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An ecological model to factors associated with booster seat use: A population based study

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ABSTRACT

Belt-positioning booster seat use (BPB) is an effective technology to prevent severe child injury in cases of car crash. However, in many countries, age-appropriate car restraint use for children aged 4–7 years old remains the lowest among all age groups. The aim of this study was to identify the main determinants of BPB use through a comprehensive approach. An ecological model was used to analyze individual, parent-child relationships, and neighborhood characteristics. Parents of children enrolled in the first and second grades completed a self-reported questionnaire (n = 745). The data were subjected to multilevel modeling. The first level examined individual and parent-child relationship variables; in addition the second level tested between neighborhood variance. According to parental self- reports, 56.6% of their children had used a BPB on each car trip during the previous month. The results indicated that the determinants positively related to BPB use were individual and parental; namely, the number of children in the family, the parents' car seat belt use, parental knowledge of children's car safety principles, and a highly authoritative parenting style. Children's temperaments and parental supervision were not associated with BPB use. At the neighborhood level, a small difference was found between neighborhoods for BPB users compared to non-users.

1. Introduction

The use of a belt-positioning booster seat (BPB) is an effective technology that can prevent severe child injury in cases of car crash (Arbogast et al., 2009; Elliott et al., 2006). Children aged 4–8 years using a BPB were shown to be 45% less likely to sustain nonfatal injuries than children of similar ages using a vehicle seat belt alone (Arbogast et al., 2009). When compared to unrestrained children, booster seat use has been estimated to reduce the risk of fatal injuries by 67% for 4–5 year-olds and by 55% for 6–8 year-olds. However, in the case of a severe car crash, the use of a booster seat may not increase the likelihood that the children will survive (Rice et al., 2009). Professional pediatric organizations consider a BPB to be the optimal form of restraint for 5–9 year olds (NHTSA, n.d.; AAP, 2016), and is mandatory by law in most developed countries. This has positively impacted children's booster seat use (Koppel et al., 2013; Mannix et al., 2012; Simniceanu et al., 2014).

Booster seats are easy to use and relatively low in cost. Nevertheless, country-wide comparisons have shown considerable differences in extent of use. Higher percentages of BPB use were observed in developed than in developing countries. In the U.S., it is estimated that nearly 35% of all 4–7 year-olds do not use the appropriate form of restraint (Pickrell and Ye, 2013) and about 20% misuse was observed among booster seat users (Greenwall, 2015). In Alberta, Canada, 47.8% of 7 year olds were observed not using a booster seat (Golonka et al., 2016). In countries such as India, parental report of non-use among children below the age of 16 was much higher, 70.9%, and in China ranged 48% to 60.8% (Ferguson et al., 2014; Pan et al., 2012) more specifically, booster seats use was observed in only 5.5% of 4–8 year olds in Beijing (Purc-Stephenson et al., 2010). In many countries, age-appropriate car restraint use for children aged 4–7 years old remains the lowest among all age groups (Brown et al., 2010; Greenwall, 2015; Ledon, 2010).

Progress in technology (booster seat, ISOFIX and LATCH) along with specific car restraint legislation has led researchers to investigate why usage rates are so low. Studies of the determinants of booster seat use have mostly dealt with child's age, parents' age, sex and education, height and weight of the child, travel characteristics (i.e. driving distance, night/day travel, driver's use of a car seat belt, number of children traveling in the car), parents' attitudes, perceptions and obstacles to use, and child car restraint legislation (Cunningham et al., 2011;

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Sauber-Schatz et al., 2015; Snowdon et al., 2008; Vesentini and Willems, 2007).

There is some indication that parent-child arguments, negotiations and placing boundaries to their children when insisting that children use the booster seat in the car (Agran et al., 2004; Lennon, 2007; Medoff-Cooper and Tulman, 2007; Simpson et al., 2002). Parent-child relationships have been studied as regards to non-intentional injuries, not specifically to booster seat use, and described on the basis of dimensions such as child temperament, parenting styles and parental supervision (Schwebel and Gaines, 2007).

Moreover, the identification of community characteristics can contribute to safety policy development. Contextual factors such as the characteristics of the place of residence (i.e. education, employment) have been studied as they pertain to childhood injuries (McClure et al., 2015; O'Campo et al., 2000; Reading et al., 1999), but these characteristics are not consistently defined or used (van Vuuren et al., 2014). To the best of our knowledge there are no studies on the putative associations between area characteristics and parent and child preventive car safety behavior.

The above-mentioned studies provide an overview of the multiplicity of personal, parent-child and community factors that can affect safety situations and behavior. However, these factors have seldom been examined in a comprehensive manner as regards car restraint use among children. To fill this gap, we implemented a modified ecological model (Belsky, 1980; Bronfenbrenner, 1977) that considers the dynamic relationships across characteristics at the individual, interpersonal, community, and societal levels. The model provides the flexibility to addresses variables in a range of health or behavioral conditions at any of the personal (such as socio-demographic and behavioral characteristics), relationships (between parents and children, like supervision and parenting style), community (neighborhood characteristics) and societal levels (for example, laws). It has been used as a framework for identifying risk factors and intervention for intimate partner violence (Smith Slep et al., 2014) and vaccination uptake (Kumar et al., 2012) among others.

