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Preventable head and facial injuries by providing free bicycle helmets and education to preschool children in a head start program

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ABSTRACT

The objectives of the study were to determine helmet use rates, incidence rates (IRs) of head and facial injuries for population attributable fraction (PAF) estimation, and to elucidate the magnitude of and changes in PAFs as the result of helmet use changes among preschool children. A study consisting of cross-sectional (survey) and longitudinal (follow-up) component was designed by including a randomly selected group of participants (n = 322) from 10 Head Start sites provided with free bicycle helmets along with a subgroup of prior helmet owners (n = 68) from the other random group (n = 285). All participants received bicycle helmet education. Helmet use surveys were conducted in May (1st Survey) and November 2008 (2nd Survey). The helmet owners were followed up to determine IRs, and incidence rate ratios (IRRs) for head and facial injuries. PAFs were computed using IRs as well as helmet use rates and IRRs. Helmet use rates increased significantly from the 1st to the 2nd Survey. The mean follow-up person-time was 5 months. The IRs for head, face (all portions), and face (upper/mid portions) injuries were higher in non-helmeted than helmeted riders. By using IRs, PAFs for the 3 injuries among the riders in both groups of helmet owners were 77%, 22%, and 32% respectively. The PAFs for each of the above injuries decreased by about 10% as helmet use rates increased. The magnitude of and changes in preventable head and facial injuries following free bicycle helmet distribution and education among helmeted riders was elucidated in this Head Start preschool children population.

Keywords: Head Injury; Facial Injury; Free Helmet Distribution; Head Start; Preschool Children; PAF

1. INTRODUCTION

Head Start Programs exist in every state in the United States, and 908,412 children were enrolled in 2007 nationwide; of these, about 90% were preschool age [1]. Head Start is a federally funded preschool program that provides health, education and social services to children from low-income families that are at or below the federal poverty level. The Community Action of Northeast Indiana (CANI) Head Start Program in Fort Wayne, Indiana serves over 800 preschool children.

The trauma program of the Parkview Hospital Level II Trauma Center in Fort Wayne, Indiana planned to distribute 800 free helmets to preschool children ages 3-5 years at the CANI Head Start sites in 2007-2008 to encourage helmet use both at school and home. Of these, about 400 helmets were available for the first year bicycle season and the remaining 400 for the next year season. One research question that intrigued the research personnel before implementing the program was, "to what extent could head and facial injuries be prevented if this population is provided free bicycle helmets and education?" In other words, could we measure the population attributable fractions for head and facial injuries among helmeted riders?

In reviewing the literature, the methodology for estimation of population attributable fraction (PAF) of bicycle related head injuries could be calculated by two formulas: one calculation using the incidence rates of injuries and the other calculation based on bicycle helmet use rate and helmet effectiveness [2]; the same author demonstrated that PAF decreased as helmet use rate increased by simulation model. Again, bicycle helmet effectiveness against head and facial injuries by case-control studies were shown for all ages [3,4] and for < 6 years old children [5]. Previous studies on population-based head injury rates among children 5 years old and under were based on hospital records [6,7]. Studies based on all cases (hospital as well as non-hospital cases) arising from the community to estimate either head and/or facial injury incidences are rare. The present study objectives were 1) to determine helmet use rates, incidence rates of head and facial injuries among helmeted and non-helmeted riders in the preschool population for PAF estimation; 2) to elucidate the magnitude of and changes in PAFs as the result of helmet use changes in the same population.

2. MATERIALS AND METHODS

2.1. Study Setting

A pilot sample survey of 221 families at 6 CANI Head Start sites in September 2007 showed that 90% of 3-5 year old children owned a bicycle or wheeled riding toy and 20% of them possessed a helmet. Ten of 11 sites that portray a diverse population with multiple languages and ethnicities in Allen, Noble and Whitley counties were selected and the one with predominant majority of white children (n = 34) was excluded. All sites provide morning (AM) and afternoon (PM) classes except one site, which offers only AM classes.

