 | 4435 | 841 | 4490 | 835 | 545 |
| Head injury | 187 | 1267 | 2886 | | 174 | 1992 | 299 | 2420 | 290 | 76 |
| Hypotension | 457 | 3659 | 524 | 174 | | 1283 | 287 | 2528 | 612 | 239 |
| Loss of consciousness | 930 | 8308 | 4435 | 1992 | 1283 | | 2413 | 6633 | 1299 | 588 |
| Muscle twitching | 154 | 1190 | 188 | 42 | 96 | 354 | 274 | 509 | 180 | 150 |
| Pallor | 424 | 6823 | 1256 | 345 | 1328 | 3486 | 622 | 4268 | 1545 | 175 |
| Presyncope | 156 | 3686 | 740 | 142 | 568 | 1413 | 302 | 1623 | 198 | 307 |
| Seizure | 514 | 1776 | 841 | 299 | 287 | 2413 | | 2020 | 759 | 119 |
| Somnolence | 657 | 3346 | 394 | 99 | 311 | 765 | 390 | 822 | 451 | 355 |
| Syncope | 1256 | 13735 | 4490 | 2420 | 2528 | 6633 | 2020 | | 3099 | 708 |
| Tremor | 1055 | 7688 | 1000 | 219 | 612 | 1812 | 1194 | 2320 | 882 | 711 |
| Unresponsive to stimuli | 662 | 2223 | 835 | 290 | 612 | 1299 | 759 | 3099 | | 29 |
| Vertigo | 389 | 7575 | 545 | 76 | 239 | 588 | 119 | 708 | 29 | |
| Vision blurred | 552 | 5796 | 364 | 86 | 270 | 659 | 229 | 975 | 100 | 816 |
| Visual impairment | 422 | 3875 | 347 | 71 | 248 | 603 | 232 | 834 | 197 | 546 |

**Table 2.** Gender ratio (female/male) of examined VAERS adverse events for COVID-19 vaccines.

| Adverse event | COMIRNATY male | COMIRNATY female | SPIKEVAX male | SPIKEVAX female | AD26.COV2.S male | AD26.COV2.S female | COMIRNATY ratio | SPIKEVAX ratio | AD26.COV2.S ratio |
|---|---|---|---|---|---|---|---|---|---|
| Altered state of consciousness | 393 | 566 | 158 | 154 | 16 | 23 | 1.44 | 0.97 | 1.44 |
| Aphasia | 802 | 1702 | 360 | 772 | 73 | 158 | 2.12 | 2.14 | 2.16 |
| Confusional state | 2595 | 3895 | 1511 | 2226 | 345 | 395 | 1.50 | 1.47 | 1.14 |
| Depressed level of consciousness | 606 | 1062 | 196 | 252 | 24 | 50 | 1.75 | 1.29 | 2.08 |
| Dizziness | 19257 | 52553 | 9905 | 27389 | 3704 | 6118 | 2.73 | 2.77 | 1.65 |
| Fall | 3738 | 4458 | 2115 | 2372 | 685 | 465 | 1.19 | 1.12 | 0.68 |
| Head injury | 883 | 895 | 396 | 524 | 222 | 127 | 1.01 | 1.32 | 0.57 |
| Hypotension | 2216 | 3604 | 998 | 1458 | 381 | 368 | 1.63 | 1.46 | 0.97 |
| Loss of consciousness | 5252 | 7569 | 2271 | 3599 | 1263 | 983 | 1.44 | 1.58 | 0.78 |
| Muscle twitching | 865 | 2148 | 310 | 861 | 111 | 200 | 2.48 | 2.78 | 1.80 |
| Pallor | 2514 | 3207 | 967 | 1014 | 706 | 376 | 1.28 | 1.05 | 0.53 |
| Presyncope | 1905 | 3718 | 762 | 1259 | 270 | 244 | 1.95 | 1.65 | 0.90 |
| Seizure | 3017 | 3968 | 1206 | 1559 | 514 | 381 | 1.32 | 1.29 | 0.74 |
| Somnolence | 2177 | 5370 | 1209 | 3031 | 297 | 513 | 2.47 | 2.51 | 1.73 |
| Syncope | 8288 | 13837 | 3163 | 5274 | 1869 | 1567 | 1.67 | 1.67 | 0.84 |
| Tremor | 3358 | 9284 | 2220 | 5563 | 781 | 1419 | 2.76 | 2.51 | 1.82 |
| Unresponsive to stimuli | 1576 | 1753 | 943 | 869 | 454 | 318 | 1.11 | 0.92 | 0.70 |
| Vertigo | 2621 | 7512 | 1247 | 3511 | 273 | 540 | 2.87 | 2.82 | 1.98 |
| Vision blurred | 2347 | 5611 | 1020 | 2561 | 461 | 854 | 2.39 | 2.51 | 1.85 |
| Visual impairment | 2057 | 4507 | 725 | 1676 | 281 | 446 | 2.19 | 2.31 | 1.59 |

