CARE IMPACT Study of Age 0-15 Year Old Occupants

2014-2018 Data

David B. Brown, PhD, P.E.
brown@cs.ua.edu

July 24, 2019

Table of Contents

Introduction

Most of the comparisons in this document are between: (1) occupants of vehicles involved in crashes who were 15 years old or less (what we will call "younger occupants"), and (2) those older occupants (16 years old or older). Both of these subsets of persons were involved in crashes. In many cases the younger and older subsets will be the same crash; the exception being crashes involving occupants who were all strictly 16 years of age or older.

These comparisons enabled the characteristics for these crashes to surface so that traffic safety professionals can determine their magnitude and optimize countermeasures with regard to younger occupants of motor vehicles. A very important general finding that confirms studies done by CSPS personnel from well over decades is the value of proper use of restraints. We will introduce the requirements of the Alabama restraint laws for younger people at this point for reference purposes.

The following is a summary of the Alabama law from the National Safety council:

- Children ages 6 until 15 are required to wear a seat belt [be properly restrained – DBB] in all seats.
- Booster seats or child safety seats are required until age 6.
- Infant seats and convertible seats are required to be rear-facing until passenger is at least one year-old or 20 lbs. in weight.
- Children must be in forward-facing seats or convertible seats until age 5 or 40 lbs
- All child restraint laws are standard enforcement.

Source: https://drivinglaws.aaa.com/tag/child-passenger-safety/

In addition, the tables on the following page have been prepared by the Alabama Department of Public Health.

The next two sections within this Introduction consider the general age distribution of all motor vehicle occupants who are involved in crashes. A set of recommendations is then given immediately following the Introduction. This is followed by a section describing the filter generation for this study. Filters were developed at the same time for two other studies that were conducted in conjunction with the study documented here: (1) Automobile drivers under the age of 16; and (2) Drivers of All-Terrain Vehicles (ATVs), Bicycles and Motorcycles. A number of filters were tried before arriving at those that would best satisfy the requirements of each of these studies. The short code given to the one used in this study was F2, which is given in the section numbers of this report for reference purposes. The IMPACT and cross-tabulation analyses are given in the final section. These are given in the same ordering as the recommendations so that the sources of the recommendations can be easily located.

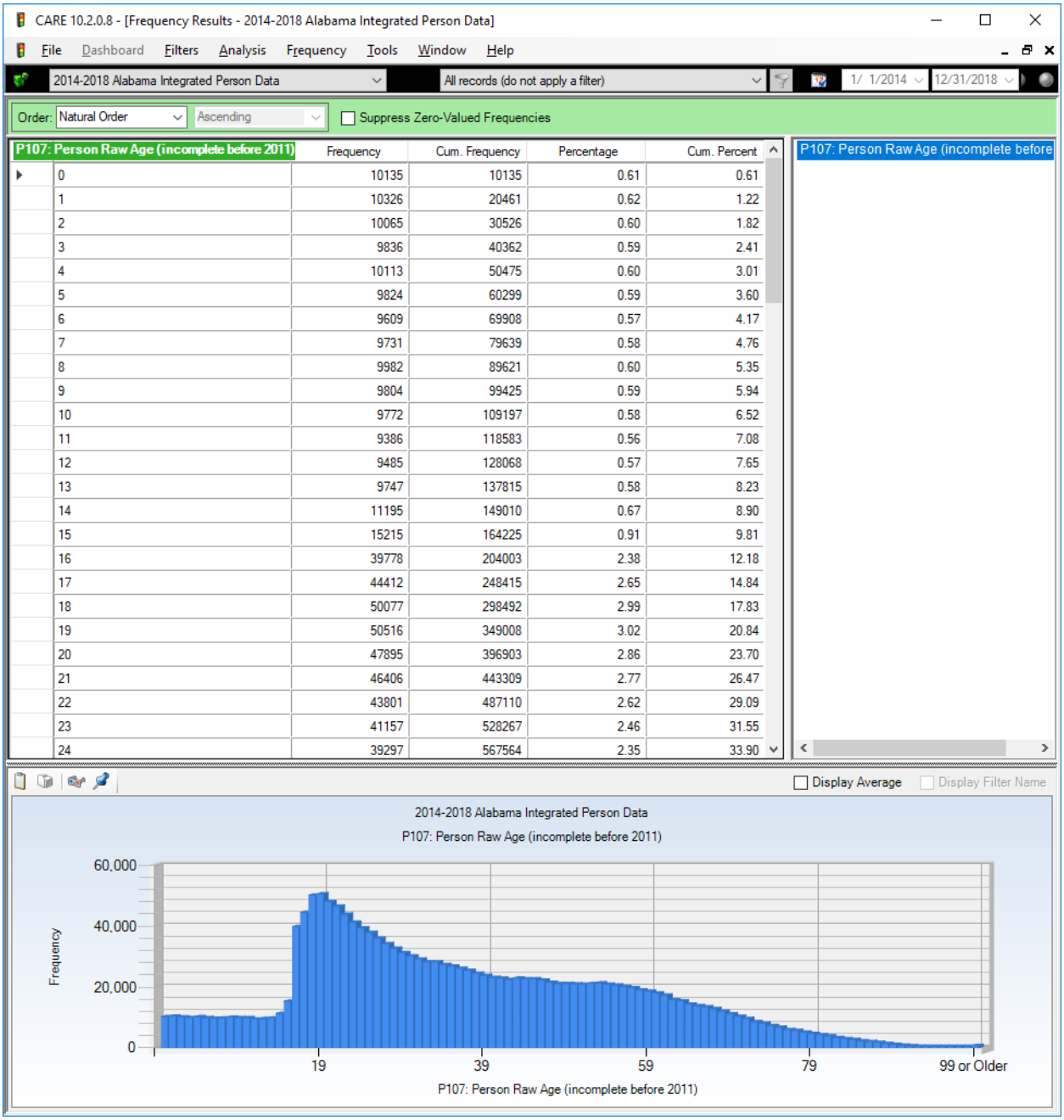
Information Related to the Alabama Child Restraint Law

Changes in Alabama Child Restraint Law Effective July 1, 2006 Specific Car Seat Criteria	
Age / Weight/ Height Requirement	**Appropriate Restraint**
Birth - age 1 or 20 pounds	Infant only or convertible seat rear facing position
Age 1 or 20 pounds - age 5 (at least) or 40 pounds	Convertible seat forward-facing position or forward-facing seat
Age 5 (at least) or 40 pounds - age 6	Booster Seat
Age 6 - age 15	Seat Belt

Comparison of Amended Alabama Law to National Guidelines Changes to the Alabama Child Restraint law are based on national guidelines from the National Highway Traffic Safety Administration.			
Alabama Law Effective July 1, 2006		**National Guidelines for Safety**	
Age / Weight/ Height Requirement	**Appropriate Restraint**	**Age / Weight/ Height Requirement**	**Appropriate Restraint**
Birth - age 1 or 20 pounds	Infant only or convertible seat rear facing	Birth – at least age 1 **AND** at least 20 pounds	Infant only /rear-facing or convertible Seat rear-facing
Age 1 or 20 lbs – age 5 (at least) or 40 pounds	Convertible seat forward facing or forward facing seat	Age 1 and at least 20 pounds –age 4 and approximately 40 pounds	Convertible seat forward facing or forward facing seat or High Back Booster with Harness
Age 5 (at least) or 40 pounds - age 6	Booster Seat	Age 4 - age 8 (at least) unless 4'9" (57" tall)	Belt-positioning Booster or High Back Belt-positioning Booster
Age 6 - age 15	Seat Belt	8 Years and older	Shoulder/Lap Seat Belt

Source: Alabama Department of Public Health: http://alabamapublichealth.gov/injuryprevention/assets/LawTable.pdf

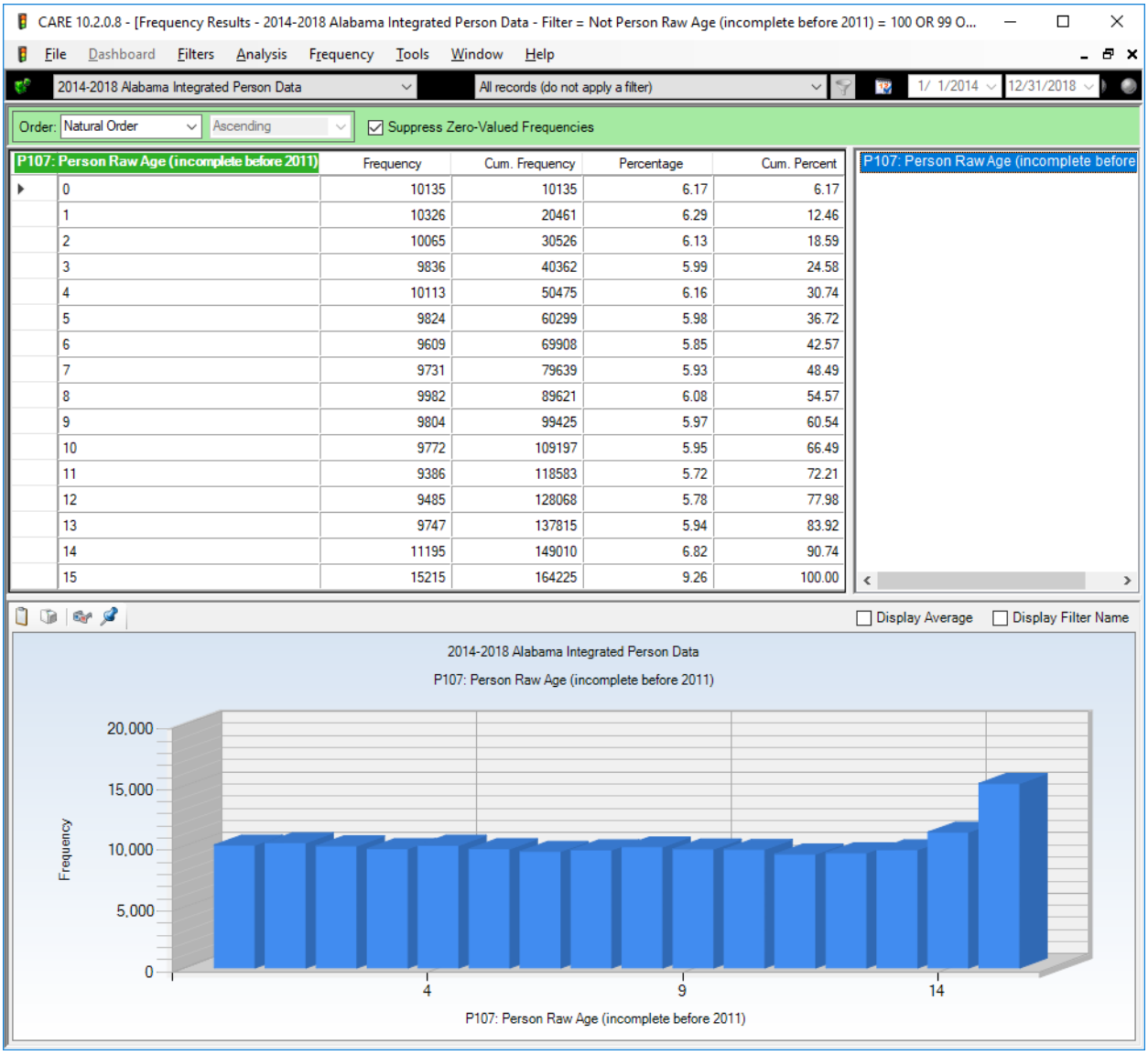
General Age Distribution of All Occupants (Including Drivers) in Crashes



There is a significant increase in occupants aged 15 and above, that gets quite dramatic at and above age 16, which is the legal age of a drivers' license unaccompanied by an adult. The large numbers of drivers in the 16-40 age range are studied in the following:

http://www.safehomealabama.gov/wp-content/uploads/2018/12/Young-Driver-IMPACT-2011-15-2016-Update-v03.pdf

Age Distribution of All 0-15 Year Old Occupants Involved in Crashes



The age of those involved in crashes are quite evenly distributed up to age 14, where two factors come into play: (1) greater use of all-terrain-vehicles (ATV), and (2) license availability for motor-driven cycles (as opposed to motorcycles – see requirements immediately below). In this regard, the analytics have been divided between passengers and drivers. This report considers occupants; another report will consider young (10-15 year old) drivers.