2.2. Study Design

It has been stated that randomized controlled trials are neither feasible nor ethical for study of bicycle helmet effectiveness against head injury and that cohort studies are also unfeasible due to low incidence of the event [8]. To achieve our objectives, we devised a study design consisting of cross-section (survey) and longitudinal (follow-up) component in helmet owners as follows: First, the principal investigator and a team member selected two groups by a toss of a coin so that each group consisted of either the AM or PM classes from each of the 8 sites. From the remaining two sites, the site with only AM classes (10^{th} site) was combined with the other site (9^{th} site) that had fewer children in its PM classes to form into a subgroup that had comparable number of children with those in AM classes of the 9^{th} site, and then these two subgroups were again selected by a toss of a coin to join the above two groups. Second, one of the two groups was randomly selected to be provided with 400 free bicycle helmets and helmet education (HE). This group formed the main focus of our study. The other group was provided with bicycle helmet education only (E) (and all would receive the remaining 400 free helmets in 2009 bicycle season). As some participants of the E group could own bicycle helmets (expected from the pilot study), we also took this subsample into our study to increase the sample size and it was termed as H'E group where H' represented those participants who owned a helmet at the beginning of the study (prior helmet owners). We employed the HE and H'E groups to conduct surveys for estimation of helmet use rates at the beginning and end of study, and for follow-up study for estimation of IRs, incidence rate ratios (IRRs). PAFs were ultimately computed. Wearing a helmet was considered as exposure and without wearing a helmet was non-exposure while riding a bicycle or wheeled riding toy. The person-time determination for estimation of IRs among helmeted and non-helmeted riders is described in section 2.6.

2.3. Participants, Provision of Helmets and Education

The eligibility criteria for a case were: a child 3 - 5 years old and his/her siblings in the same age range, registered with the CANI Head Start Program, possession of a bicycle or a wheeled riding toy, and the child's caregiver speaking English or Spanish. The study started to recruit participants' caregivers in mid-May 2008 by a team of 7 Parkview Hospital community nurses and 6 Spanish speaking CANI personnel. The study ended on November 15, 2008.

The provision of free helmets was done by the nurses to the HE group in area site classrooms. The helmets were manufactured by Bell Sports Inc, Rantoul, IL, USA and comply with the Consumer Product Safety Commission bicycle safety standards. If a caregiver from the E group expressed a concern about obtaining a helmet before the end of the study, a voucher was issued to receive a free helmet and fitting from the hospital's safety store. Two professional health educators provided the classroom education to both caregivers and children from both groups through a video (which had already been used regularly for 9 years in area schools) on rules of bicycling and the importance of proper helmet use to prevent head injury, as well as a classroom melon drop demonstration with and without a helmet at the time of recruitment. Besides the video, the caregivers received information pamphlets on the risks of head injury from a bicycle crash, the effectiveness of helmets', strategy's to fit helmets, and encouraging their use while children are still young. Spanish language was used in translation for questionnaires, and other forms, and for communication with the Hispanic caregivers. Each family that submitted completed questionnaires was presented with a retail gift card. One family was awarded a grand prize of a large TV by random drawing. Approval from the Parkview

Health Institutional Review Board to undertake this study was obtained in April 2008.

2.4. Definitions

Helmet use was defined as a child wearing a helmet "always" or "most of the time" while riding, and non-use was defined as when the child "did not wear" or wore a helmet "some of the time" while riding the vehicle [9].

The definitions for head and facial injuries followed closely to those of Thompson *et al*. [10] and were phrased understandable to the caregivers. A head injury was defined as consisting of superficial cuts/scrapes (lacerations/abrasions), bruises on the scalp, bumps to the head and passing out (possible concussion) and broken bones in the head (skull fractures). A facial injury for all areas consisted of superficial cuts/scrapes, and bruises to the face, including the forehead, eye (external), nose, mouth (intra-oral), cheek, ear (external), chin (lower jaw), and facial bone fractures. The upper and mid-portion of face was taken as occurring to the forehead, eye, nose, cheek or ear.

2.5. Data Sources and Measurement

2.5.1. Helmet Use Study Component

The nurses provided a simple, self-administered, pretested, and structured questionnaire to the caregivers to record helmet use in HE and E groups at the beginning (1st Survey) and end of study (2nd Survey). H'E was identified after the 1st Survey. The questionnaire contained data on the caregivers including highest education attained, ethnicity, and language spoken. The data gathered on the children included sex, type of vehicle possessed, helmet ownership, and the numbers of helmet use while riding the vehicle. To supplement the helmet use by questionnaire method, the nurse used observation method by asking the caregiver during the home visit (see below) to let the child ride the bicycle or other riding vehicle, and observed whether the child rode and wore a helmet with or without prompting in the HE group as was done in one study [11].

