

ANALYSIS OF THE SELECTION OF A CHILD SEAT

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Abstract

The selection of a child seat is not an easy task for future parents. Information about child seats, assembly methods, usability and prices affect the purchasing preferences of parents or legal guardians of children. The article contains information about the factors to pay attention to when buying a child seat. The main purpose of the article is to analyze and evaluate information on the selection of a vehicle seat for the right passenger vehicle and child. The article presents information on groups of child seats and the method of their installation in a passenger vehicle. The purchasing predispositions of parents and legal guardians in terms of the selection of a child seat were also described. It should be noted that most respondents pay attention to the level of safety of child seats than to their price.

Keywords: child seat; crash tests; safety

1. Introduction

The child's safety is always the parent's first priority [16]. Therefore, care for the child should translate into issues related to transporting children in a passenger vehicle. According to Global Road Safety 2010–2018, road accidents are the leading cause of people aged 5 to 20 [17]. On the other hand, children aged 3 to 11 years account for 42% of all child fatalities [18]. According to the police headquarters, in 2021, 433 people died in road accidents in Poland as a result of head-on collisions. There were 2,489 frontal accidents in 2021. It should be noted that the number of frontal collisions is almost three times lower than the number of side collisions (7,371 accidents in 2021), the number of fatalities in side accidents is 443. The number of fatalities, the results of a side collision are almost the same as in a head-on collision. In 2022, there were 1,794 road accidents in Poland involving children aged 0 to 14. In these incidents, 53 children were killed and 1,863 were injured. Compared to 2021, the number of accidents increased by 1.1%, the number of fatalities by 6%, and the number of injured children by 1.7% [4]. The victims of road accidents of children in 2019–2022 are presented in Table 1.

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Tab. 1. Victims of road accidents of children in 2019–2022 [9]

Ages	Fatalities, n				Injured, n			
	2019	2020	2021	2022	2019	2020	2021	2022
0–6	22	12	23	22	790	470	527	499
7–14	46	32	27	31	1831	1135	1305	1364
Sum	68	44	50	53	2621	1605	1832	1863

Of course, there may be many reasons for the upward trend in accidents involving children and adolescents [3]. Among them, however, there are gross errors of adults: permission to ride with or without seat belts fastened loosely, in an unsuitable vehicle seat or without it, or in a booster seat that does not provide any protection in a collision or accident. Therefore, in order to give the child maximum safety, it should be transported in a properly selected child seat in terms of the child's age and body structure [19]. In addition, it should be noted that the safest way to install a child seat in a passenger vehicle is to install the seat rear-facing (RWF seat). It is recommended to transport your child rearward-facing for as long as possible (at least until the age of 4). It is safer to transport your child in a rear-facing child seat. The baby's head makes up about 25% of its body mass and is placed on the cervical vertebrae that have not yet ossified. In the event of a collision, the head of a child sitting in a forward-facing vehicle seat is pushed forward with considerable force. Thus, the vulnerable, uneducated neck of a small child will not be able to withstand such overloads, which in extreme cases may result in the death of the child. In the case of RWF vehicle seats, the impact force is distributed over the child's back and the backrest of the vehicle seat. This situation means that the neck of a child transported in a rear-facing child seat is protected.

Until recently, in the Polish road traffic law, one of the determinants of whether a child should travel in a child seat or not was his age. By law, every child up to 12 years of age had to be transported in a child seat. From 2017, the obligation to transport children in a vehicle in a child seat depends on the child's height. According to the Polish road traffic law, a child who is less than 150 cm tall must be transported in a child seat. However, it should be noted that choosing the right child seat is not an easy task and causes a lot of problems, especially for novice parents.

The main purpose of this article is to draw attention to the difficulties arising from the selection of a vehicle seat. The article contains information about road accidents in 2019–2022. The second section provides information on the types of child seats available, including how they are installed. The third part deals with information on crash tests of child seats, while the fourth section deals with the subject of consumer characteristics of a child seat that shape purchasing preferences.