"The requirements for motorcycle license credentials vary depending on whether you want to operate a motor-driven cycle or a regular motorcycle. The minimum motorcycle license age for a motor-driven cycle is 14 years of age. To get an M class license, which allows you to operate other motorcycles, you must be at least 16 years of age. If you already hold a motor-driven cycle

license when you turn 16 years of age, then you can visit one of the ALEA driver license office locations to get a license that will allow you to operate both motorcycles and motor-driven cycles if you wish." Source: https://www.dmv.com/al/alabama/apply-motorcycle-license

Recommendations

The following summary is a list of results obtained from the analyses that follow. They are generally in the same order as the section numbers for ready reference.

- Vehicle Types and Driver Characteristics
    - F2.1 P101. Unit Type. The over-represented unit types (at the top of the tabular display) could either indicate that these types of vehicles are more apt to be chosen (e.g., for family transportation). Alternatively, if we assume that those carrying young people choose the same vehicle types as those who do not, then the onus would shift to the drivers of these over-represented unit types. It is our opinion that these results are a combination of the two, and this will be further established by the other attributes. The recommendation is not to get a different type of vehicle, but to observe the problems being faced in the vehicles of choice for families. See F2.3 for potential reasons for increased crashes in these vehicles.
    - F2.2 P507 Driver Raw Age. Since all driver ages 17 and younger are over-represented, this would seem to be the target driver population to attempt to influence in recognizing the special problems when transporting people 15 years and younger. We recommend the consideration of PI&E programs being developed that include this target as well as the considerations given below.
    - F2.3 P020 Primary Contributing Circumstances (and F2.4). The recommendation here is to try to implement a countermeasure that will get those transporting younger children to pull over to the side when they are being distracted. Perhaps some PI&E can be created that will enable parents/guardians to identify this problem before it gets to the point of causing a crash. While only 3,164 crashes were attributed to Distracted by Driver, it has risen to the top because its percent of all crashes is 2.50% compared to the control subset that only has 0.65%. If this problem could be reduced to what it is in the population without the young passengers, the savings would be 2,335 crashes over the five years of the study. Looking down the PCC list, most of the other items could be attributed to a root cause of distraction. Officer's will generally indicate a definitive, provable PCC as opposed to a speculative root cause. It is hard to imagine that so many would take chances when transporting children and ignore signs and signals to the point that their failing to yield the right of way in all categories adds up to 26,102 crashes. However, this is not unlikely when being distracted, so the recommendation is that distraction from the "kids" be given major consideration.

- Injury Severity
    - F2.5 P328 Person Injury Type for Passengers Aged 0-15. The impressive results for lower severity injuries in younger occupants has two sources: (1) their inherent ability to survive the same crash that would cause death (or more severe injury) to an older person, and/or (2) the use and protective value of recommended restraints. Defeating the restraint countermeasure by improper use will be discussed below. At this point it is good to note that the fatality comparison between the younger and older occupants is one fatality in every 385 persons involved for the older subset, but for the younger subset it is one fatality for every 1,111 involved persons. Thus, the younger passengers have only about one third of the probability of being killed.
    - F2.6 p328 Injury Severity by P075 Person Relationship to the Causal Vehicle. One reason for the very strong relationship in the higher severities in the causal vehicle is the fact that single-vehicle crashes have no second vehicle. However, the major finding is that if you are the victim vehicle in a crash as opposed to the causal vehicle, your young passengers will have a much higher chance of survival as well as resisting the higher person severities. While we should be concerned about the behavior of those around us, defensive driving starts with each one of us.
    - F2.7 P328 Severity by P323 Safety Equipment of Passengers Aged 0-15. It is well known that proper restraints are the number one defensive measure against fatal injury. The purpose of the discussion given for this and the next section is to show how dramatic that difference is for young people. Where child restraints are not being considered, the results apply to older children. While not as large a difference as child restraints, the probability of the older child (properly restrained) being killed is only 1 in 2,812 as compared to 1 in 52 if not restrained. This is over 50 times higher probability of being killed for those not restrained.
    - F2.8 P328 Severity by P323 Restraint Use for Child Restraints. The results are even more dramatic for children in child restraint devices who are properly restrained. Not restrained is still a death probability of 1 in 52, but restrained properly in a child restraint reduces the probability of death to 1 in 5195, which is an improvement factor of close to 100 times the benefit. *But the major finding of this section has to do with the proper use of child safety seats*. For example, the forward facing child seat used improperly has a death rate of 1 in 85, which is not that much different from no restraint at all (which is 1 in 52). When used properly, the forward facing seat has a 1 in 3708 death rate, which is an improvement of over 43 times that of improper use. This argues strongly for training programs to educate parents on the proper use of child restraints. In brief, they may not reduce injury severity nearly to their potential if used improperly.

- Seating Position
    - F2.9 P321 Seating Position IMPACT of Passengers Aged 0-15. This present the seating positions of passengers aged 0-15 (red bars) compared to older passengers (blue bars) on a percentage basis with the driver position suppressed. This is given to provide perspective on the comparisons that follow.
    - F2.10 P321 Seating Position by P328 Person Injury Type (Passengers Aged 0-15). This display makes it quite clear that children do not belong in the front seat regardless of their ages. This should be a constant mantra of child safety advocates – "properly restrained and in the back seat."
    - F2.11 P321 Seating Position by P323 Restraint (Safety Equipment) of Passengers Aged 0-15. This answers the question: when restraints are used what seating positions are most common. It seems that the use of restraints and the proper seating position go together in the majority of cases.

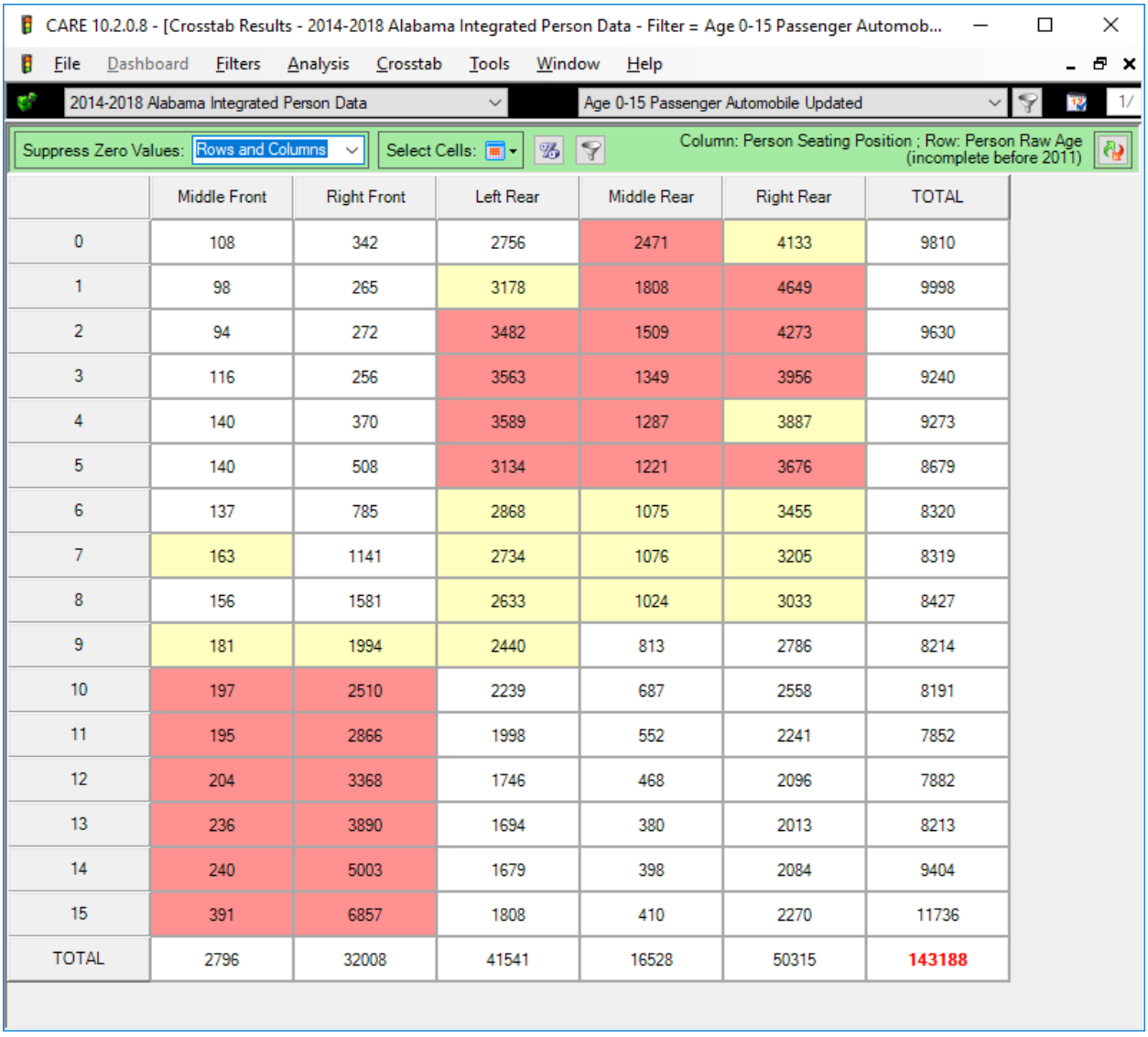
- Other Attributes
    - F2.12 P008 Time of Day of Crashes with Passengers Aged 0-15. Children must be transported at given times of day, and there is really no way around this. The results here reflect this, being significantly over-represented in the 2 PM to 9 PM time frames.
    - F2.13 P011 Highway Classification of Crashes with Passengers Aged 0-15. Like time of day, there is probably little that can be done to alter the particular roadways that must be traveled with child passengers. It is good for drivers to know, however, which roadway types generally have the higher severities. This is given in the next section.
    - F2.14 P011 Highway Classification by P328 Person Injury Type. The message here is that increase speed kills, each 10 MPH doubles the probability that the crash will result in a fatality. It is important to observe the speed limits, especially on county roads. Appeals to the safety of the precious child cargo should have the effect of reducing both the frequency and severity of crashes, especially on county roads.

Filter Definition

Filter 2: F2=Occupant Age < 16 AND Automobile Passenger (not the driver)

The following cross-tabulation illustrates the filter used for this study.