2.5.2. Injury Study Component

Another simple, self-administered, pretested, and structured questionnaire was also given to the caregivers for recording demographic information of both caregivers and children, and injuries that occurred during the follow-up. The variables for each injury included, among others, the date of injury, helmet wearing status, nature of injury, anatomic location of injury, and type of treatment sought. In addition, a systematic random sample of 20% of families by site from the HE and E groups were selected to use as a validation subsample of study subjects to carry out a one-time home visit by the field team members. It began 4 weeks after the recruitment for determining any discrepancies on recording injuries and to verify injury location diagnoses.

All questionnaires were collected at the Head Start sites, by US mail services, and at home visits. Telephone calls were periodically made to increase the response rate.

2.6. Statistical Analysis

Helmet uses among helmet owners were analyzed by HE and H'E groups and Survey. Statistical tests were performed using 2-tail P value <0.05 as statistical significance [12].

A child possessing a helmet could have multiple episodes of bodily injuries including head and/or face from falls while riding, switching helmet wearing to non-wearing and vice versa, during the following-up period. Based on this context, assignment of person-time (person-days) contributing to an injury including the head and face within a child was determined as the period of exposure up to the moment of that injury event while riding by wearing a helmet or period of non-exposure without wearing a helmet. In other words, a child could have a number of exposure and non-exposure person-days depending upon helmet wearing status at the time of injury event while riding. Those children without reporting any injuries and therefore unable to know their helmet wearing experience were excluded from the person time determination. Based on these assumptions, the person-days for incidence rates (IRs) were computed from the participants' start and end dates of follow-up and the dates of injuries as follows:

1) For a child, either with one or more injury events, wearing or not wearing a helmet at one or all injury dates, person-days = End Date – Start Date.

2) For a child with 2 or more events, person-days for the 1st or with the same continuously wearing or not wearing occurring events = Injury Date (of 1st or that of last continuous event) – Start Date. For subsequent differing wearing event (s), person-days = Injury Date (of that or last event] – Injury Date (of previous event) and were repeated if such alternate (s) of wearing/non-wearing continued to occur. But the person-days for the final injury event = End Date – Last Counted Injury Date so that the child total person-days were completely distributed by helmet wearing status.

The sum of helmeted or non-helmeted person-days was taken as the denominator for respective IR. Incidence rate ratios (IRRs) along with 95% CI values were calculated and the values of helmet effectiveness [13] in this preschool age were derived. PAFs for head and facial injuries were computed as follows [2]:

$$PAF = \frac{IR_t - IR_e}{IR_e} \quad (1)$$

where PAF = Population Attributable Fraction,
IR_t = Incidence rate of injury in all riders,
IR_e = Incidence rate of the injury in helmeted riders.

$$PAF = \frac{P_{nh}(RR-1)}{P_{nh}(RR-1)+1} \quad (2)$$

where P_{nh} = Proportion of riders who do *not* wear a *helmet*.

RR or *IRR* = Relative risk of injury among the non-helmeted riders Compared to helmeted riders.

Validation for head and facial injuries was done in both HE and E groups as some of the E group participants, besides the prior helmet owners, acquired helmets from vouchers and other sources during the study period. Follow-up loss analysis from each study component was confined to the HE group (because of small sample size in H'E group) by comparing the distribution of demographic characteristics of children and their caregivers between the completed follow-up category and the loss in follow-up category.

3. RESULTS

3.1. Baseline Characteristic Features

The baseline characteristic features of the study participants and their caregivers are shown in **Table 1**. The distribution of demographic variables of participants and of caregiver's education and ethnicity between the HE and H'E was not statistically significant. However, the distribution of caregiver's education and ethnicity in the Helmet Use Study and caregiver's education in the Injury Study between HE and E groups were statistically significant. **Figure 1** shows flow of participants and study sizes through each stage of the two study components.