2. Types of child seats

When choosing a child seat, there are a few important things to keep in mind. The child seat should be safe and fit the vehicle. Before buying a child seat, try the seat on the passenger vehicle in which the child will be transported [1]. It should be noted that the height of the rear seat of a passenger vehicle, the location of the seat belts, its equipment and the height of the ISOFIX mount differ in terms of the model and brand of passenger vehicles [4]. Therefore, not every child seat will perfectly fit our passenger vehicle, and even more so to the dimensions of the child, and not in every vehicle the best seat will offer the right backrest angle. There are two general types of child seats depending on how they are attached to the seat [11]:

- Fastened with seat belts – secured with the vehicle's seat belts
- ISOFIX/i-Size – Attaches to anchor rods built into vehicle seats

Some child seats available on the market can be installed using both methods of attachment. Mostly, child seats fastened with standard seat belts can be mounted on any seat of the rear seat. When attaching a child seat using the ISOFIX base, please note that most passenger vehicles will not be equipped with the ISOFIX anchor located in the middle of the passenger vehicles rear seat. In addition, most rear vehicle seats will have a booster in the center section which would make it difficult to install a child seat. Figure 1 shows an exemplary scheme of attaching a child seat in a passenger vehicle using the ISOFIX base [12]. In most passenger vehicles, infants can occupy the rear center seat using a rear-facing child seat secured with standard seat belts [12, 14].

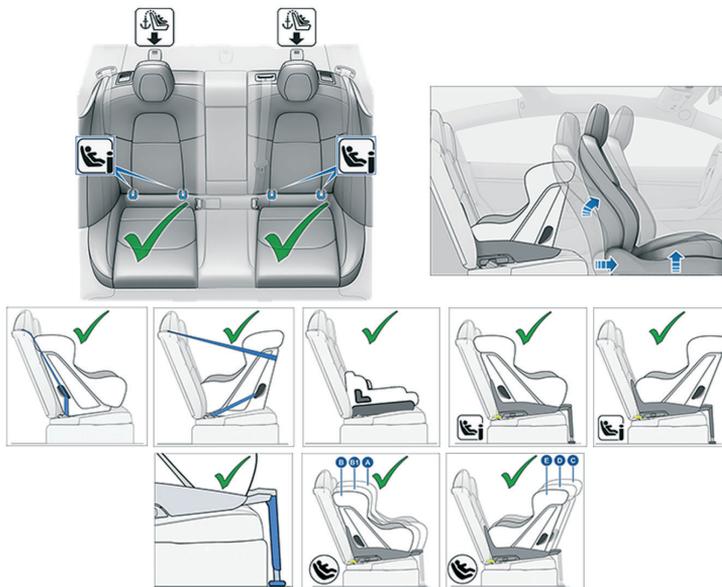


Fig. 1. Mounting the child seat on the rear seat of a passenger vehicle with ISOFIX base [12]

Unfortunately, it is not possible to equip a passenger vehicle with one universal child seat that will be used from the birth of the child to approximately 12 years of age. The differences between a newborn and a one-year-old or two-year-old child are clearly visible. Therefore, depending on the degree of development of the child or the maturation of its bone structures, internal organs, body mass and height, we must choose the right child seat. We can distinguish several groups of child seats, such as [4]:

- for newborns – up to a maximum of 87 cm rear-facing,
- for older children – up to 105 or 125 cm – rear-facing,
- for large children from 100 cm to 150 cm forward facing.

Rear-facing child seats are generally intended for newborns and infants from approximately 12 to 15 months of age, and for seniors up to 4 years (up to 105 cm) or seniors up to 6 years (up to 125 cm). The determinant of their use is the mass and height of the child. When the child's head protrudes beyond the backrest of the child seat, the parent should replace the seat with a larger one. These types of child seats have a characteristic cradle-like shape. Such a child seat most often has the option of mounting in a pram, it should be noted that this is not its main purpose. The child should stay in the child seat for no more than 2 hours. After this time, a break of at least 45 minutes is recommended to continue the journey. When using the seat of the youngest group, remember that it must not be installed in the front vehicle seat with an active front airbag [5, 15]. In addition, this type of child seat must never be used in a forward-facing position. Child seats of the youngest group can be registered in a passenger vehicle using standard seat belts or using the ISOFIX base [5]. Figure 2 shows the markings on how to install a child seat in a passenger vehicle.



Fig. 2. Marking of the methods of mounting the child seat of the youngest group in a passenger vehicle

When the child reaches the mass of 9 kg and begins to sit up unaided, it can be transported in the seat of the next group. These types of child seats have a backrest adjustment function so that the child can fall asleep freely in the child seat while driving. The group of (100–150) cm vehicle seats are the last child vehicle seats. Children, instead of using the inner belts of a child seat, can already use standard seat belts placed in a passenger vehicle [20]. In addition, the seats of this group have the ability to adjust not only the backrest but also the headrest, thanks to which they grow with the child. However, it should be remembered that each child grows at a different pace and sometimes the recommended age group will not be suitable for our child. It is then worth looking at the growth groups and adapting them to the current needs of the child, as well as visiting a specialist store to verify the child's needs.