P321 by P107 Automobile Passenger Aged 0-15



	Middle Front	Right Front	Left Rear	Middle Rear	Right Rear	TOTAL
0	108	342	2756	2471	4133	9810
1	98	265	3178	1808	4649	9998
2	94	272	3482	1509	4273	9630
3	116	256	3563	1349	3956	9240
4	140	370	3589	1287	3887	9273
5	140	508	3134	1221	3676	8679
6	137	785	2868	1075	3455	8320
7	163	1141	2734	1076	3205	8319
8	156	1581	2633	1024	3033	8427
9	181	1994	2440	813	2786	8214
10	197	2510	2239	687	2558	8191
11	195	2866	1998	552	2241	7852
12	204	3368	1746	468	2096	7882
13	236	3890	1694	380	2013	8213
14	240	5003	1679	398	2084	9404
15	391	6857	1808	410	2270	11736
TOTAL	2796	32008	41541	16528	50315	143188

The cross-tabulation P321 Person Sating Position by P107 Person Age Automobile Passenger was run for all passengers using the CARE Person Dataset. Those cells that qualified were for age 0-5 and all seating positions except the driver position. Vehicles passengers in seating positions that are outside of that given above were not considered (e.g., large vans and bussed). This filter was called "Age 0-15 Passenger Automobile Updated" and given a code of F2 for easier reference.

Over the five years of the study (2014-2018), there were143,350 persons who qualified as given in the grand total above 16 involved as passengers. A further update was done, and the number was reduced to the 143,188 given above by removal of drivers and non-motorists who may have been miss-coded into one of the standard seating positions given above.

As shown above, the vast majority of parents are keeping their children much safer in the back seat. This perception seems to shift at ages 6-9 and the numbers are almost linear with the age. Children should be kept restrained in the back seat at least until age 13, even though this is not required by law. Here is a summary of the Alabama law from the National Safety council repeated from above:

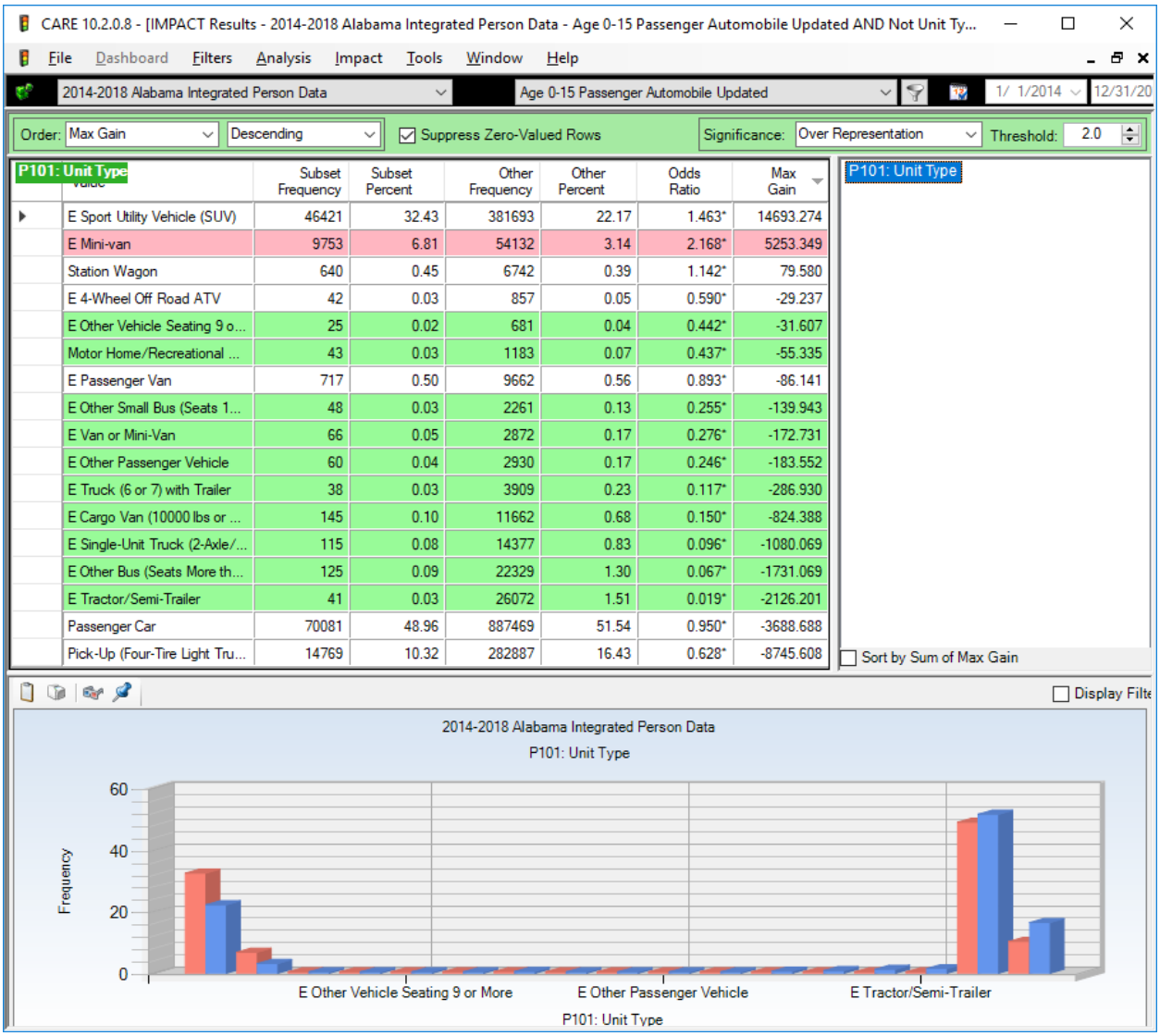
- Children ages 6 until 15 are required to wear a seat belt [be properly restrained – DBB] in all seats.
- Booster seats or child safety seats are required until age 6.
- Infant seats and convertible seats are required to be rear-facing until passenger is at least one year-old or 20 lbs. in weight.
- Children must be in forward-facing seats or convertible seats until age 5 or 40 lbs
- All child restraint laws are standard enforcement.

Source: https://drivinglaws.aaa.com/tag/child-passenger-safety/

Analysis for F2 Involved Passengers of Age < 16 (Updated to Remove Drivers)

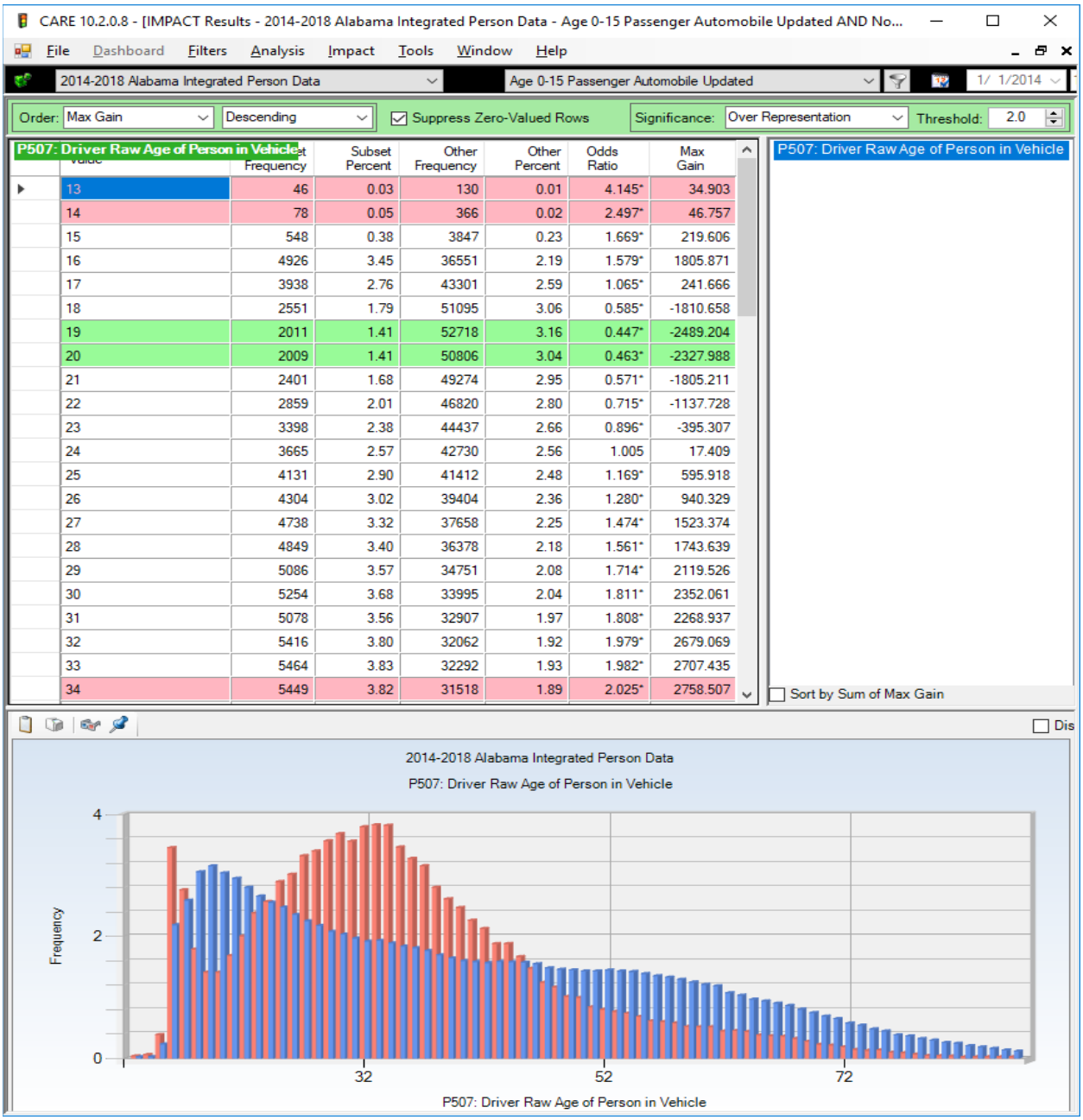
F2 = Age 0-15 Passenger Automobile Updated

F2.1 P101 Unit Type of Crashes with Passengers Aged 0-15



Unit types with less than 20 crashes were suppressed in the above. As expected, vehicle types common to family transport were over-represented. Although passenger cars were under-represented, they composed close to half (48.96%) with young 70,081 person occupants. The large number of unit types that have less than 0.10% will have little impact on the results below.