3.2. Vehicle Ownership, Helmet Distribution and Use

The majority of the children owned a bicycle (over 80%), followed by a scooter (27%), tricycle (25.0%) and rollerblades/skates (over 15%). This pattern was observed in the HE and E groups. All participants received free helmets in the HE group irrespective of their prior ownership. Participants in the E group received 41 free helmets by vouchers and a few of them obtained helmets from other sources. A total of 97 helmet owners, including prior helmet owners, were reported at the end of study in this group. Highly increases in helmet use rates were observed from the 1st to the 2nd Survey in HE and H'E groups but statistically significant increase in the former group (**Table 2**).

3.3. Incidence of Head and Facial Injuries by Helmet Wearing Status

The mean ± SD follow-up months for the HE group and H'E group were 4.8 ± 1.4 and 5.2 ± 1.1, respectively. About 67% of head and facial injuries were related to bicycle-riding. The IRs for head and facial injuries were much lower in the helmeted than non-helmeted riders in HE and in both groups combined (**Table 3**). As the number of head and facial injuries in the H'E group were small, the findings in this group were not shown separately and in subsequent tables. The 95% CIs of IRR values for head and facial injuries (all portions) between helmeted vs. non-helmeted riders were below 1.0 in HE group (**Table 3**).

During home visits, 62 preschool children were available for the observation. The caregivers agreed to let 51 children ride in front of the home visiting nurse and 50 children participated. Of those participated, 34 (68.0%) wore a helmet while riding, with a breakdown of 21 (42.0%) children remembering to wear a helmet following a prompt from the caregiver about the helmet, and 13 (26.0%) wore without the prompt.

3.4. Helmet Effectiveness

Helmet effectiveness was derived from IRRs (**Table 3**). The bicycle helmet effectiveness value for head injury was 94% for helmet users in the HE group and the finding was similar in both groups combined. The helmet effectiveness was 62% for all facial areas, and that for the upper and mid-portion of the face was 75% in HE group, and the values for facial injuries were higher than those in both groups combined.

3.5. Preventable Fractions

The PAFs as measured by the IRs for the head, face (all portions) and face (upper/mid portions) in HE group were 75%, 25% and 37% respectively and the corresponding values for facial injuries were relatively lower in the combined group (**Table 3**). The PAF values in HE group when measured by helmet effectiveness and the helmet use rate were 84%, 36% and 51% for the above corresponding injuries at the baseline, and each value decreased at the end of study as the result of increase in helmet use rates (**Table 4**). Again, the corresponding values for facial injuries were slightly lower in the combined group. However, the overall trend and magnitude of difference were similar in HE and both groups combined.

Table 1. Comparison of baseline characteristic features of two study components.

Characteristic	Helmet Use Study					Injury Study				
	HE[a]	E[b]	H'E[c]	χ^2 test[d] (HE v. E)	χ^2 test[d] (HE v. H'E)	HE[a]	E[b]	H'B[c]	χ^2 test[d] (HE v. E)	χ^2 test[d] (HE v. H'E)
Participants, n	322	285	68			254	213	54		
Sex, %				*ns*[e]	*ns*[e]				*ns*[e]	*ns*[e]
Male	50.0	55.4	55.9			49.6	55.9	51.9		
Female	50.0	44.6	44.1			50.4	44.1	48.1		
Age (y), %				*ns*[e]	*ns*[e]				*ns*[e]	*ns*[e]
3	27.0	26.3	17.6			29.1	29.6	22.2		
4	38.8	38.6	48.5			36.6	39.0	46.3		
5	34.2	35.1	33.8			34.3	31.5	31.5		
Caregivers, n	246	215	56			190	159	43		
Education, %				$P < 0.05$	*ns*[e]				$P < 0.05$	*ns*[e]
Some schooling	26.4	24.7	19.6			25.3	21.4	20.9		
High school diploma	42.7	28.4	32.1			44.2	28.9	30.2		
College education	22.4	28.8	35.7			23.2	31.4	37.2		
Other	0.8	0.9)	1.8			1.1	1.3	2.3		
Missing	7.7	17.2	10.7			6.3	17.0	9.3		
Ethnicity, %				$P < 0.05$	*ns*[e]				*ns*[e]	*ns*[e]
Black	43.5	33.5	30.4			38.4	30.2	23.3		
Hispanic	25.6	29.8	23.2			26.8	30.2	23.3		
White	28.0	30.7	42.9			32.6	32.1	48.8		
Other	2.4	5.6	3.6			2.1	6.9	4.7		
Missing	0.4	0.5	0			0	0.6	0		

[a]HE = Provision with free helmet distribution and helmet education; [b]E = Provision with helmet education only; [c]H'E = A subgroup of E group with prior helmet owners (See explanation for prior helmet owners in text); [d]Statistical tests were done after excluding other and missing categories; [e]*ns* = Not significant.