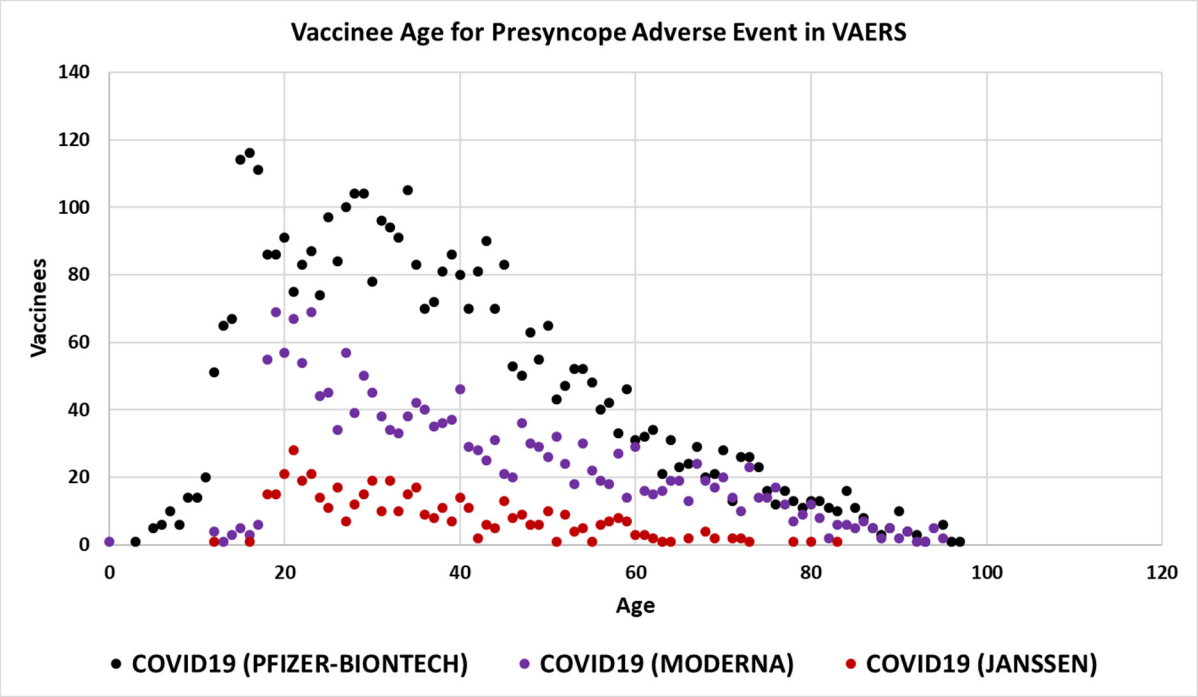


**Figure 3.** Age of Vaccinees experiencing presyncope post COVID-19 vaccination.

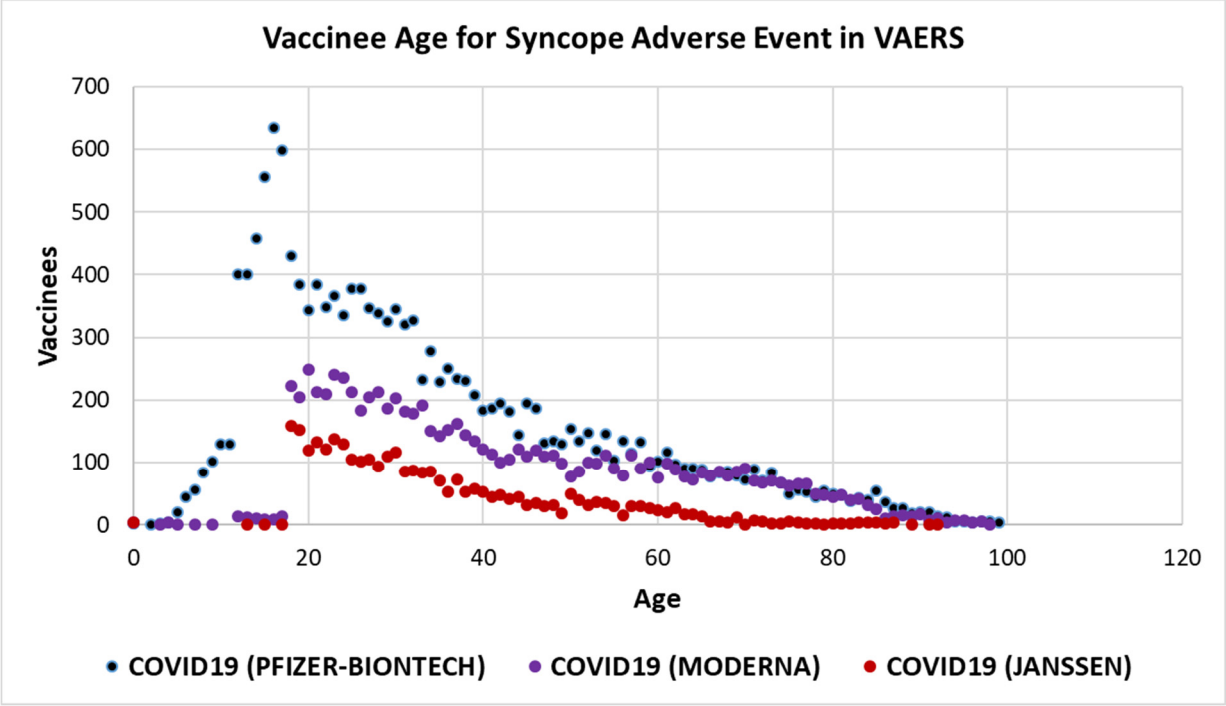


**Figure 4.** Age of Vaccinees experiencing syncope post COVID-19 vaccination.

## 4. Discussion

All of the VAERS adverse events from 1990 to Oct 21, 2022 are summarized in the Supplemental data for combined adverse events (Table S1) and 20 individual adverse events (Tables S2–S21).

### *4.1. Vasovagal reaction (VVR)*

Some vaccinees experience VVR adverse events immediately post vaccination, typically within 15 minutes of vaccination. The highest frequency of examined adverse events (Figures 1 and 2) are highest within 24 hours with risks decreasing rapidly for the subsequent days. VVR adverse events are most common for adolescents and young adults [2]. For the examined COVID-19 post-vaccination adverse events, this risk appears to decay in an approximate linear relationship from ages 20 to 100 (Figures 3 and 4). While a subset of the post-vaccination adverse events may be caused by VVR, the time of onset and an age of vaccinees affected suggest that the majority of these adverse events are not caused by VVR.

### *4.2. Immediate onset of adverse events*

Immediate onset adverse events are observed for multiple high reactogenicity vaccines [1]. The highest levels of examined adverse events in VAERS are reported for the two COVID-19 mRNA vaccines (Pfizer-BioNTech and Moderna) and the COVID-19 adenovirus vaccine (Janssen) (Figures 1 and 2 and Supplemental data Tables S1–S21). The observed immediate onset pattern of these adverse events is also observed for some non-COVID-19 vaccines. Expressing the SARS-CoV-2 Spike mRNA in innate immune cells is a possible cause of the observed higher reactogenicity level of COVID-19 vaccines (Figures 1 and 2 and Supplemental data Tables S1–S21). The consistent onset pattern observed across unrelated vaccines (Figures 1 and 2 and Supplemental data Tables S1–S21) suggests that innate immune responses are the principal driver of the majority of these adverse events experienced by vaccinees. Innate immune responses release inflammatory molecules, including histamine, as part of the innate immune responses to vaccinations. Many of the post-vaccination symptoms overlap with those of mast cell activation (MCA) [14]. The observation of consistent onset data patterns across unrelated vaccines enables the exclusion of individual vaccine and adjuvant components (which drive reactogenicity level) with implication of immune responses to vaccinations. The immediate onset patterns of all of the examined adverse events also enables the exclusion of other possible etiology models (e.g., antibody responses can be excluded, etc.). The co-occurrences of these pairs of adverse events (Table 1) is suggestive of shared or overlapping etiology.