F2.2 P507 Driver Raw Age of Passenger (who was <16) in Vehicle



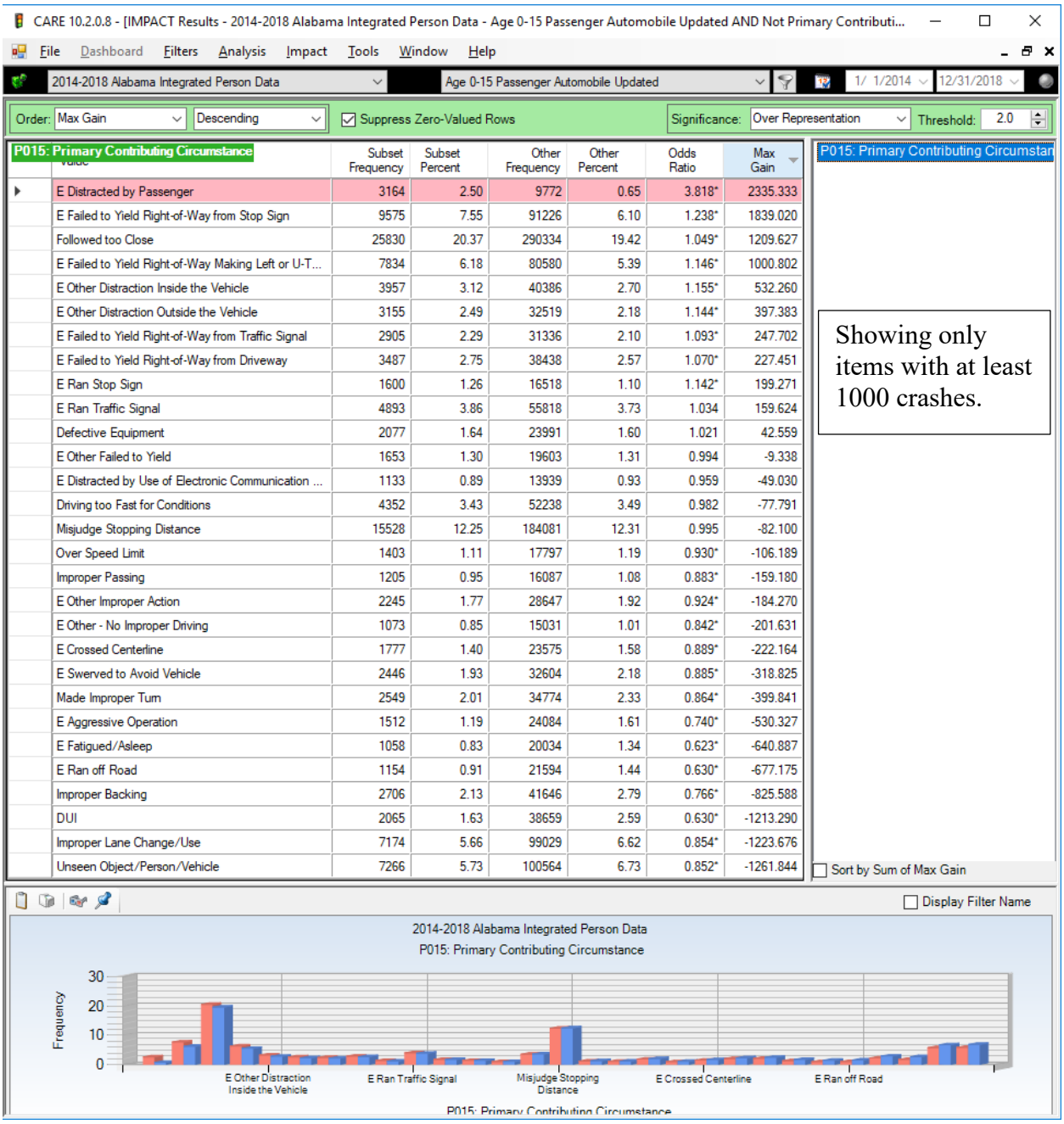
Value	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
13	46	0.03	130	0.01	4.145*	34.903
14	78	0.05	366	0.02	2.497*	46.757
15	548	0.38	3847	0.23	1.669*	219.606
16	4926	3.45	36551	2.19	1.579*	1805.871
17	3938	2.76	43301	2.59	1.065*	241.666
18	2551	1.79	51095	3.06	0.585*	-1810.658
19	2011	1.41	52718	3.16	0.447*	-2489.204
20	2009	1.41	50806	3.04	0.463*	-2327.988
21	2401	1.68	49274	2.95	0.571*	-1805.211
22	2859	2.01	46820	2.80	0.715*	-1137.728
23	3398	2.38	44437	2.66	0.896*	-395.307
24	3665	2.57	42730	2.56	1.005	17.409
25	4131	2.90	41412	2.48	1.169*	595.918
26	4304	3.02	39404	2.36	1.280*	940.329
27	4738	3.32	37658	2.25	1.474*	1523.374
28	4849	3.40	36378	2.18	1.561*	1743.639
29	5086	3.57	34751	2.08	1.714*	2119.526
30	5254	3.68	33995	2.04	1.811*	2352.061
31	5078	3.56	32907	1.97	1.808*	2268.937
32	5416	3.80	32062	1.92	1.979*	2679.069
33	5464	3.83	32292	1.93	1.982*	2707.435
34	5449	3.82	31518	1.89	2.025*	2758.507

The red bars represent the raw ages of drivers who had a crash with occupants aged 15 or less. The subset definition filter for the red bars excludes drivers who are less than 16, since it is defined by the passengers age 15 or younger. Clearly, drivers of these passengers *may be of any age*, as indicated above. Ages of drivers for which there were less than 10 crashes were excluded. It seems that younger passengers are quite often being driven by their slightly older

friends or siblings. However, being a passenger is no longer necessary once they (the young passengers) obtain their own drivers' licenses. It is important to recognize that the red and blue bars do not relate to specific passenger ages. The red distribution given is for drivers of ALL passengers 0-15, and the blue bars represent drivers involved in crashes that did not have any passengers 0-15.

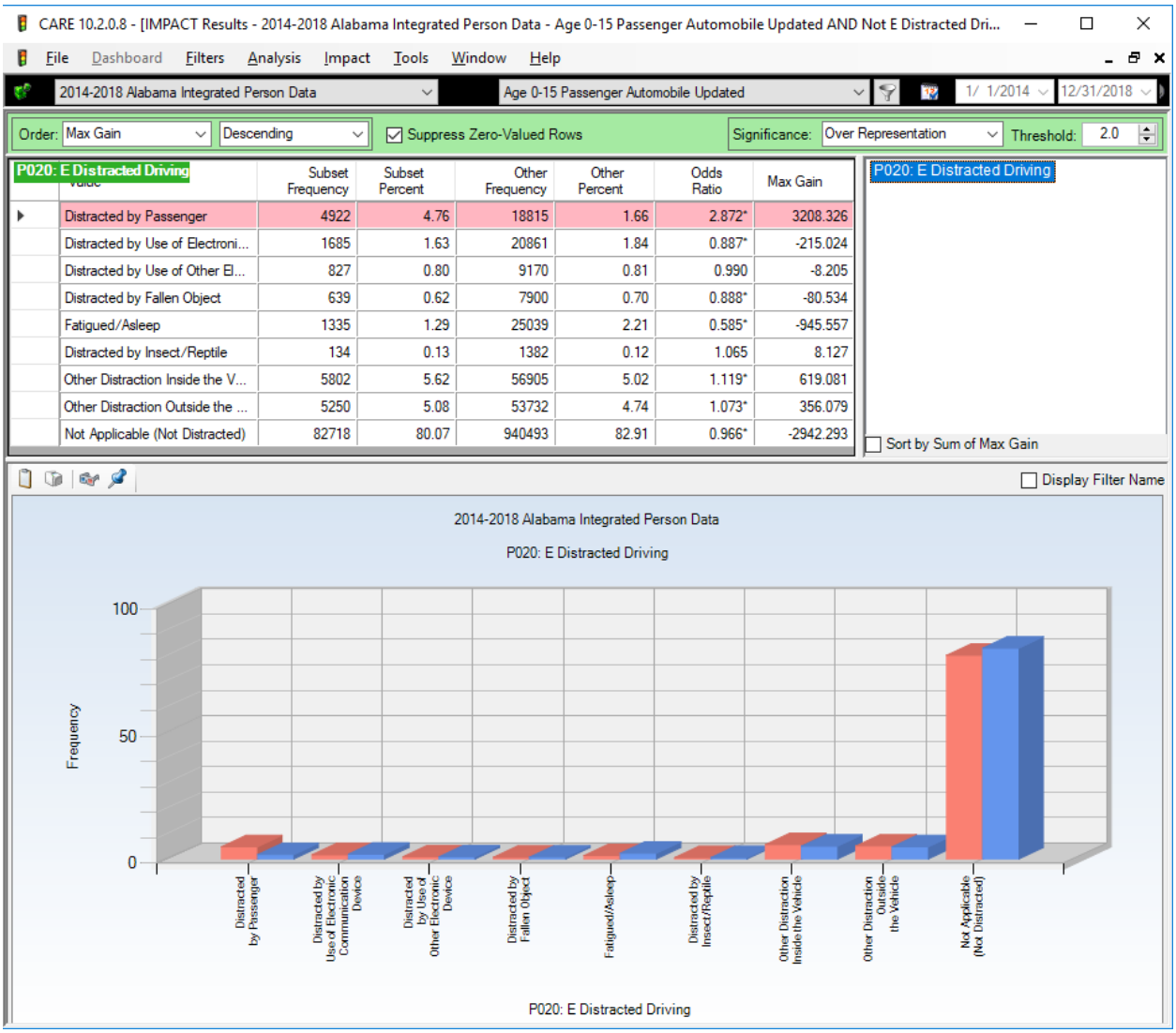
There is a major shift at driver age 18, where it appears that there is resistance either on the driver's part or the passenger's for them to travel together. This continues up until driver age 25, at which time many have probably started their families, which would account for their young passengers' ages.

F2.3 P015 Primary Contrib Circumstance for Crashes with Passengers Aged 0-15



The following items bear special attention: Distracted by Passenger (3164=most over-represented; close to 4 times expected); Failed to Yield Right-of-Way (all FTY=26,102); Followed too Close (25,830). Further information on distracted driving is given for the next attribute.