Table 2. Helmet use rate by group and survey.

Helmet Wearing Status[a]	HE Group[b]		H'E Group[c]		Combined	
	1st Survey	2nd Survey	1st Survey	2nd Survey	1st Survey	2nd Survey
Yes	65.6	80.5	49.3	62.2	59.0	77.4
No	33.4	19.5	50.7	37.8	41.0	22.6
Total	100.0 (99)[d]	100.0 (221)	100.0 (67)	100 (45)	100.0 (166)	100.0 (266)
Difference between 1st and 2nd Surveys	$z = 2.696$ $P < 0.01$		$z = 1.351$ $P > 0.05$		$z = 4.076$ $P < 0.001$	

[a]Helmet wearing status not documented: 2 cases in 1st Survey and 7 cases in 2nd Survey under HE group, and 1 case in 1st Survey and 1 case in 2nd Survey under H'E Group; [b]HE = As in **Table 1**; [c]H'E = As in **Table 1**; [d]Number of participants in parentheses.

Table 3. Incidence rates of head and facial injuries per helmet wearing status in helmet owners.

Helmet Wearing Status		Helmet Owners (n = 82) in HE Group			All Helmet Owners (n = 105)[a]		
		Head	Face (all portions)	Face (upper/mid)	Head	Face (all portions)	Face (upper/mid)
Helmeted and Non-Helmeted Riders	No.	10	20	6	12	26	8
	Person Time (days)	12,965	12,965	12,965	16,742	16,742	16,742
	IR[b]/100 children/year	28.15	56.31	16.89	26.16	56.68	17.44
Helmeted Riders	No.	2	12	3	2	15	4
	Person Time (days)	10,361	10,361	10,361	12,360	12,360	12,360
	IR[b]/100 children/year	7.05	42.27	10.57	5.91	44.30	11.81
Non-Helmeted Riders	No.	8	8	3	10	11	4
	Person Time (days)	2604	2604	2604	4382	4382	4382
	IR[b]/100 children/year	112.14	112.14	42.05	83.29	91.62	33.32
Helmeted vs. Non-Helmeted Riders	IRR[c] 95% Confidence interval	0.06 (0.01 - 0.30)	0.38 (0.15 - 0.92)	0.25 (0.05 - 1.25)	0.07 (0.02 - 0.32)	0.48 (0.22 - 1.05)	0.35 (0.09 - 1.42)
	Helmet Effectiveness (1-IRR[c])	94%	62%	75%	93%	52%	65%
	PAF[d] (%)	75.0	24.9	37.4	77.4	21.8	32.3

[a]All helmet owners in HE and prior helmet owners in H'E groups; [b]Incidence rate; [c]Incidence rate ratio; [d] $PAF = \frac{IR_t - IR_e}{IR_t}$, (See explanation for the parameters in text).

Table 4. Population attributable fraction (PAF%) at baseline and end of study.

	Helmet Owners in HE Group				All Helmet Owners[a]			
	Relative Risk[b]	Baseline	End of Study	Difference In PAF	Relative Risk[b]	Baseline	End of Study	Difference In PAF
Head	0.06				0.07			
Helmet Use Rate[c] (%)		65.6	80.5			59.0	77.4	
PAF[f] (%)		84.4	75.3	9.1		84.5	75.0	9.5
Face (All Portions)	0.38				0.48			
Helmet Use Rate[c] (%)		65.6	80.5			59.0	77.4	
PAF[f] (%)		36.0	24.1	11.9		30.8	19.7	11.1
Face (Upper/Mid)	0.25				0.35			
Helmet Use Rate[c] (%)		65.6	80.5			59.0	77.4	
PAF[f] (%)		50.8	36.9	13.9		43.2	29.6	13.7

[a]As in **Table 3**; [b]Relative risk (IRR) of corresponding injury among helmeted compared to non-helmeted riders; see **Table 2**; [c]Taken from **Table 2**; [d] $PAF = \frac{P_{nh}(RR-1)}{P_{nh}(RR-1)+1}$, (See explanation for the parameters in text).