The main idea behind i-Size classification is to replace mass criteria with height criteria. Thanks to this standard, it is much easier to choose a child seat. i-Size seats achieve the best results in crash tests. They protect the child's head and cervical vertebrae much better, thanks to which they meet the latest safety standards. Until the age of 15 months, i-Size introduced restrictions requiring the transport of children rear-facing due to the very fragile body of the baby. To ensure maximum safety, it is worth remembering that i-Size vehicle seats are only compatible with vehicles that have ISOFIX. Thanks to the ISOFIX bezel, the installation of the seat is much faster, moreover, the use of the ISOFIX base for mounting the child seat eliminates errors in mounting the seat [6]. Figures 3 and 4 show examples of child seats installed on the Isofix base.



Fig. 3. Child seat 0+ mounted on the ISOFIX base, rear-facing [6]



Fig. 4. Child seat "I" mounted on the ISOFIX base, facing the direction of travel [6]

3. Crash tests of child seat

Every seat approved for sale in European countries should receive the European approval standard ECE R129, called i-Size. It is worth remembering, however, that the ECE R44/04 approval itself is not a guarantee of safety. Homologation only means that the European Union has only stated that a given vehicle seat is intended for a specific mass group [6]. Therefore, when choosing a child seat, pay attention to whether the seat has passed ADAC tests or other safety tests recognized in Europe. The most important crash tests in Europe include ADAC, OEAMTC and Test Plus. The safety tests take into account not only the effects of the collision, but also the quality of the cover materials, the size and mass of the seat and the assembly. These are the most important components affecting user safety. The frame of the ADAC vehicle seat crash test is shown in Figure 5.



Fig. 5. Crash test frame of ADAC vehicle seats [8]

ADAC is the most recognized by consumers in Europe test assessing the safety of child seats. When assessing vehicle seats, ADAC takes into account: safety, operation (is it easy and intuitive), ergonomics, harmful substances, cleaning. The highest rating in the test is 5 stars and the lowest is 1 star [10]. TEST PLUS is considered extremely rigorous and is only for rear-facing (RWF) models. Test Plus was introduced by the Swedish automotive institutes: VTI (Swedish National Institute for Road and Transport Development) and NFT (National Road Safety Society). This tests child seats in two mass categories up to 18 kilograms and up to 25 kilograms.

Safety tests for children's vehicle seats are carried out in laboratory conditions in an identical situation, so that the results they achieve are reliable – during the simulation of a side impact at a speed of 50 km/h and a frontal impact at a speed of 72 km/h. In the category related to comfort, specialists check whether a given model of the vehicle seat is comfortable for the child and whether it sits in a comfortable position. Under the watchful eye of experts, the softness of the upholstery is also checked and whether the seat belts or other structural elements do not oppress the small passenger. Usability is another category evaluated in the ADAC test. Here, experts check how the vehicle seat behaves during everyday use. The method of its assembly and disassembly is checked. The last category considered in this test is cleaning. The ease of keeping the seat clean is assessed here, as well as whether the upholstery is easy to disassemble and whether it is machine washable [2, 7, 10].

Test Plus stands out from other vehicle seat safety tests in that the forces acting on the dummy's neck are measured using sensors. This means that forward-facing vehicle seats have no chance of passing the test due to too much stress on the child's neck during the impact. Higher speed than R44 and R129 homologation tests. Extremely short stopping distance which makes the test even more ruthless. The seat is simulated during this test with a frontal impact at 56.5 km/h and a short stopping distance. The pressure forces acting on the head and neck of a dummy placed in a speeding seat, which collides with a specially designed wall, are then measured. Models in which the mass acting on the dummy's head and neck is reduced to safe values pass the test, the rest are eliminated. Vehicle seats that pass the voluntary PLUS TEST are undoubtedly the safest.

4. Shopping preferences

Vehicle seats have been produced at least since the 1950s. There are a lot of companies in the world that specialize in their production, constantly outdoing each other in creating ever safer solutions and new designs. These solutions are designed to ensure full safety when transporting a child in vehicle seats. Unfortunately, the vast majority of manufacturers focus only on this aspect, omitting very important other features that a child seat should meet. We are talking about issues related to travel comfort, vibration comfort or modern solutions aimed at safe movement of a child placed in a rear-facing vehicle seat. Both on the foreign and Polish market there are no technological solutions that would combine all these aspects into one whole. From the moment of mass production, manufacturers who are not really involved, appeared on the Polish market in the creation of vehicle seats from the very beginning, i.e. project, design, tests, etc. The vast majority of players on the Polish market are producers using available, ready-made solutions that are created on the foreign market, and are sold on the Polish market as licensed products. From these available products, companies create a product that they then sell under their own brand. Unfortunately, the problem with this type of solutions is that a given company has no influence on the quality, introduced changes or the possibility of improvements in certain areas because it is not physically a product designed by them. Based on the survey conducted by NEST bank in 2017, it can be seen that safety tests are the main factor that parents and legal guardians pay attention to when buying a child seat. 900 respondents took part in the survey. The charac-