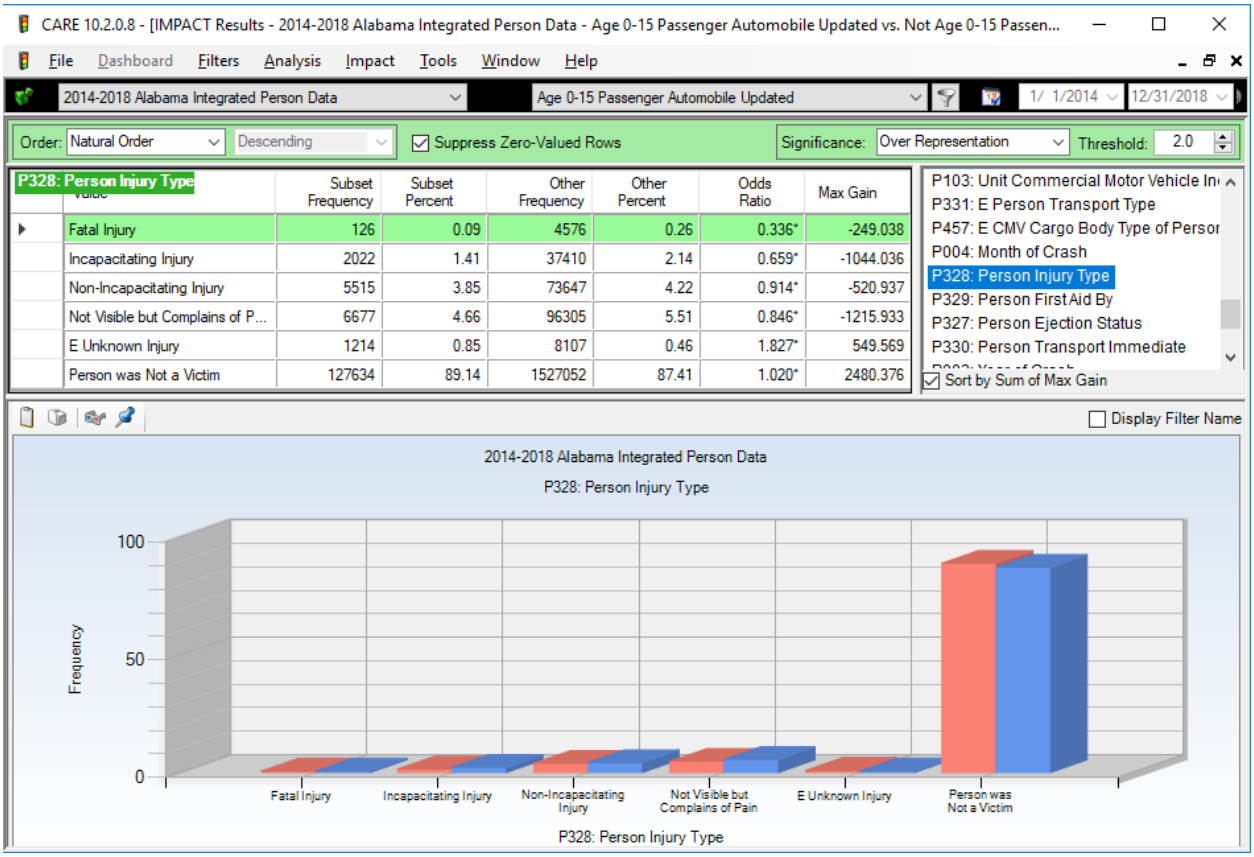
F2.4 P020 Distracted Driving for Crashes with Passengers Aged 0-15



Since the subset, by definition of F2, includes small children and younger adolescence, it is reasonable that these passengers would cause more distraction in their vehicles than the vehicles that do not include them. The odds ratio is nearly three times (2.872) its expected value, and the number of persons involved in crashes where a passenger causes a distraction is 3,208 persons.

This argues strongly for some PI&E that will lead parents and those transporting children to pull over off the road in relatively uncontrolled situations. We argue strongly against some ads we have heard that state that having screaming kids in the back seat is just as bad as DUI. This tends to give an excuse (false justification) to those who drive impaired.

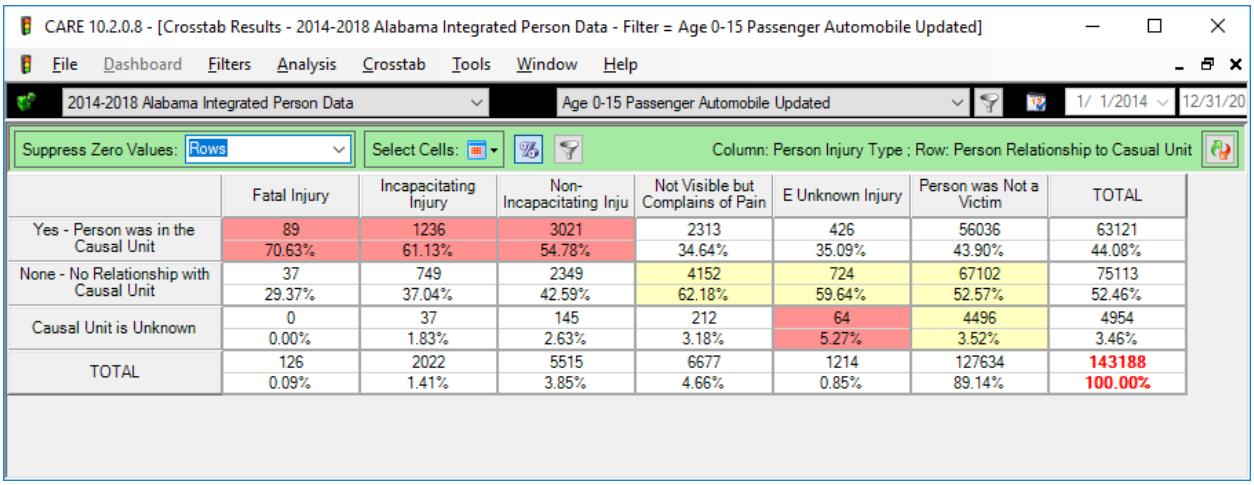
F2.5 P328 Person Injury Type for Passenger Aged 0-15



This gives a further overall picture of how many young people were injured and killed as non-driving occupants in traffic crashes over the five-year period of the study.

Younger persons' survivability is clearly seen in the display above, with the proportion of fatalities being only about one-third (0.336) of its expectation when compared to the population of older people. While the other three injury categories are not nearly as inconsistent with the general population, they are all significantly under-represented. The proportion of those not injured are over-represented by about 2%, this is a fairly large increase in the number of people (2,480 persons) who escaped injury altogether. There is no doubt that the proper use of child safety restraints is a major cause of this favorable outcome.

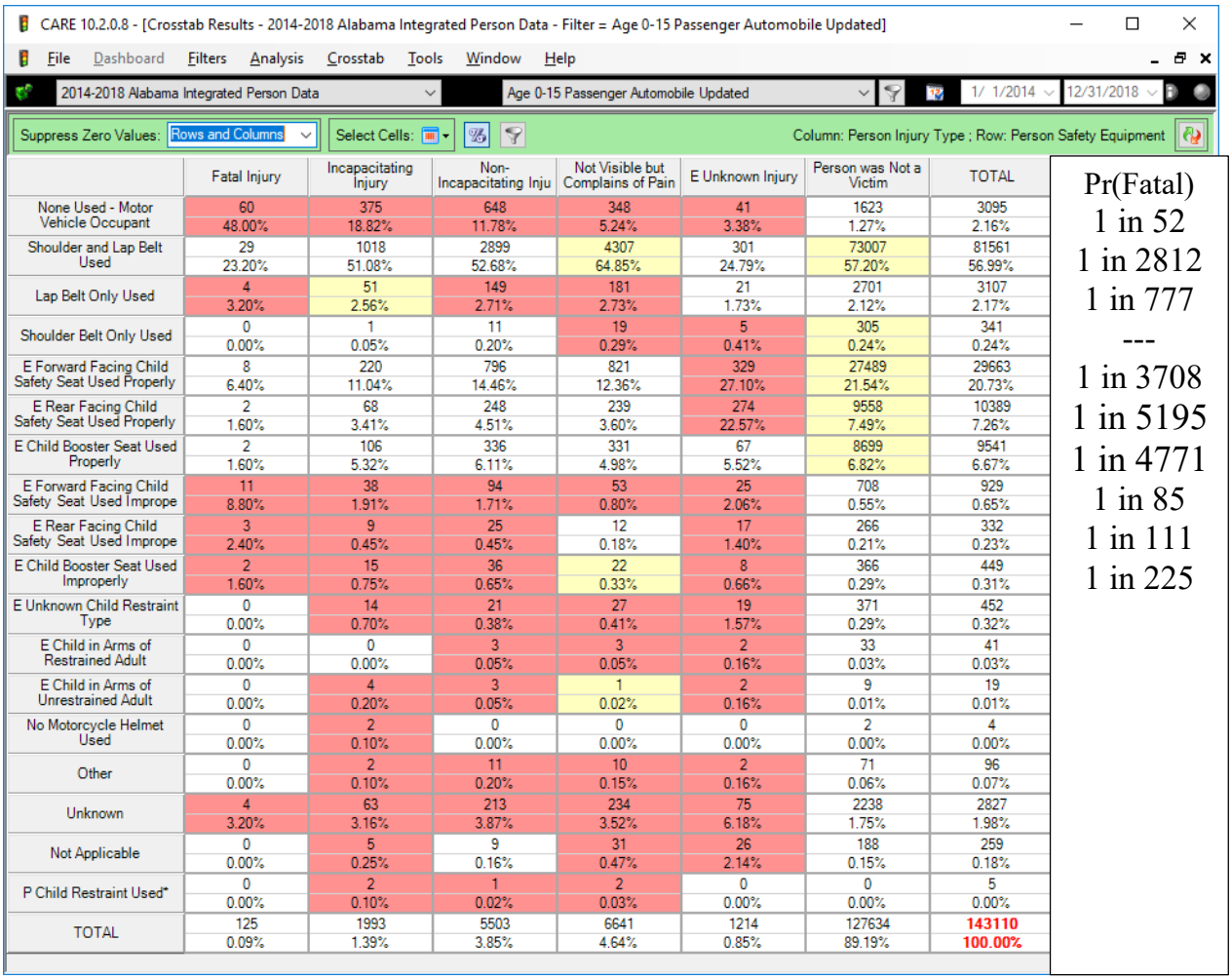
F2.6 P328 Injury Sev by P075 Rel to Causal V in Crashes w/ Age 0-15 Psngrs



	Fatal Injury	Incapacitating Injury	Non-Incapacitating Inju	Not Visible but Complains of Pain	E Unknown Injury	Person was Not a Victim	TOTAL
Yes - Person was in the Causal Unit	89 70.63%	1236 61.13%	3021 54.78%	2313 34.64%	426 35.09%	56036 43.90%	63121 44.08%
None - No Relationship with Causal Unit	37 29.37%	749 37.04%	2349 42.59%	4152 62.18%	724 59.64%	67102 52.57%	75113 52.46%
Causal Unit is Unknown	0 0.00%	37 1.83%	145 2.63%	212 3.18%	64 5.27%	4496 3.52%	4954 3.46%
TOTAL	126 0.09%	2022 1.41%	5515 3.85%	6677 4.66%	1214 0.85%	127634 89.14%	**143188** **100.00%**

Young passengers suffer the greater severities when they are in the causal vehicle as opposed to what we call the “victim” vehicle.