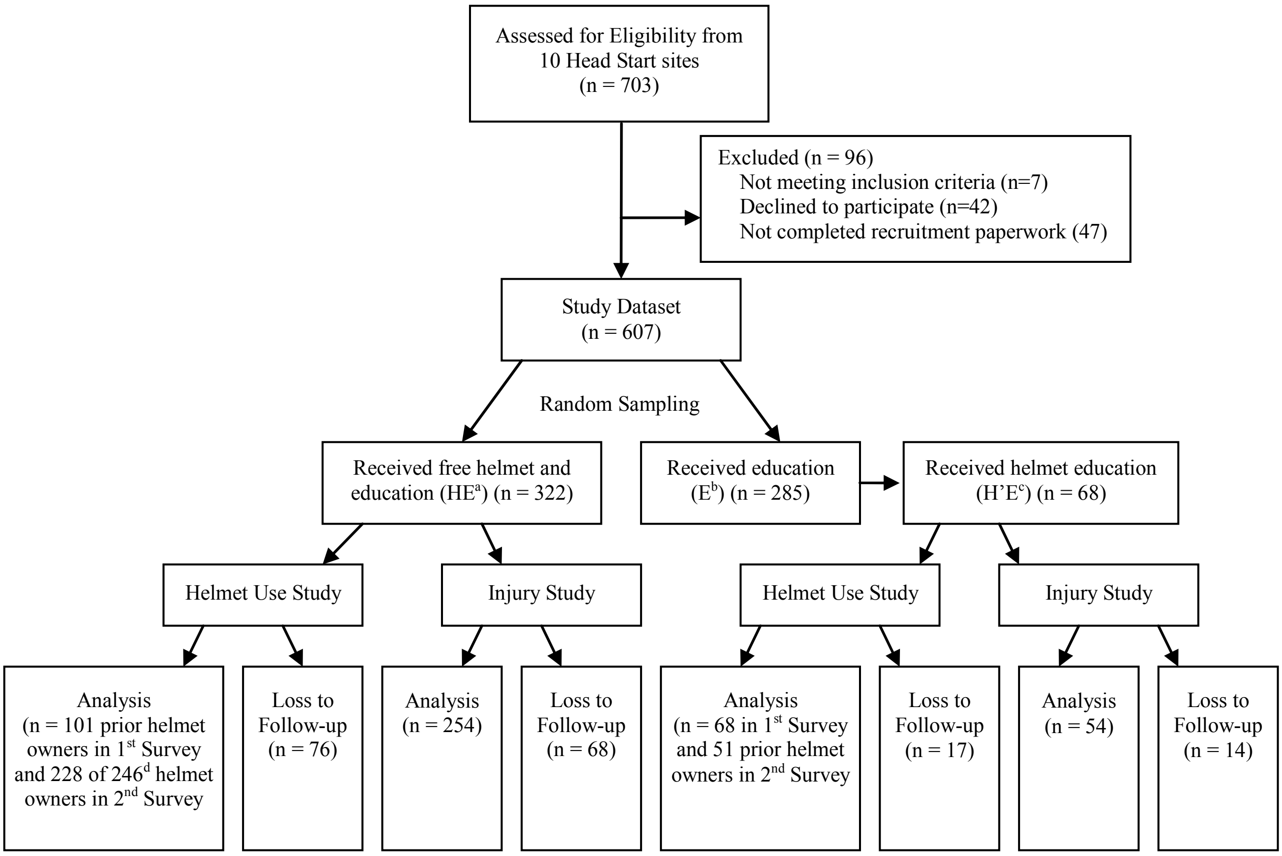

Figure 1. Comparing flow of participants and study sizes through each stage of study component. [a]HE as in **Table1**; [b]E as in **Table 1**; [c]H'E as in **Table 1**; [d]14 participants that might have lost their helmets and 4 did not give information on helmet ownership.

3.6. Other Outcomes

A total of 9 cases gave a history of needing medical attention at emergency departments or physician offices; 8 cases did not wear a helmet. All injuries were mainly due to falling off of the bicycle. No hospitalizations or deaths were reported from injuries while riding bicycles or toys.

The reported characteristic features of caregivers for injury data from home visits were correct in 90.5% (38/42) of participants in the HE group and 97.6% (40/41) in the E group. In both groups combined, the positive and negative predictive values for head injury were 100% (7/7) and (45/45) and the facial injuries (all areas) were 85% (11/13), and 96% (43/45), respectively.