teristics of NEST bank respondents in terms of the factors they pay attention to when buying a child seat are presented in Figure 6. The vast majority of parents pay attention to safety certificates when buying a child seat [82.8%]. Less important are: service life [42.5%], price [42.3%], crash tests [38.8%]. The opinion of friends/family is the least important [18.0%] [13].

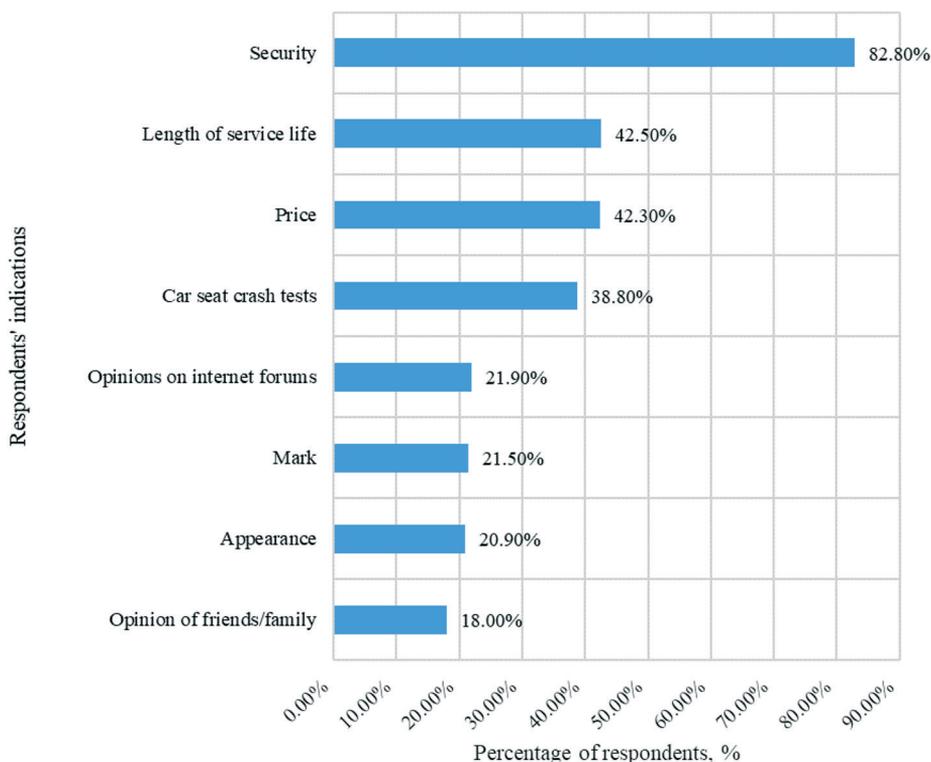


Fig. 6. Characteristics of NEST bank respondents in terms of factors they pay attention to when buying a child seat

5. Conclusions

The right choice of vehicle seat depends on the age and height of the child. It's important to buy the right type of child seat, as regulations not only state that children must travel in a vehicle seat, but also specify the type of seat they must use. Many parents prefer the comfort of an infant vehicle seat because the vehicle seat can be removed from the vehicle without having to unfasten the seat belt and possibly wake up a sleeping baby. The base of the vehicle seat remains attached to the vehicle, the carrier simply snaps on and slides out of the base, keeping potential assembly errors to a minimum.

By law, all children under 150 cm tall or under 12 years of age must have their own car seat. All car seats should be designed to provide your child with the best possible protection and meet the current safety regulations set out in UNECE R129.

It is recommended that your child continue to use a rear-facing vehicle seat until they are at least 4 years old. This is because a child's body, especially the neck, is particularly vulnerable under this age to severe impacts and stretching (spinal cord and spinal cord injuries), and a rear-facing vehicle seat provides additional protection.

In terms of comfort, it is worth choosing a chair that will be relatively light. We must remember that for more than a year when using the child seat, we will carry the child and the seat. The differences in the mass of the seats are really big. Vehicle seats from 2.5 kg to over 5 kg are available on the market.

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