F2.7 P328 Severity by P323 Safety Equipment of Passengers Aged 0-15



CARE 10.2.0.8 - [Crosstab Results - 2014-2018 Alabama Integrated Person Data - Filter = Age 0-15 Passenger Automobile Updated]

File Dashboard Filters Analysis Crosstab Tools Window Help

2014-2018 Alabama Integrated Person Data | Age 0-15 Passenger Automobile Updated | 1/ 1/2014 | 12/31/2018

Suppress Zero Values: Rows and Columns | Select Cells: | Column: Person Injury Type ; Row: Person Safety Equipment

	Fatal Injury	Incapacitating Injury	Non-Incapacitating Inju	Not Visible but Complains of Pain	E Unknown Injury	Person was Not a Victim	TOTAL
None Used - Motor Vehicle Occupant	60 48.00%	375 18.82%	648 11.78%	348 5.24%	41 3.38%	1623 1.27%	3095 2.16%
Shoulder and Lap Belt Used	29 23.20%	1018 51.08%	2899 52.68%	4307 64.85%	301 24.79%	73007 57.20%	81561 56.99%
Lap Belt Only Used	4 3.20%	51 2.56%	149 2.71%	181 2.73%	21 1.73%	2701 2.12%	3107 2.17%
Shoulder Belt Only Used	0 0.00%	1 0.05%	11 0.20%	19 0.29%	5 0.41%	305 0.24%	341 0.24%
E Forward Facing Child Safety Seat Used Properly	8 6.40%	220 11.04%	796 14.46%	821 12.36%	329 27.10%	27489 21.54%	29663 20.73%
E Rear Facing Child Safety Seat Used Properly	2 1.60%	68 3.41%	248 4.51%	239 3.60%	274 22.57%	9558 7.49%	10389 7.26%
E Child Booster Seat Used Properly	2 1.60%	106 5.32%	336 6.11%	331 4.98%	67 5.52%	8699 6.82%	9541 6.67%
E Forward Facing Child Safety Seat Used Improp	11 8.80%	38 1.91%	94 1.71%	53 0.80%	25 2.06%	708 0.55%	929 0.65%
E Rear Facing Child Safety Seat Used Improp	3 2.40%	9 0.45%	25 0.45%	12 0.18%	17 1.40%	266 0.21%	332 0.23%
E Child Booster Seat Used Improperly	2 1.60%	15 0.75%	36 0.65%	22 0.33%	8 0.66%	366 0.29%	449 0.31%
E Unknown Child Restraint Type	0 0.00%	14 0.70%	21 0.38%	27 0.41%	19 1.57%	371 0.29%	452 0.32%
E Child in Arms of Restrained Adult	0 0.00%	0 0.00%	3 0.05%	3 0.05%	2 0.16%	33 0.03%	41 0.03%
E Child in Arms of Unrestrained Adult	0 0.00%	4 0.20%	3 0.05%	1 0.02%	2 0.16%	9 0.01%	19 0.01%
No Motorcycle Helmet Used	0 0.00%	2 0.10%	0 0.00%	0 0.00%	0 0.00%	2 0.00%	4 0.00%
Other	0 0.00%	2 0.10%	11 0.20%	10 0.15%	2 0.16%	71 0.06%	96 0.07%
Unknown	4 3.20%	63 3.16%	213 3.87%	234 3.52%	75 6.18%	2238 1.75%	2827 1.98%
Not Applicable	0 0.00%	5 0.25%	9 0.16%	31 0.47%	26 2.14%	188 0.15%	259 0.18%
P Child Restraint Used*	0 0.00%	2 0.10%	1 0.02%	2 0.03%	0 0.00%	0 0.00%	5 0.00%
TOTAL	125 0.09%	1993 1.39%	5503 3.85%	6641 4.64%	1214 0.85%	127634 89.19%	143110 100.00%

Pr(Fatal)
1 in 52
1 in 2812
1 in 777
---
1 in 3708
1 in 5195
1 in 4771
1 in 85
1 in 111
1 in 225

Ordered by best first:

- None Used - Motor Vehicle Occupant (1 in 52) = Worst
- Shoulder and Lap Belt Used (1 in 2812)
- Lap Belt Only Used (1 in 777)
- Forward Facing Child Safety Seat Used Properly (1 in 3708)
- Rear Facing Child Safety Seat Used Properly (1 in 5195) = Best
- Child Booster Seat Used Properly (1 in 4771) = Second Best
- Forward Facing Child Safety Seat Used Improperly (1 in 85) = Second Worst
- Rear Facing Child Safety Seat Used Improperly (1 in 111)
- Child Booster Seat Used Improperly (1 in 225)

The table below gives results for the three highest severity classifications: Fatal, Incapacitating Injury and Non-Incapacitating Injury. It shows the value, not just of being restrained, but of being restrained *properly*. The results demonstrate definitively that proper use of child restraints is critical.

Injury Probabilities for Various Restraint Conditions

RESTRAINT CONDITION	Fatal	Incapac	Non-Incap	No Injury	TOTAL
None Used - Motor Vehicle Occupant	60	375	648	1623	3095
Shoulder and Lap Belt Used	29	1018	2899	73007	81561
Lap Belt Only Used	4	51	149	2701	3107
Forward Facing Child Safety Seat Used Properly	8	220	796	27489	29663
Rear Facing Child Safety Seat Used Properly	2	68	248	9558	10389
Child Booster Seat Used Properly	2	106	336	8699	9541
Forward Facing Child Safety Seat Used Improperly	11	38	94	708	929
Rear Facing Child Safety Seat Used Improperly	3	9	25	266	332
Child Booster Seat Used Improperly	2	15	36	366	449
N=RESTRAINT CONDITION INJURY PROBABILITY (1 in every N crashes)					
None Used - Motor Vehicle Occupant	51.6	8.3	4.8	1.91	
Shoulder and Lap Belt Used	2812.4	80.1	28.1	1.12	
Lap Belt Only Used	776.8	60.9	20.9	1.15	
Forward Facing Child Safety Seat Used Properly	3707.9	134.8	37.3	1.08	
Rear Facing Child Safety Seat Used Properly	5194.5	152.8	41.9	1.09	
Child Booster Seat Used Properly	4770.5	90.0	28.4	1.10	
Forward Facing Child Safety Seat Used Improperly	84.5	24.4	9.9	1.31	
Rear Facing Child Safety Seat Used Improperly	110.7	36.9	13.3	1.25	
Child Booster Seat Used Improperly	224.5	29.9	12.5	1.23	
IMPROPER USE INJURY PROBABILITY MULTIPLIER					
Forward Facing Child Safety Seat Used Improperly	43.9	5.5	3.8	0.82	
Rear Facing Child Safety Seat Used Improperly	46.9	4.1	3.2	0.87	
Child Booster Seat Used Improperly	21.2	3.0	2.3	0.89	

The table above is quite useful in visualizing the full consequences of not using restraints properly. The non-child restraint categories apply to passengers who are less than 15, and they are best interpreted only to that age classification.

F2.8 P328 by P323 for Child Restraints Only

Analysis of the Harm Produced by Improper Use of Child Safety Seats

The table below gives results for the three highest severity classifications: Fatal, Incapacitating Injury (Incap) and Non-Incapacitating Injury (Non-Incap). There is also a column for No Injury. It shows the values, not only of being restrained, but also of being restraint properly.

Injury Probabilities for Various Child Restraint Conditions

RESTRAINT CONDITION	Fatal	Incapac	Non-Incap	No Injury	TOTAL
Forward Facing Child Safety Seat Used Properly	8	220	796	27489	29663
Rear Facing Child Safety Seat Used Properly	2	68	248	9558	10389
Child Booster Seat Used Properly	2	106	336	8699	9541
Forward Facing Child Safety Seat Used **Improperly**	11	38	94	708	929
Rear Facing Child Safety Seat Used **Improperly**	3	9	25	266	332
Child Booster Seat Used **Improperly**	2	15	36	366	449
N=RESTRAINT CONDITION FATALITY/INJURY PROBABILITY (1 in every N crashes)					
Forward Facing Child Safety Seat Used Properly	3707.9	134.8	37.3	1.08	
Rear Facing Child Safety Seat Used Properly	5194.5	152.8	41.9	1.09	
Child Booster Seat Used Properly	4770.5	90.0	28.4	1.10	
Forward Facing Child Safety Seat Used **Improperly**	84.5	24.4	9.9	1.31	
Rear Facing Child Safety Seat Used **Improperly**	110.7	36.9	13.3	1.25	
Child Booster Seat Used **Improperly**	224.5	29.9	12.5	1.23	
IMPROPER USE INJURY-PROBABILITY MULTIPLIER					
Forward Facing Child Safety Seat Used **Improperly**	43.9	5.5	3.8	0.82	
Rear Facing Child Safety Seat Used **Improperly**	46.9	4.1	3.2	0.87	
Child Booster Seat Used **Improperly**	21.2	3.0	2.3	0.89	

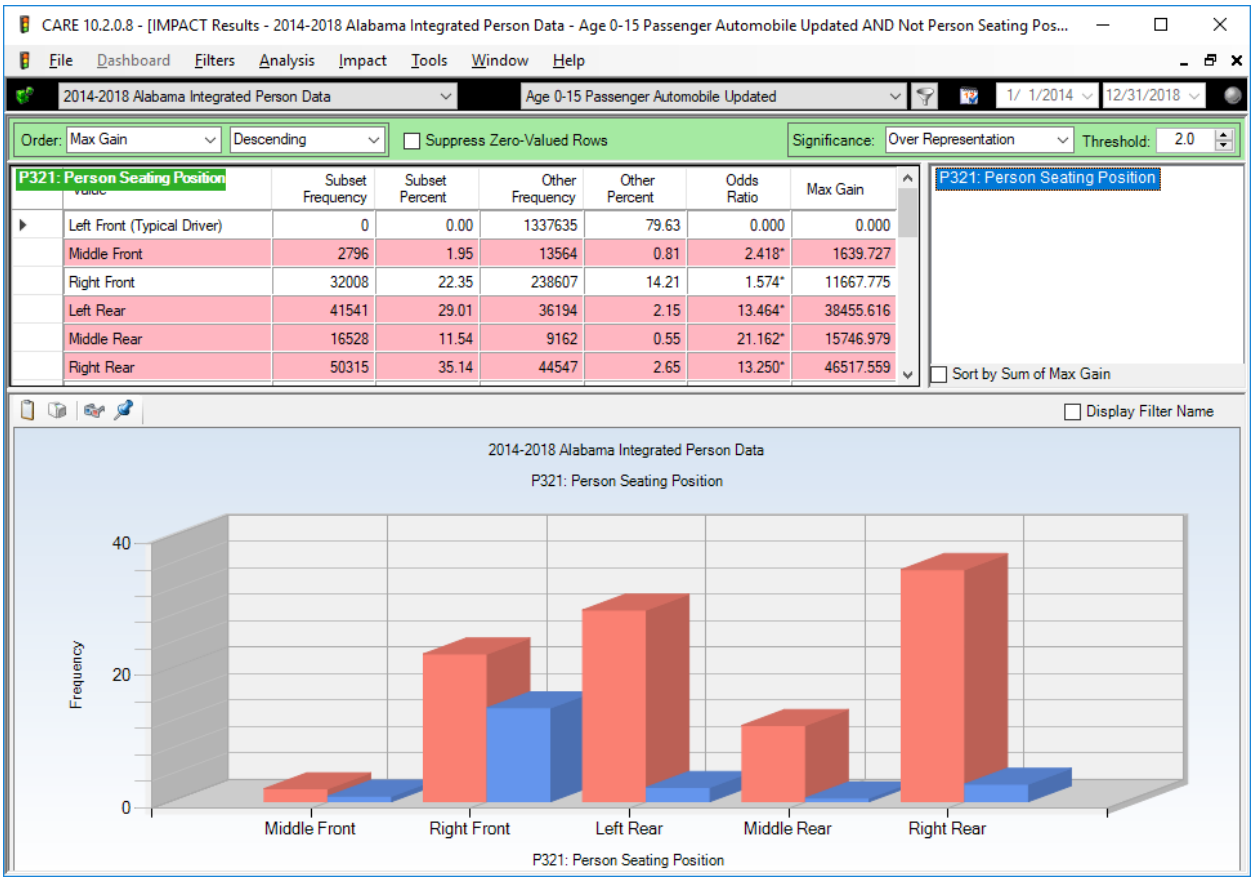
The middle part of the table above provides perspective on the raw numbers at the top. It is very important to interpret these properly. *The larger the number the better*. For example, one fatality in every 1000 crashes is far better than one fatality in every 50 crashes. We have omitted the "no restraint" option in the tables above since the emphasis here is on comparing proper with improper use. But the ratio for not being restrained at all is about 1 in 50, and the other injury severities are similarly very much worse than those for any use of restraints.