Approximately 20% to 25% in HE or H'E group by study components were lost to follow-up (**Figure 1**). However, the distributions of demographic characteristics of children and parent information were not significantly different between the completed follow-up vs. the loss in follow-up categories in both the component studies under the HE group. The differences in distributions in H'E group were not analyzed due to small numbers of loss to follow-up.

4. DISCUSSION

The similarity in distributions of demographic variables of preschool children participants in the HE and E groups may represent the source population in the study area. Although the numbers of helmet owner were small in H'E group, it may be a complement to the whole study by examining the results in HE, and HE and H'E combined (**Tables 2-4**). The increase in helmet use from the 1st to the 2nd Survey in the HE and H'E groups among the preschool children might be due to provision of multifaceted bicycle helmet education to the caregivers and their children, and inclusion of reinforcing factors, such as, use of Spanish language for Spanish speakers and provision of incentives [14]. Many helmet wearing occurrences in children could be due to parental prompting.

There were a few studies on IR for head injury in preschool age children. One study, taking injured patients resulting from bicycle crashes from one source and population denominator from another source, showed that IR among 0 - 4 years old in Washington State for head injury was 0.068 per 100 population in a year [7] The rate was much lower when compared to our corresponding rate, as the former study was based on emergency department data only.

This might be the first innovative longitudinal (follow-up) study in helmet owners to estimate IRs based on person-days and helmet protective effects for head and facial injuries. We took advantage of multiple episodes of injuries occurring within a child (54/105), including those treated at home and outpatient clinics**.** A similar finding of helmet protective effects between this and other studies, for instance, helmet protective effect of 85% for head [15], and of 65% for upper and mid-face injuries [10], signifies the appropriateness of our study design.

The rates of injuries were much higher in non-helmeted children. For instance, the rate for head injury was 14 times (83.29/5.91) higher in non-helmeted than helmeted riders (**Table 3**). These findings indicate the significance of reduction of head and facial injuries by helmet wearing while riding and starting at the preschool age. A similar study of increase in helmet use and decrease in incidence of bicycle-related head injury was shown in 5-14 year-old children [16].

Perhaps, this is also the first study to determine PAF as an indication of public health importance and demonstration of our program's worth [17] by providing free bicycle helmets and helmet education in our local Head Start Program. For instance, of 100 vehicle-related head injuries occurring in this target preschool population, 77 of them would be avoided if every educated rider in the population had worn a helmet; see **Table 3**. We found the PAFs decreased as the helmet use rates increased as shown in simulation by Kopjar [2]. In this study, PAFs estimated by IRs seem to represent the average values when compared with those values based on helmet use rate and helmet effectiveness. The similarity of findings on helmet use rates by observation and reporting, the high predictive values for head and facial injuries on validation, and the similarity of demographic data of caregivers and their children between completed and follow-up loss denote the study data were reasonably reliable. Rockhill *et al*. mentioned the misuse of PAF with respective to computational and interpretational issues [18]. We employed the PAF formulas that were suitably created for bicycle related injuries [2]. Kopjar commented that the protective effect of helmets was not confounded by previous non-use, and there was no evidence of competing risks replacing the ones removed by helmet use; these conditions were the basic criteria for external validity of PAF estimates [2].

5. LIMITATIONS

The injury events in the follow-up study were based mainly on reporting. Person-time data were available only from 32.3% (82/254) of participants in the HE group and 42.6% (23/54) in the H'E group. Verification of types of helmet used was not done at the time of injury. Few off-road head and facial injuries were reported from riding bicycles and other wheeled-riding toys within the observation period. Among those children reported without injuries, 45 children in the HE group and 13 children in the H'E group used bicycles with training wheels. Due to low incidence of head and facial injuries, PAFs by ethic groups could not be determined. In addition, we were unable to collect and assess the injury data by home visit for the entire follow-up period. The extent of follow-up loss of participants, the possible reporting biases, and the findings were mentioned in the results.

6. CONCLUSIONS

We demonstrated the public health importance and our program's worth by elucidating the magnitude of preventable head and facial injuries in helmeted riders following the free bicycle helmet distribution and helmet education in this Head Start preschool children population.

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