Specifically, the aim of this study was to examine BPB use and its determinants, at the individual, parent-child and neighborhood levels. The societal level, as represented by laws on car restraint use, was not included as it is globally mandatory for children from birth to the age of 8 years old. We hypothesized that of the overall characteristics tested, BPB use would be negatively related to child age, family size, and the child's temperament but positively related to parents' education, and knowledge about child car safety and seat belt use. We also hypothesized that BPB would be positively related to an authoritative parenting style and parental supervision but negatively related to a permissive parenting style; finally we predicted at least 10% variance between neighborhoods in BPB use.

2. Methods

2.1. Target population and sample size

The target population was composed of parents of children in the first and second grades enrolled in elementary schools in two cities in central Israel. Sample calculations were based on the distribution of the children in the population in terms of: city (two cities), child's age (by proxy, first grade, 6–7 year olds; second grade, 7–8 year olds), gender (boys/girls), and city (city A, 56 neighborhoods; city B, 11 neighborhoods. City neighborhoods are not administratively independent, but were solely defined by population characteristics here). Sample size was calculated according to the proportion of booster seat miss-use (32.6%) (Gitelman et al., 2009). In order to account for the neighborhood characteristics, and since children do not necessarily attend neighborhood schools, it was assumed that the majority of the participants, 80%, were similar in terms of their characteristics. Variability was assumed for the remaining 20% of the children in the first and second grades who do not reside in the neighborhood in which their school is located. It was further assumed that of this 20%, 30% would randomly live in other neighborhoods (range from 16 to 24, and number of children by neighborhood from 25 to 55). Assuming dependence between children in the neighborhood, an Intra-class Correlation Coefficient Index (ICC) of 10% was assumed, based on multilevel studies in Israel and worldwide (Bell et al., 2013; Buckner, 1988; Khoury-Kassabri et al., 2004; Merlo et al., 2006). To determine the final sample size, power was set as a function of the ICC Index, the number of neighborhoods and number of children per neighborhood according to the assumptions above. Sampling 20 schools with 80 students per school resulted in a power of 80%. Since the number of students per class varied from 25 to 30, three classes were sampled in each school. Assuming an 80% response rate from school principals, the number of schools sampled was increased from 20 to 25.

For a random sample of schools, lots were drawn, such that all schools had the same probability of being selected. In city A, 17 schools out of 65 schools were sampled, of which 11 responded; in city B, 8 schools out of 15 were sampled, of which 6 responded. The final sample covered 17 schools (a response rate of 68%) and 745 parents (a response rate of 53% of all parents approached); 11 neighborhoods, 550 parents for the multi-level analysis, with a power of 78%. Since there was a 10%-22% spread of missing values in the different variables, several imputation methods were tested. Given that only a few cases were added by imputation, the original values were used for analysis with no imputation. For the two level statistical analyses of the neighborhoods, 195 parents with missing values were excluded.

2.2. Data collection

The IRB approved the study. Permission to conduct the study was obtained from the Ministry of Education. Questionnaire administration was approved and coordinated with all participating school principals and teachers. Research assistants distributed the questionnaires to parents during parent-teacher meetings in August-October 2010. The research assistants provided brief verbal and written explanations about the objectives of the questionnaire and how to complete them and collected them when completed. Questionnaire acceptance constituted parents' consent to participate. Parents who did not attend the parent-teacher meetings were sent questionnaires and 76 completed questionnaires were returned. Informational pamphlets regarding booster seat use were distributed to the parents when data collection was over. Inclusion criteria was ownership of a car, and the ability to read Hebrew (two parents were excluded). Neighborhood characteristics were taken from the Israeli Central Bureau of Statistics (ICBS, 2008) registry according to statistical areas defined in the 2008 census.

2.2.1. Dependent variable

Child's belt positioning booster seat use (BPB), as recommended by the American Academy of Pediatrics and the National Highway Traffic Safety Administration, was measured on two questions: 1) booster seat use “In the last month, how often did your child use a booster seat?" and 2) belt use ‘In the last month, how often did your child use the car's belt?" (always, almost always, sometimes, rarely, never). A dichotomous variable was calculated, where the answer “always’ to both questions was scored ‘1 = always belted booster seat use’, and all other combinations were scored as “0 = not always belted booster seat use”.

2.2.2. Independent variables

2.2.2.1. Individual characteristics. The characteristics included socio-demographic data, driving characteristics, parental knowledge regarding their child's safety in the car, and the child's temperament. Socio-demographic variables included child's age and sex, parents' age, respondent's sex, education, income and origin, and the number of children in the family. Driving characteristics included number of cars owned by the family, number of seats in the car, who usually drives the