The bottom part of the table provides even more perspective since it directly compares the results of the probabilities given above, which is quite useful in visualizing the full consequences of not using restraints properly. These results were surprising even to many who have been in the traffic safety community for decades. As an example, the use of forward-facing child safety seats are extremely effective when used properly, reducing the chance of fatality from 1 in 50 down to

1 in 3707.9. However, when used improperly, the chances of death increases to 1 in 84.5 (which is not that much different from the worst case situation of no restraint all=1 in 50). The bottom table shows that this is a probability increase of 43.9 times the proper-use estimate.

The most effective child restraint is "Rear Facing Child Safety Seat Used Properly," which reduces the death rate to 1 in 5194.5. However, if not used properly, it is disabled to the extent that the probability of death rises to 1 in 110.7. This has the highest multiplier, equal to 46.9, meaning that the 5194.5 is about 46.9 times 110.7. These results demonstrate definitively that *proper use of child restraints is critical.*

F2.9 P321 Seating Position IMPACT of Passengers Aged 0-15



Over-representations in the back seat position are expected; this gives the degree of these over-representations and the number of people affected. The large number in the driver position for older occupants essentially dwarfs the percentages in the other positions. But the red bars give an accurate perception of the younger passengers.

F2.10 P321 Seating Position by P328 Person Injury Type (Passengers Aged 0-15)

CARE 10.2.0.8 - [Crosstab Results - 2014-2018 Alabama Integrated Person Data - Filter = Age 0-15 Passenger Automobile Updated]

File Dashboard Filters Analysis Crosstab Tools Window Help

2014-2018 Alabama Integrated Person Data | Age 0-15 Passenger Automobile Updated | 1/ 1/2014

Suppress Zero Values: Rows and Columns | Select Cells: | Column: Person Seating Position ; Row: Person Injury Type

	Middle Front	Right Front	Left Rear	Middle Rear	Right Rear	TOTAL
Fatal Injury	2 0.07%	34 0.11%	34 0.08%	17 0.10%	39 0.08%	126 0.09%
Incapacitating Injury	46 1.65%	643 2.01%	521 1.25%	233 1.41%	579 1.15%	2022 1.41%
Non-Incapacitating Inju	122 4.36%	1562 4.88%	1532 3.69%	610 3.69%	1689 3.36%	5515 3.85%
Not Visible but Complains of Pain	171 6.12%	1824 5.70%	1824 4.39%	699 4.23%	2159 4.29%	6677 4.66%
E Unknown Injury	50 1.79%	136 0.42%	343 0.83%	204 1.23%	481 0.96%	1214 0.85%
Person was Not a Victim	2405 86.02%	27809 86.88%	37287 89.76%	14765 89.33%	45368 90.17%	127634 89.14%
TOTAL	2796 1.95%	32008 22.35%	41541 29.01%	16528 11.54%	50315 35.14%	143188 100.00%

Considering the transpose of the cross-tabulation above (severity by seating position):

CARE 10.2.0.8 - [Crosstab Results - 2014-2018 Alabama Integrated Person Data - Filter = Age 0-15 Passenger Automobile Updated]

File Dashboard Filters Analysis Crosstab Tools Window Help

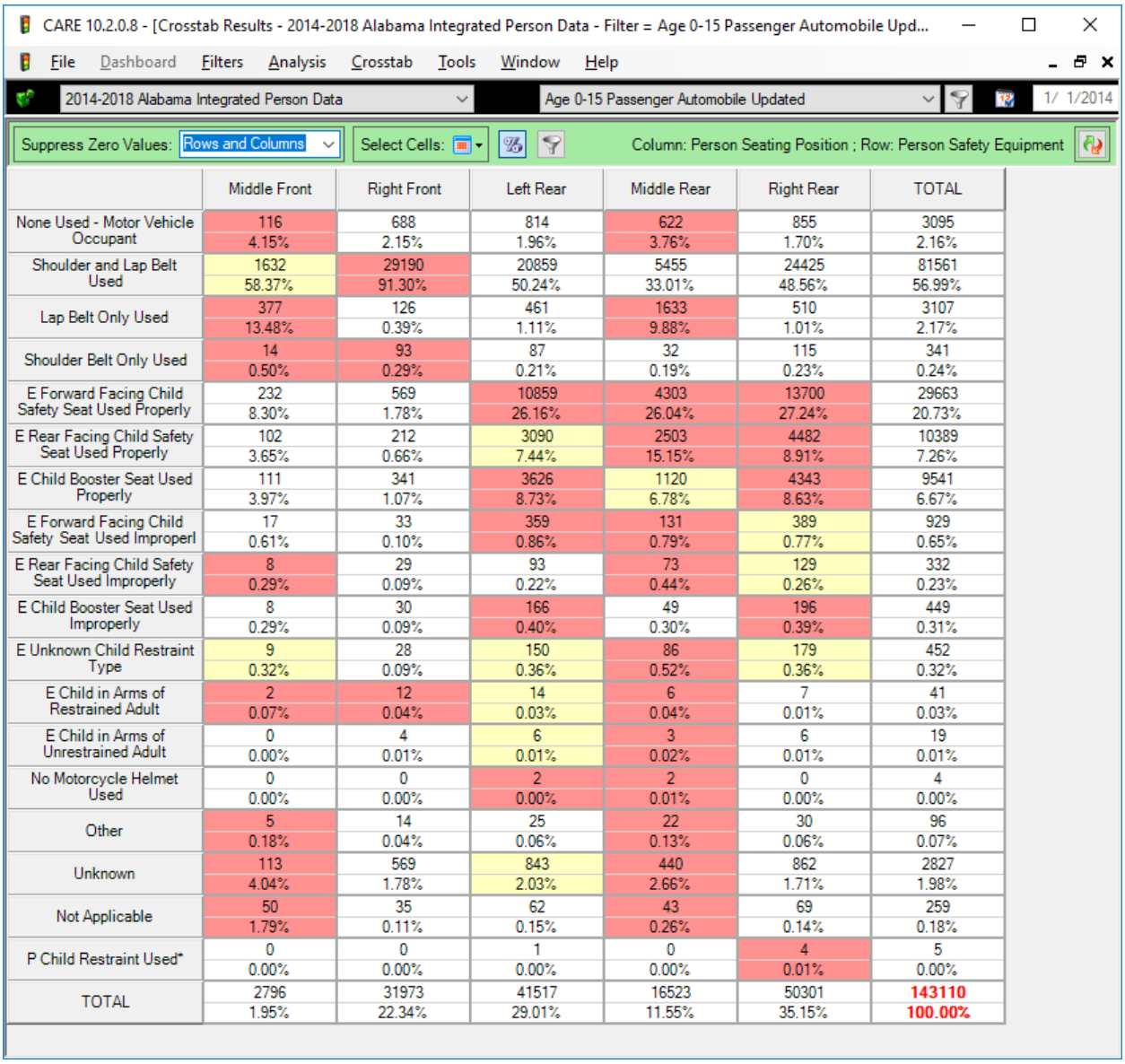
2014-2018 Alabama Integrated Person Data | Age 0-15 Passenger Automobile Updated | 1/ 1/2014

Suppress Zero Values: Rows and Columns | Select Cells: | Column: Person Injury Type ; Row: Person Seating Position

	Fatal Injury	Incapacitating Injury	Non-Incapacitating Inju	Not Visible but Complains of Pain	E Unknown Injury	Person was Not a Victim	TOTAL
Middle Front	2 1.59%	46 2.27%	122 2.21%	171 2.56%	50 4.12%	2405 1.88%	2796 1.95%
Right Front	34 26.98%	643 31.80%	1562 28.32%	1824 27.32%	136 11.20%	27809 21.79%	32008 22.35%
Left Rear	34 26.98%	521 25.77%	1532 27.78%	1824 27.32%	343 28.25%	37287 29.21%	41541 29.01%
Middle Rear	17 13.49%	233 11.52%	610 11.06%	699 10.47%	204 16.80%	14765 11.57%	16528 11.54%
Right Rear	39 30.95%	579 28.64%	1689 30.63%	2159 32.33%	481 39.62%	45368 35.55%	50315 35.14%
TOTAL	126 0.09%	2022 1.41%	5515 3.85%	6677 4.66%	1214 0.85%	127634 89.14%	143188 100.00%

Clearly the right front position is the most vulnerable position, with the middle front showing lower numbers because of the relatively few persons who were sitting in this position at the time of the crash (2,796).

F2.11 P321 Seating Pos by P323 Safety Equipment of Passengers Aged 0-15



CARE 10.2.0.8 - [Crosstab Results - 2014-2018 Alabama Integrated Person Data - Filter = Age 0-15 Passenger Automobile Upd...

File Dashboard Filters Analysis Crosstab Tools Window Help

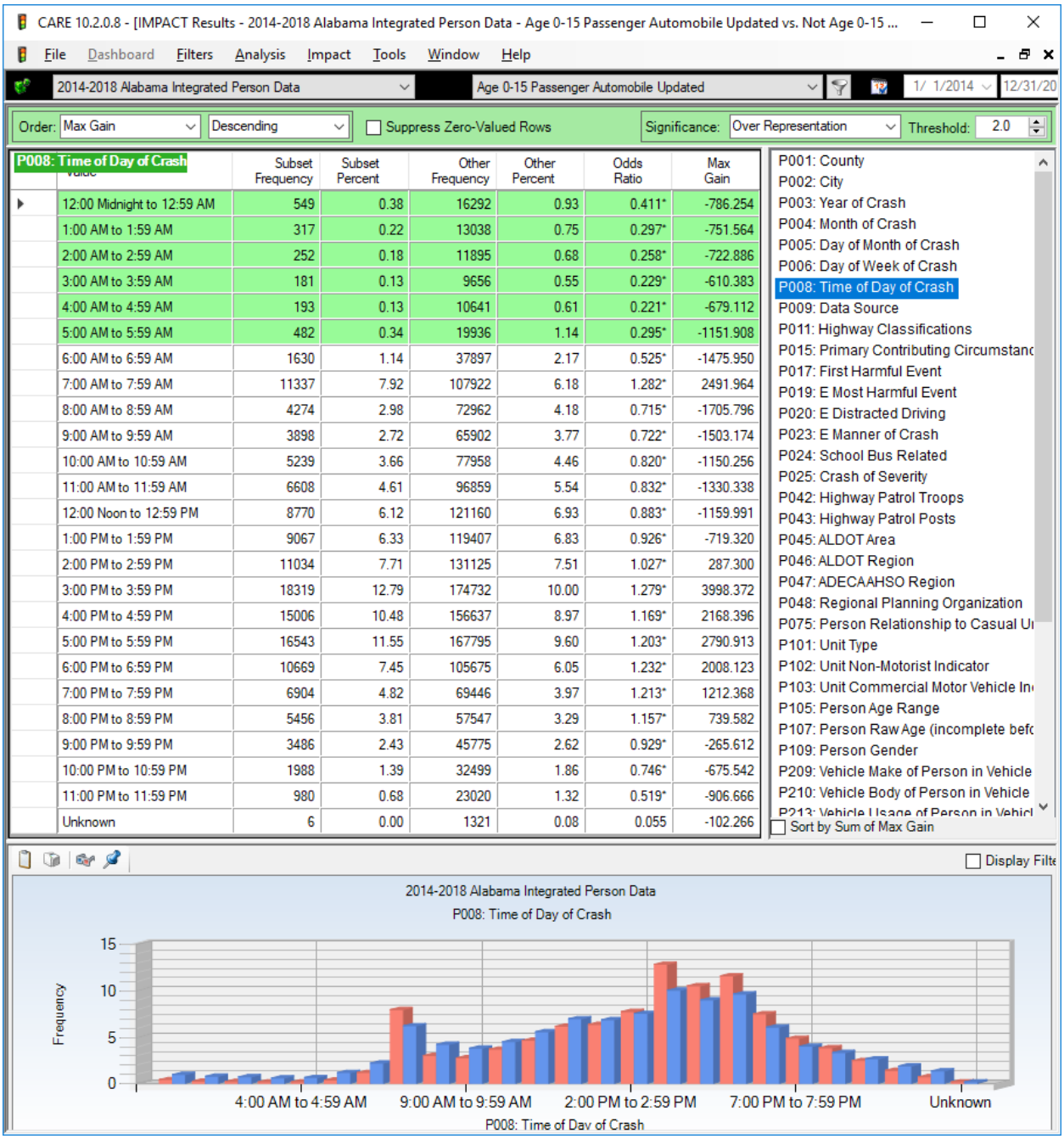
2014-2018 Alabama Integrated Person Data | Age 0-15 Passenger Automobile Updated | 1/ 1/2014