### *4.3. Gender bias*

The number of adverse event reports for some adverse events is generally higher for females, but can vary by vaccine type (mRNA versus adenoviral) (Table 2). Pearson correlations, r, of the gender ratios (female/male) are 0.95 for COMIRNATY versus SPIKEVAX, 0.81 for COMIRNATY versus AD26.COV2.S, and 0.71 for SPIKEVAX versus AD26.COV2.S. The mRNA vaccines are

taken up by neutrophils and monocytes with modified monocytes migrating to lymph nodes. AD26.COV2.S infects muscle cells. These differences in gender ratios may be influenced the different vaccine type mechanisms for activating immune responses. The differences in gender bias ratios (female/male) (Table 2) may indicate more than one etiology for these adverse events.

### *4.4. Granulocytes and mast cell mediators*

Innate immune responses include activation of granulocytes and mast cells to release inflammatory molecules including histamine. The amount of inflammatory molecules released is predicted to correlate with the reactogenicity level of the vaccine. Cysteinyl leukotrienes are synthesized following degranulation of granulocytes and promote increased permeability of endothelium, enhancing vasodilation, and recruiting inflammatory cells; cysteinyl leukotrienes appear have higher potency than histamine with regard to their vascular effects (reviewed [15]). Histamine and platelet activating factor (PAF) can activate nitric oxide production resulting in dilation of blood vessels and dysfunction of the endothelial barrier (reviewed [15]). Histamine, cysteinyl leukotrienes, PAF, and additional inflammatory molecules are candidate drivers of the examined adverse events (Figures 1 and 2).

The majority of reactogenicity adverse events following vaccinations are predicted to be caused by elevated histamine levels [1] including menstrual adverse events [16], and cardiac adverse events including myocarditis and pericarditis [17]. The histamine tolerance level can vary by individual for multiple reasons including drugs [18], foods [13,18], gastrointestinal microbiome [18], stage of menstrual cycle [13], and pregnancy; histamine intolerance may be associated with the rarity of the adverse events affecting consciousness level, etc.

### *4.5. Loss of consciousness/syncope and seizure injury risks*

The rare adverse events of loss of consciousness/syncope and seizure have rapid onset (Figure 1) with little or no advance warning; when they occur while driving a vehicle, operating heavy equipment, or in elevated locations, the risks for an accident or falling is significantly increased. Seizure can be associated with a syncopal episode. Figure 1 illustrates loss of consciousness, syncope, and seizure adverse events immediately post vaccinations with the greatest risk within the first 24 and 48 hours. These immediate onset patterns provide support for the addition of safety warnings to current high reactogenicity treatments, including COVID-19 mRNA and adenovirus vaccines. Vaccinees exercising caution and avoiding higher risk activities for a day or two will likely reduce falls, head injuries, and other rare accidents.

Elevated histamine has a potential role for a subset of the evaluated adverse events including hypotension, loss of consciousness, presyncope, syncope, etc. However, seizures may have a different etiology. Low levels of histamine are associated with convulsions and seizures [19]. It is suggested that H1 antagonists should not be administered to patients with febrile seizures to avoid disturbing the anticonvulsive central histaminergic system [20,21].

## 5. Conclusions

Vaccinations provide protection against potential pathogen infections. Rare adverse events impacting consciousness and risk of falling occur with immediate onset patterns. The majority of these adverse events are reported within the 48 hours of vaccination. Avoidance of activities like driving, operating heavy machinery, with increased risks of falling, etc. for 1 to 2 days post vaccination provide an opportunity to reduce the frequencies of falls, head injuries, and other rare accidents.

## Conflict of interest

The author declares no conflict of interest.

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