Suppress Zero Values: Rows and Columns | Select Cells: | Column: Person Seating Position ; Row: Person Safety Equipment

	Middle Front	Right Front	Left Rear	Middle Rear	Right Rear	TOTAL
None Used - Motor Vehicle Occupant	116 4.15%	688 2.15%	814 1.96%	622 3.76%	855 1.70%	3095 2.16%
Shoulder and Lap Belt Used	1632 58.37%	29190 91.30%	20859 50.24%	5455 33.01%	24425 48.56%	81561 56.99%
Lap Belt Only Used	377 13.48%	126 0.39%	461 1.11%	1633 9.88%	510 1.01%	3107 2.17%
Shoulder Belt Only Used	14 0.50%	93 0.29%	87 0.21%	32 0.19%	115 0.23%	341 0.24%
E Forward Facing Child Safety Seat Used Properly	232 8.30%	569 1.78%	10859 26.16%	4303 26.04%	13700 27.24%	29663 20.73%
E Rear Facing Child Safety Seat Used Properly	102 3.65%	212 0.66%	3090 7.44%	2503 15.15%	4482 8.91%	10389 7.26%
E Child Booster Seat Used Properly	111 3.97%	341 1.07%	3626 8.73%	1120 6.78%	4343 8.63%	9541 6.67%
E Forward Facing Child Safety Seat Used Improperl	17 0.61%	33 0.10%	359 0.86%	131 0.79%	389 0.77%	929 0.65%
E Rear Facing Child Safety Seat Used Improperly	8 0.29%	29 0.09%	93 0.22%	73 0.44%	129 0.26%	332 0.23%
E Child Booster Seat Used Improperly	8 0.29%	30 0.09%	166 0.40%	49 0.30%	196 0.39%	449 0.31%
E Unknown Child Restraint Type	9 0.32%	28 0.09%	150 0.36%	86 0.52%	179 0.36%	452 0.32%
E Child in Arms of Restrained Adult	2 0.07%	12 0.04%	14 0.03%	6 0.04%	7 0.01%	41 0.03%
E Child in Arms of Unrestrained Adult	0 0.00%	4 0.01%	6 0.01%	3 0.02%	6 0.01%	19 0.01%
No Motorcycle Helmet Used	0 0.00%	0 0.00%	2 0.00%	2 0.01%	0 0.00%	4 0.00%
Other	5 0.18%	14 0.04%	25 0.06%	22 0.13%	30 0.06%	96 0.07%
Unknown	113 4.04%	569 1.78%	843 2.03%	440 2.66%	862 1.71%	2827 1.98%
Not Applicable	50 1.79%	35 0.11%	62 0.15%	43 0.26%	69 0.14%	259 0.18%
P Child Restraint Used*	0 0.00%	0 0.00%	1 0.00%	0 0.00%	4 0.01%	5 0.00%
TOTAL	2796 1.95%	31973 22.34%	41517 29.01%	16523 11.55%	50301 35.15%	143110 100.00%

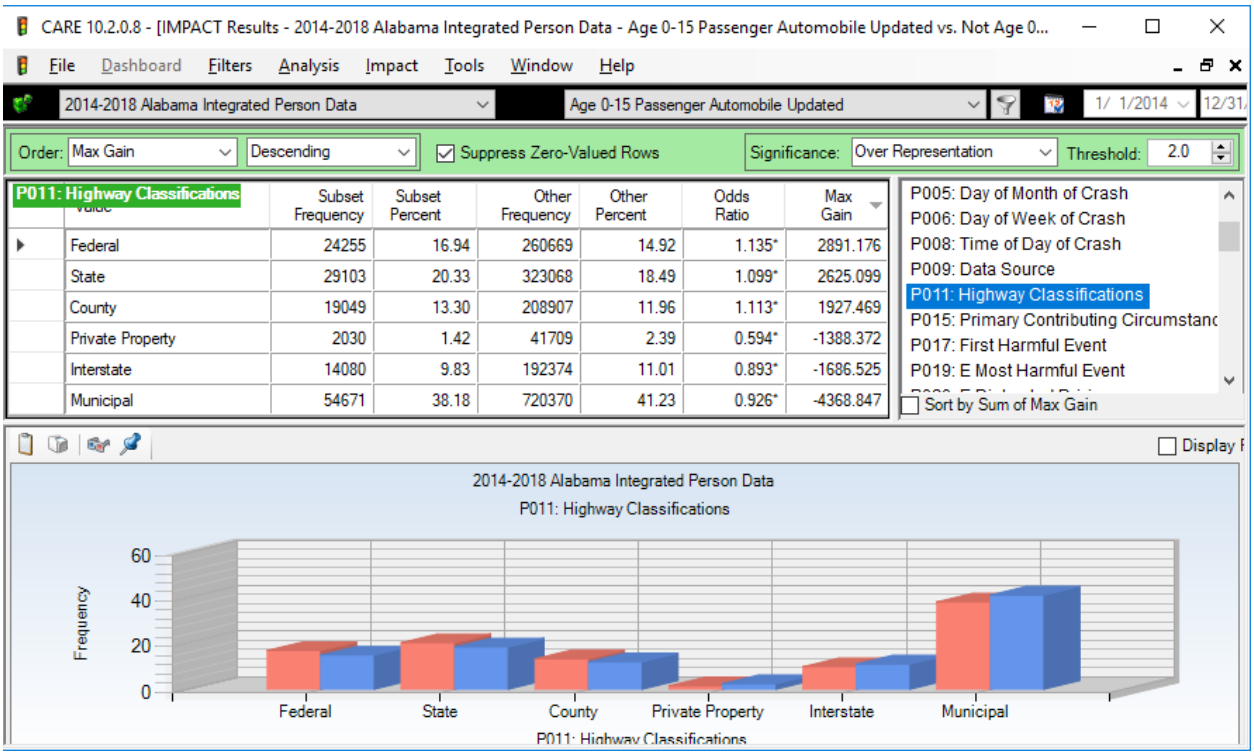
The cross-tabulation above is useful for determining the seating positions in which the use of proper safety restraints is most often deficient. The None Used row at the top is probably the most useful, showing that the middle front and middle rear are the positions that are most over-represented from a proportion point of view. Entries will not appear in these positions if the position is vacant. The left and right rear have the higher numbers, but their lower proportions are only because most children are being restrained in these positions so their proportions are relatively low (no red background).

F2.12 P008 Time of Day of Crashes with Passengers Aged 0-15

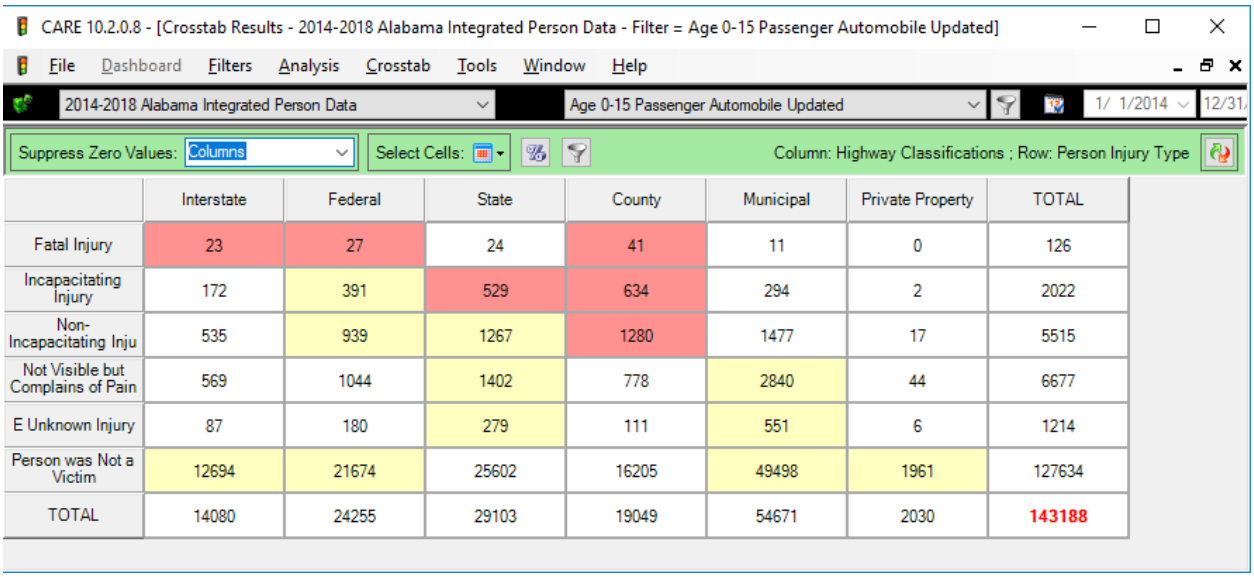


Over-represented times of day reflect the before and after school hours. The collective from 2 PM to 9 PM is the worst time, but it is the reasonable time for these young people to be transported.

F2.13 P011 Highway Classification of Crashes with Passengers Aged 0-15



F2.14 P011 Highway Classification by P328 Person Injury Type



	Interstate	Federal	State	County	Municipal	Private Property	TOTAL
Fatal Injury	23	27	24	41	11	0	126
Incapacitating Injury	172	391	529	634	294	2	2022
Non-Incapacitating Inju	535	939	1267	1280	1477	17	5515
Not Visible but Complains of Pain	569	1044	1402	778	2840	44	6677
E Unknown Injury	87	180	279	111	551	6	1214
Person was Not a Victim	12694	21674	25602	16205	49498	1961	127634
TOTAL	14080	24255	29103	19049	54671	2030	143188

Younger occupants' injury and fatal crashes tend to occur on rural Federal, State and County roads as opposed to Interstates and Municipal streets. The severity of these crashes is most highly correlated with the speed at impact, which puts the rural roads and Interstates, as seen in the cross-tabulation above. County roads typically have a 45 MPH speed limit, and if this limit were obeyed at all times, it would cut down significantly on the fatalities on the county roads.